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Audrey O'Shea



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Published by John Wiley & Sons, Inc., Hoboken, New Jersey.
Published simultaneously in Canada.

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Library of Congress Control Number: 2025911378

Paperback ISBN: 9781394330331
ePDF ISBN: 9781394330355
ePub ISBN: 9781394330348

Cover Design: Wiley

Cover Image: Lighthouse in Maine. © Jeremy Woodhouse/Getty Images

This book is dedicated to my husband Rick, the wind beneath my wings.
—Audrey

Acknowledgments

My most sincere thanks to the Sybex/Wiley team, particularly to Kenyon Brown for the opportunity to author this edition. Also Pete Gaughan and Annie Melnick for their support. Special thank you to Jan Lynn Neal, our project manager, for her always positive and encouraging correspondence, and for giving a gentle nudge when I need it. To Chris Crayton, thank you for pointing out all the little things and providing a fresh perspective. To Kezia Endsley and Jajneswar Chhotaray, thank you so much for those final touches and the joy of working with you. And to all the people behind the scenes, this book would not be possible without you. Thank you.

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Introduction

If you’re picking up this book, there’s a good chance that you want to pass the CompTIA A+ exam. It means that you’re likely either an IT professional looking for certifications or someone who has a bit of computer knowledge and wants to start an IT career. The A+ exam is entry level and is often the first certification test IT technicians take.

Although still considered an entry-level credential, the exam has become more challenging compared to what it was a few years ago. The newest exam puts a slightly higher importance on networking, security, and troubleshooting. New topics include Windows N versions, macOS features and system folders, additional Linux commands, and of course, outdated concepts and commands have been removed. They’ve also removed the troubleshooting steps but expect that anyone taking the exam will have a general understanding of how to go about troubleshooting computer issues.

Although we’re confident that if you can answer all the questions in this book correctly, you can pass the exam, we encourage you to take time to read the explanations and go beyond memorizing questions and answers. One reason is that the questions on the actual exams will be different than the ones written for this book. Another (better) reason is that life isn’t a multiple-choice exam. When you’re in the field and trying to fix a computer, you won’t have possible solutions given to you—you need to have a solid base of knowledge from which to work.

CompTIA® A+® Complete Practice Tests, Fourth Edition, combined with the Sybex *CompTIA® A+® Complete Study Guide, Sixth Edition* (both the Standard and Deluxe Editions), will help give you the foundation you need to pass the exams. Study them well, and they will also give you the tools you need to navigate a myriad of technical topics and make you more valuable to prospective employers.

What Is A+ Certification?

The A+ certification program was developed by the Computing Technology Industry Association (CompTIA) to provide an industrywide means of certifying the competency of computer service technicians. The A+ certification is granted to those who have attained the level of knowledge and troubleshooting skills that are needed to provide capable support in the field of personal computers and mobile devices. It is similar to other certifications in the computer industry, such as the Cisco Certified Network Associate (CCNA) program and the Microsoft certification programs. The theory behind these certifications is that if you need to have service performed on a certain vendor’s products, you will prefer to use a technician who has been certified in one of the appropriate certification programs rather than just the first “expert” that pops up in a Google search. The difference with A+ is that it’s an industrywide certification and vendor agnostic. That means by passing it, you’re capable of handling different issues regardless of the software or hardware vendor.

Everyone must take and pass two exams: Core 1 (220–1201) and Core 2 (220–1202). You don't have to take the 220–1201 exam and the 220–1202 exam at the same time, but the A+ certification isn't awarded until you've passed both tests.

Tests are administered by CompTIA's global testing partner, Pearson VUE. For more information on taking the exam, visit the CompTIA website at www.comptia.org. You can also visit Pearson VUE at www.pearsonvue.com.

Who Should Buy This Book?

If you want to pass the A+ exam, this book is definitely for you. This book is an exam prep book, so if you're an experienced computer professional, a book like this may be all you need to pass the exam.

However, a book of exam questions isn't designed to give you all the background you need to truly understand the basics of personal computers, mobile devices, and networking. If you're newer to the industry, we encourage you to buy a study guide as well, such as the Sybex *CompTIA A+ Complete Study Guide*. The study guide will provide more depth and context to help you acquire the skills and knowledge you need to be successful. This book then becomes a great companion as you prepare to take the exam.

How to Use This Book and the Interactive Online Learning Environment and Test Bank

This book includes over 1,000 practice test questions, which will help you get ready to pass the A+ exam. The interactive online learning environment that accompanies *CompTIA A+ Complete Practice Tests* provides a robust test bank to help you prepare for the certification exams and increase your chances of passing them the first time! By using this test bank, you can identify weak areas up front and then develop a solid studying strategy using each of these testing features.

The test bank also offers two practice exams. Take these practice exams just as if you were taking the actual exam: that is, without any reference material. When you've finished the first exam, move on to the next one to solidify your test-taking skills. If you get more than 90% of the answers correct, you're ready to take the certification exams.



You can access the Sybex interactive online test bank at www.wiley.com/go/Sybextestprep.



Like all exams, the A+ certification from CompTIA is updated periodically and may eventually be retired or replaced. At some point after CompTIA is no longer offering this exam, the old editions of our books and online tools will be retired. If you have purchased this book after the exam was retired or are attempting to register in the Sybex online learning environment after the exam was retired, please know that we make no guarantees that this exam's online Sybex tools will be available once the exam is no longer available.

Tips for Taking the A+ Exams

Here are some general tips for taking your exams successfully:

- Bring two forms of ID with you. One must be a photo ID, such as a driver's license or passport. The other can be another ID with your name or a recent photo. Both IDs must have your signature. These requirements sometimes change, so be sure to check for updates on the Candidate ID Policy page of www.comptia.org before scheduling your test.
- Arrive early at the exam center so you can relax and review your study materials, particularly tables and lists of exam-related information.
- Read the questions carefully. Don't be tempted to jump to an early conclusion. Make sure you know exactly what the question is asking.
- Don't leave any unanswered questions. Unanswered questions are scored against you. If you're not sure, take your best guess.
- There will be questions with multiple correct responses. Be sure to read the messages displayed to know how many correct answers you must choose.
- When answering multiple-choice questions that you're not sure about, use a process of elimination to rule out the obviously incorrect answers first. Doing so will improve your odds if you need to make an educated guess.
- If a question will take some time, flag it to return to it later. You can move forward and backward through the exam.
- Keep track of your remaining time. You must submit the exam before your time expires.
- For the latest pricing on the exams and updates to the registration procedures, visit CompTIA's website at www.comptia.org.

Exam Objectives

CompTIA goes to great lengths to ensure that its certification programs accurately reflect the IT industry's best practices. Exam content comes from surveying and receiving feedback from companies and people currently working in the industry, as well as input from subject

matter experts (SMEs). This ensures that the test objectives and weightings truly reflect the job requirements.

The SMEs work in focus groups to write and review hundreds of test items. The process is estimated to take over 5,000 SME hours to develop a single exam. And, in many cases, they must go back to the drawing board for further refinements before the exam is ready to go live in its final state.

CompTIA also uses a trained psychologist/psychometrician to ensure that the test and test development process exceed the certification industry's standards.

CompTIA ensures that their tests are developed with impartiality and objectivity, and they take security of the exam contents very seriously. By maintaining exam question confidentiality, the certification retains its validity and value in the computer industry.

So, rest assured, the content you're about to learn will serve you long after you take the exam.

A+ Certification Exam Objectives: Core 1 (220-1201)

The following table lists the domains measured by this examination and the extent to which they are represented on the exam:

Domain	Percentage of Exam
1.0 Mobile Devices	13%
2.0 Networking	23%
3.0 Hardware	25%
4.0 Virtualization and Cloud Computing	11%
5.0 Hardware and Network Troubleshooting	28%
Total	100%
Objective	Chapter(s)
1.0 Mobile Devices	
1.1 Given a scenario, monitor mobile device hardware and use appropriate replacement techniques.	1, 10
Battery	1, 10

Objective	Chapter(s)
Keyboard/keys	1, 10
Random-access memory (RAM)	1, 10
Hard disk drive (HDD)/solid-state drive (SSD)	1, 10
Wireless cards	1, 10
Physical privacy and security components	1, 10
- Biometrics	
- Near-field scanner features	
Wi-Fi antenna connector/placement	1, 10
Camera/webcam	1, 10
Microphone	1, 10
1.2 Compare and contrast accessories and connectivity options for mobile devices.	1, 10
Connection methods	1, 10
- Universal Serial Bus (USB)/USB-C/microUSB/miniUSB	
- Lightning	
- Near-field communication (NFC)	
- Bluetooth	
- Tethering/hotspot	
Accessories	1, 10
- Stylus	
- Headsets	
- Speakers	
- Webcam	
Docking station	1, 10
Port replicator	1, 10
Trackpad/drawing pad/track points	1, 10

Objective	Chapter(s)
1.3 Given a scenario, configure basic mobile device network connectivity and provide application support.	1, 10
Wireless/cellular data network (enable/disable)	1, 10
- 3G/4G/5G	
- Hotspot	
- Wi-Fi	
- Subscriber Identity Module (SIM) eSIM	
Bluetooth	1, 10
- Enable Bluetooth	
- Enable pairing	
- Find a device for pairing	
- Enter the appropriate personal identification number (PIN) code	
- Test connectivity	
Location services	1, 10
- Global positioning system (GPS) services	
- Cellular location services	
Mobile device management (MDM)	1, 10
- Device configurations	
- Corporate	
- Bring your own device (BYOD)	
- Policy enforcement	
- Corporate applications	
Mobile device synchronization	1, 10
- Recognizing data caps	
- Calendar	
- Contacts	
- Business applications	
- Mail	
- Cloud storage	

Objective	Chapter(s)
2.0 Networking	
2.1 Compare and contrast Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) ports, protocols, and their purposes.	2, 10
Ports and protocols	2, 10
- 20–21 – File Transfer Protocol (FTP)	
- 22 – Secure Shell (SSH)	
- 23 – Telnet	
- 25 – Simple Mail Transfer Protocol (SMTP)	
- 53 – Domain Name System (DNS)	
- 67/68 – Dynamic Host Configuration Protocol (DHCP)	
- 80 – Hypertext Transfer Protocol (HTTP)	
- 110 – Post Office Protocol 3 (POP3)	
- 137–139 – Network Basic Input/Output System (NetBIOS)/NetBIOS over TCP/IP (NetBT)	
- 143 – Internet Mail Access Protocol (IMAP)	
- 389 – Lightweight Directory Access Protocol (LDAP)	
- 443 – Hypertext Transfer Protocol Secure (HTTPS)	
- 445 – Server Message Block (SMB)/Common Internet File System (CIFS)	
- 3389 – Remote Desktop Protocol (RDP)	
TCP vs. UDP	2, 10
2.2 Explain wireless networking technologies.	2, 10
Frequencies	2, 10
- 2.4GHz	
- 5GHz	
- 6GHz	

Objective	Chapter(s)
Channels	2, 10
- Regulations	
- Channel selection	
- Widths	
- Frequencies	
- Bands	
Bluetooth	2, 10
802.11 standards	2, 10
NFC	2, 10
Radio-frequency identification (RFID)	2, 10
2.3 Summarize services provided by networked hosts.	2, 10
Server roles	2, 10
- DNS	
- DHCP	
- Fileshare	
- Print servers	
- Mail servers	
- Syslog	
- Web servers	
- Authentication, authorization, and accounting (AAA)	
- Database servers	
- Network Time Protocol (NTP)	
Internet appliances	2, 10
- Spam gateways	
- Unified threat management (UTM)	
- Load balancers	
- Proxy servers	
Legacy/embedded systems	2, 10
- Supervisory control and data acquisition (SCADA)	
Internet of Things (IoT) devices	2, 10

Objective	Chapter(s)
2.4 Explain common network configuration concepts.	2, 10
DNS	2, 10
- A	
- AAAA	
- Canonical Name (CNAME)	
- Mail exchanger (MX)	
- Text (TXT)	
- Spam management	
(i) DomainKeys Identified Mail (DKIM)	
(ii) Sender Policy Framework (SPF)	
(iii) Domain-based Message Authentication, Reporting, and Conformance (DMARC)	
DHCP	2, 10
- Leases	
- Reservations	
- Scope	
- Exclusions	
Virtual LAN [local area network] (VLAN)	2, 10
Virtual private network (VPN)	2, 10
2.5 Compare and contrast common networking hardware devices.	2, 10
Routers	2, 10
Switches	2, 10
- Managed	
- Unmanaged	
Access points	2, 10
Patch panel	2, 10
Firewall	2, 10

Objective	Chapter(s)
Power over Ethernet (PoE) - Injectors - Switch - PoE standards	2, 10
Cable modem	2, 10
Digital subscriber line (DSL)	2, 10
Optical network terminal (ONT)	2, 10
Network interface card (NIC) - Physical media access control (MAC) address	2, 10
2.6 Given a scenario, configure basic wired/wireless small office/home office (SOHO) networks.	2, 10
Internet Protocol (IP) addressing - IPv4 - Private addresses - Public addresses - IPv6 - Automatic Private IP Addressing (APIPA) - Static - Dynamic - Subnet mask - Gateway	2, 10
2.7 Compare and contrast Internet connection types, network types, and their characteristics.	2, 10
Internet connection types - Satellite - Fiber - Cable - DSL - Cellular - Wireless Internet service provider (WISP)	2, 10

Objective	Chapter(s)
Network types	2, 10
- LAN	
- Wide area network (WAN)	
- Personal area network (PAN)	
- Metropolitan area network (MAN)	
- Storage area network (SAN)	
- Wireless local area network (WLAN)	
2.8 Explain networking tools and their purposes.	2, 10
Crimper	2, 10
Cable stripper	2, 10
Wi-Fi analyzer	2, 10
Toner probe	2, 10
Punchdown tool	2, 10
Cable tester	2, 10
Loopback plug	2, 10
Network tap	2, 10
3.0 Hardware	
3.1 Compare and contrast display components and attributes.	3, 10
Types	3, 10
- Liquid crystal display (LCD)	
- In-plane switching (IPS)	
- Twisted nematic (TN)	
- Vertical alignment (VA)	
- Organic light-emitting diode (OLED)	
- Mini light-emitting diode (Mini-LED)	
Touch screen/digitizer	3, 10
Inverter	3, 10

Objective	Chapter(s)
Attributes	3, 10
- Pixel density - Refresh rates - Screen resolution - Color gamut	
3.2 Summarize basic cable types and their connectors, features, and purposes.	3, 10
Network cables	3, 10
- Copper - Categories (i) T568A/T568B standards	
- Coaxial	
- Shielded twisted pair (i) Direct burial	
- Unshielded twisted pair	
- Plenum-rated	
- Optical - Single-mode - Multimode	
Peripheral cables	3, 10
- USB 2.0 - USB 3.0 - Serial - Thunderbolt	
Video cables	3, 10
- High-Definition Multimedia Interface (HDMI) - DisplayPort - Digital Visual Interface (DVI) - Video Graphics Array (VGA)	

Objective	Chapter(s)
Hard drive cables	3, 10
- Serial Advanced Technology Attachment (SATA) - External SATA (eSATA)	
Adapters	3, 10
Connector types	3, 10
- RJ11 - RJ45 - F type - Straight tip (ST) - Subscriber connector (SC) - Lucent connector (LC) - Punchdown block - MicroUSB - MiniUSB - USB-C - Molex - Lightning - DB9	
3.3 Compare and contrast RAM characteristics.	3, 10
Form factors	3, 10
- Small outline dual inline memory module (SODIMM) - Dual In-line Memory Module (DIMM) - Double Data Rate (DDR) iterations - Error correcting code (ECC) RAM vs. non-ECC RAM	
Channel configurations	3, 10
3.4 Compare and contrast storage devices.	3, 10
Hard drives	3, 10
- Spindle speeds - Form factors - 2.5 - 3.5	

Objective	Chapter(s)
Solid State Drives	3, 10
- Communications interfaces <ul style="list-style-type: none">- Non-volatile Memory Express (NVMe)- SATA- Peripheral Component Interconnect Express (PCIe)- Serial Attached SCSI [Small Computer System Interface] (SAS)	
- Form factors <ul style="list-style-type: none">- M.2- Mini-serial Advanced Technology Attachment (mSATA)	
- Drive configurations <ul style="list-style-type: none">- Redundant Array of Independent Disks (RAID) 0, 1, 5, 6, 10	
Removable Storage	3, 10
- Flash drives	
- Memory cards	
Optical drives	3, 10
3.5 Given a scenario, install and configure motherboards, central processing units (CPUs), and add-on cards.	3, 10
Motherboard form factors	3, 10
- Advanced Technology eXtended (ATX)	
- microATX	
- Information Technology eXtended (ITX)	
Motherboard connector types	3, 10
- Peripheral Component Interconnect (PCI)	
- PCI Express (PCIe)	
- Power connectors	
- SATA	
- eSATA	
- Headers	
- M.2	

Objective	Chapter(s)
Motherboard compatibility	3, 10
- CPU socket types <ul style="list-style-type: none">- Advanced Micro Devices, Inc. (AMD)- Intel	
- Multisocket	
Basic Input/Output System (BIOS)/Unified Extensible Firmware Interface (UEFI) settings	
- Boot options	
- USB permissions	
- Trusted Platform Module (TPM) security features	
- Fan considerations	
- Secure Boot	
- Boot password	
- BIOS password	
- Temperature monitoring	
Virtualization support	3, 10
Encryption	
- TMP	
- Hardware security module (HSM)	
CPU architecture	3, 10
- x86/x64	
- Advanced RISC [Reduced Instruction Set Computer] Machine (ARM)	
- Core configurations	
Expansion cards	3, 10
- Sound card	
- Video card	
- Capture card	
- Network interface card (NIC)	

Objective	Chapter(s)
Cooling	3, 10
- Fans	
- Heat sink	
- Thermal paste/pads	
- Liquid	
3.6 Given a scenario, install the appropriate power supply.	3, 10
Input 110–120 VAC vs. 220–240 VAC	3, 10
Output 3.3 V vs. 5 V vs. 12 V	3, 10
20+4 pin motherboard connector	3, 10
Redundant power supply	3, 10
Modular power supply	3, 10
Wattage rating	3, 10
Energy efficiency	3, 10
3.7 Given a scenario, deploy and configure multifunction devices/printers and settings.	3, 10
Properly unbox device and consider set-up location	3, 10
Use appropriate drivers for a given operating system	3, 10
- Printer Control Language (PCL) vs. PostScript	
Firmware	3, 10
Device connectivity	3, 10
- USB	
- Ethernet	
- Wireless	
Public/shared devices	3, 10
- Printer share	
- Print server	

Objective	Chapter(s)
Configuration settings	3, 10
- Duplex - Orientation - Tray settings - Quality	
Security	3, 10
- User authentication - Badging - Audit logs - Secured prints	
Network scan services	3, 10
- Email - SMB - Cloud services	
Automatic document feeder (ADF)/flatbed scanner	3, 10
3.8 Given a scenario, perform appropriate printer maintenance.	3, 10
Laser	3, 10
- Maintenance: Replace toner, apply maintenance kit, calibrate, and clean	
Inkjet	3, 10
- Ink cartridge, print head, roller, and feeder - Maintenance: Clean printheads, replace cartridges, calibrate, and clear jams	
Thermal	3, 10
- Feed assembly - Special thermal paper - Maintenance: Replace paper, clean heating element, and remove debris	
Impact	3, 10
- Multipart paper - Maintenance: Replace ribbon, replace printhead, and paper	

Objective	Chapter(s)
4.0 Virtualization and Cloud Computing	
4.1 Explain virtualization concepts.	4, 10
Purpose of virtual machines	4, 10
- Sandbox	
- Test development	
- Application virtualization	
- Legacy software/OS	
- Cross-platform virtualization	
Requirements	4, 10
- Security	
- Network	
- Storage	
Desktop virtualization	4, 10
- Virtual Desktop Infrastructure (VDI)	
Containers	4, 10
Hypervisors	4, 10
- Type 1	
- Type 2	
4.2 Summarize cloud computing concepts.	4, 10
Common cloud models	4, 10
- Private cloud	
- Public cloud	
- Hybrid cloud	
- Community cloud	
- Infrastructure as a service (IaaS)	
- Software as a service (SaaS)	
- Platform as a service (PaaS)	

Objective	Chapter(s)
Cloud characteristics	4, 10
- Shared resources vs. dedicated resources	
- Metered utilization	
- ingress/egress	
- Elasticity	
- Availability	
- File synchronization	
- Multitenancy	

5.0 Hardware and Network Troubleshooting

5.1 Given a scenario, troubleshoot motherboards, RAM, CPUs, and power.	5, 10
--	-------

Common symptoms	5, 10
- Power-on self-test (POST) beeps	
- Proprietary crash screens	
- Blank screen	
- No power	
- Sluggish performance	
- Overheating	
- Burning smell	
- Random shutdown	
- Application crashes	
- Unusual noise	
- Capacitor swelling	
- Inaccurate system date/time	

Objective	Chapter(s)
5.2 Given a scenario, troubleshoot drive and RAID issues.	5, 10
Common symptoms	5, 10
- Light-emitting diode (LED) status indicators	
- Grinding noises	
- Clicking sounds	
- Bootable device not found	
- Data loss/corruption	
- RAID failure	
- Self-monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) failure	
- Extended read/write times	
- Low performance input/output operations per second (IOPS)	
- Missing drives in OS	
- Array missing	
- Audible alarms	
5.3 Given a scenario, troubleshoot video, projector, and display issues.	5, 10
Common symptoms	5, 10
- Incorrect input source	
- Physical cabling issues	
- Burned-out bulb	
- Fuzzy image	
- Display burn-in	
- Dead pixels	
- Flashing screen	
- Incorrect color display	
- Audio issues	
- Dim image	
- Intermittent projector shutdown	
- Sizing issues	
- Distorted image	

Objective	Chapter(s)
5.4 Given a scenario, troubleshoot common mobile device issues.	5, 10
Common symptoms	5, 10
- Poor battery health	
- Swollen battery	
- Broken screen	
- Improper charging	
- Poor/no connectivity	
- Liquid damage	
- Overheating	
- Digitizer issues	
- Physically damaged ports	
- Malware	
- Cursor drift/touch calibration	
- Unable to install new applications	
- Stylus does not work	
- Degraded performance	
5.5 Given a scenario, troubleshoot network issues.	5, 10
Common symptoms	5, 10
- Intermittent wireless connectivity	
- Slow network speeds	
- Limited connectivity	
- Jitter	
- Poor Voice over Internet Protocol (VoIP) quality	
- Port flapping	
- High latency	
- External interference	
- Authentication failures	
- Intermittent Internet connectivity	

Objective	Chapter(s)
5.6 Given a scenario, troubleshoot printer issues.	5, 10
Lines down the printed pages	5, 10
Garbled print	
Paper jams	
Faded prints	
Paper not feeding	
Multipage misfeed	
Multiple prints pending in queue	
Speckling on printed pages	
Double/echo images on the print	
Grinding noise	
Finishing issues	
- Staple jams	
- Hole punch	
Incorrect page orientation	
Tray not recognized	
Connectivity issues	
Frozen print queue	

A+ Certification Exam Objectives: Core 2 (220-1202)

The following table lists the domains measured by this examination and the extent to which they are represented on the exam.

Domain	Percentage of Exam
1.0 Operating Systems	28%
2.0 Security	28%
3.0 Software Troubleshooting	23%
4.0 Operational Procedures	21%
Total	100%

Objective	Chapter(s)
1.0 Operating Systems	
1.1 Explain common operating system (OS) types and their purposes.	6, 11
Workstation systems (OSs)	6, 11
- Windows	
- Linux	
- macOS	
- Chrome OS	
Mobile OSs	6, 11
- iPadOS	
- iOS	
- Android	
Various filesystem types	6, 11
- New Technology File System (NTFS)	
- Resilient File System (ReFS)	
- File Allocation Table 32 (FAT32)	
- Fourth extended filesystem (ext4)	
- Extended filesystem (XFS)	
- Apple File System (APFS)	
- Extensible File Allocation Table (exFAT)	
Vendor life-cycle limitations	6, 11
- End-of-life (EOL)	
- Update limitations	
Compatibility concerns between operating systems	6, 11

Objective	Chapter(s)
1.2 Given a scenario, perform OS installations and upgrades in a diverse environment.	6, 11
Boot methods	6, 11
- Universal Serial Bus (USB)	
- Network	
- Solid-state/flash drives	
- Internet-based	
- External/hot-swappable drive	
- Internal hard drive (partition)	
- Multiboot	
Types of installations	6, 11
- Clean install	
- Upgrade	
- Image deployment	
- Remote network installation	
- Zero-touch deployment	
- Recovery partition	
- Repair installation	
- Other considerations	
- Third-party drivers	
Partitioning	6, 11
- GUID [globally unique identifier] Partition Table (GPT)	
- Master boot record (MBR)	
Drive format	6, 11
Upgrade considerations	6, 11
- Backup files and user preferences	
- Application and driver support/backward compatibility	
- Hardware compatibility	

Objective	Chapter(s)
Feature updates	6, 11
- Product life-cycle	
1.3 Compare and contrast basic features of Microsoft Windows editions.	6, 11
Windows 10 editions	6, 11
- Home	
- Pro	
- Pro for Workstations	
- Enterprise	
Windows 11 editions	6, 11
- Home	
- Pro	
- Enterprise	
N versions	6, 11
Feature differences	6, 11
- Domain vs. workgroup	
- Desktop styles/user interface	
- Availability of Remote Desktop Protocol (RDP)	
- Random-access memory (RAM) support limitations	
- BitLocker	
- gpedit.msc	
Upgrade paths	6, 11
- In-place upgrade	
- Clean install	
Hardware requirements	6, 11
- Trusted Platform Module (TPM)	
- Unified Extensible Firmware Interface (UEFI)	

Objective	Chapter(s)
1.4 Given a scenario, use Microsoft Windows operating system features and tools.	6, 11
Task Manager	6, 11
- Services	
- Startup	
- Performance	
- Processes	
- Users	
Microsoft Management Console (MMC) snap-in	6, 11
- Event Viewer (eventvwr.msc)	
- Disk Management (diskmgmt.msc)	
- Task Scheduler (taskschd.msc)	
- Device Manager (devmgmt.msc)	
- Certificate Manager (certmgr.msc)	
- Local Users and Groups (lusrmgr.msc)	
- Performance Monitor (perfmon.msc)	
- Group Policy Editor (gpedit.msc)	
Additional tools	6, 11
- System Information (msinfo32.exe)	
- Resource Monitor (resmon.exe)	
- System Configuration (msconfig.exe)	
- Disk Cleanup (cleanmgr.exe)	
- Disk Defragment (dfsgui.exe)	
- Registry Editor (regedit.exe)	
1.5 Given a scenario, use the appropriate Microsoft command-line tools.	6, 11
Navigation	6, 11
- cd	
- dir	

Objective	Chapter(s)
Network	6, 11
- ipconfig	
- ping	
- netstat	
- nslookup	
- net use	
- tracert	
- pathping	
Disk management	6, 11
- chkdsk	
- format	
- diskpart	
File management	6, 11
- md	
- rmdir	
- robocopy	
Informational	6, 11
- hostname	
- net user	
- winver	
- whoami	
OS management	
- gpupdate	
- gprest	
- sfc	
1.6 Given a scenario, configure Microsoft Windows settings.	6, 11
Internet Options	6, 11
Devices and Printers	6, 11
Programs and Features	6, 11
Network and Sharing Center	6, 11
System	6, 11

Objective	Chapter(s)
Windows Defender Firewall	6, 11
Mail	6, 11
Sound	6, 11
Device Manager	6, 11
Indexing Options	6, 11
Administrative Tools	6, 11
File Explorer Options	6, 11
- View hidden files	
- Hide extensions	
- General options	
- View options	
Power Options	6, 11
- Hibernate	
- Power plans	
- Sleep/suspend	
- Standby	
- Choose what closing the lid does	
- Turn on fast startup	
- Universal Serial Bus (USB) selective suspend	
Ease of Access	6, 11
Time and Language	6, 11
Update and Security	6, 11
Personalization	6, 11
Apps	6, 11
Privacy	6, 11
Devices	6, 11
Network and Internet	6, 11
Gaming	6, 11
Accounts	6, 11

Objective	Chapter(s)
1.7 Given a scenario, configure Microsoft Windows networking features on a client/desktop.	6, 11
Domain joined vs. workgroup	6, 11
- Shared resources	
- Printers	
- File servers	
- Mapped drives	
Local OS firewall settings	6, 11
- Application restrictions and exceptions	
- Configuration	
Client network configuration	6, 11
- Internet Protocol (IP) addressing scheme	
- Domain Name System (DNS) settings	
- Subnet mask	
- Gateway	
- Static vs. dynamic	
Establish network connections	6, 11
- Virtual private network (VPN)	
- Wireless	
- Wired	
- Wireless wide area network (WWAN)/cellular network	
Proxy settings	6, 11
Public network vs. private network	6, 11
File Explorer navigation – network paths	6, 11
Metered Connections and limitations	6, 11

Objective	Chapter(s)
1.8 Explain common features and tools of the macOS/desktop operating system.	6, 11
Installation and uninstallation of applications	6, 11
- File types <ul style="list-style-type: none">- .dmg- .pkg- .app	
- App Store	
- Uninstallation process	
System folders	6, 11
- /Applications	
- /Users	
- /Library	
- /System	
- /Users/Library	
Apple ID and corporate restrictions	6, 11
Best practices	6, 11
- Backups	
- Antivirus	
- Updates/patches	
- Rapid Security Response (RSR)	
System Settings	6, 11
- Displays	
- Networks	
- Printers	
- Scanners	
- Privacy	
- Accessibility	
- Time Machine	

Objective	Chapter(s)
Features	6, 11
- Multiple desktops	
- Mission Control	
- Keychain	
- Spotlight	
- iCloud	
- iMessage	
- FaceTime	
- Drive	
- Gestures	
- Finder	
- Dock	
- Continuity	
Disk Utility	6, 11
FileVault	6, 11
Terminal	6, 11
Force Quit	6, 11
1.9 Identify common features and tools of the Linux client/desktop operating system.	6, 11
File management	6, 11
- ls	
- pwd	
- mv	
- cp	
- rm	
- chmod	
- chown	
- grep	
- find	

Objective	Chapter(s)
Filesystem management	6, 11
- <code>fsck</code>	
- <code>mount</code>	
Administrative	6, 11
- <code>su</code>	
- <code>sudo</code>	
Package management	6, 11
- <code>apt</code>	
- <code>dnf</code>	
Network	6, 11
- <code>ip</code>	
- <code>ping</code>	
- <code>curl</code>	
- <code>dig</code>	
- <code>traceroute</code>	
Informational	6, 11
- <code>man</code>	
- <code>cat</code>	
- <code>top</code>	
- <code>ps</code>	
- <code>du</code>	
- <code>df</code>	
Text editors	6, 11
- <code>nano</code>	

Objective	Chapter(s)
Common configuration files	6, 11
- /etc/passwd	
- /etc/shadow	
- /etc/hosts	
- /etc/fstab	
- /etc/resolv.conf	
OS components	6, 11
- systemd	
- kernel	
- bootloader	
Root account	6, 11
1.10 Given a scenario, install applications according to requirements.	6, 11
System requirements for applications	6, 11
- 32-bit vs. 64-bit dependent application requirements	
- Dedicated vs. integrated graphics card	
- Video random-access memory (VRAM) requirements	
- RAM requirements	
- Central processing unit (CPU) requirements	
- External hardware tokens	
- Storage requirements	
- Application to OS compatibility	
Distribution methods	6, 11
- Physical media vs. mountable ISO file	
- Downloadable package	
- Image deployment	

Objective	Chapter(s)
Impact considerations for new applications	6, 11
- Device	
- Network	
- Operations	
- Business	
1.11 Given a scenario, install and configure cloud-based productivity tools.	6, 11
Email systems	6, 11
Storage	6, 11
- Sync/folder settings	
Collaboration tools	6, 11
- Spreadsheets	
- Videoconferencing	
- Presentation tools	
- Word processing tools	
- Instant messaging	
Identity synchronization	6, 11
Licensing assignment	6, 11
2.0 Security	
2.1 Summarize various security measures and their purposes.	7, 11
Physical security	7, 11
- Bollards	
- Access control vestibule	
- Badge reader	
- Video surveillance	
- Alarm systems	
- Motion sensors	
- Door locks	
- Equipment locks	
- Security guards	
- Fences	

Objective	Chapter(s)
Physical access security	7, 11
- Key fobs - Smart cards - mobile digital key - Keys - Biometrics - Retina scanner - Fingerprint scanner - Palm print scanner - Facial recognition technology (FRT) - Voice recognition technology - Lighting - Magnetometers	
Logical Security	7, 11
- Principle of least privilege - Zero Trust model - Access control lists (ACLs) - Multifactor authentication (MFA) - Email - Hardware token - Authenticator application - Short Message Service (SMS) - Voice call - Time-based one-time password (TOTP) - One-time password/passcode (OTP) - Security Assertions Markup Language (SAML) - Single sign-on (SSO) - Just-in-time access - Privileged access management (PAM) - Mobile device management (MDM) - Data loss prevention (DLP) - Identity access management (IAM) - Directory services	

Objective	Chapter(s)
2.2 Given a scenario, configure and apply basic Microsoft Windows OS security settings.	7, 11
Defender Antivirus	7, 11
- Activate/deactivate	
- Updated definitions	
Firewall	7, 11
- Activate/deactivate	
- Port security	
- Application security	
Users and groups	7, 11
- Local vs. Microsoft account	
- Standard account	
- Administrator	
- Guest user	
- Power user	
Log-in OS options	7, 11
- Username and password	
- Personal identification number (PIN)	
- Fingerprint	
- Facial recognition	
- Single sign-on (SSO)	
- Passwordless/Windows Hello	
NTFS vs. share permissions	7, 11
- File and folder attributes	
- Inheritance	
Run as administrator vs. standard user	7, 11
User Account Control (UAC)	7, 11

Objective	Chapter(s)
BitLocker	7, 11
BitLocker To Go	7, 11
Encrypting File System (EFS)	7, 11
Active Directory	7, 11
- Joining domain	
- Assigning log-in script	
- Moving objects within organizational units	
- Assigning home folders	
- Applying Group Policy	
- Selecting security groups	
- Configuring folder redirection	
2.3 Compare and contrast wireless security protocols and authentication methods.	7, 11
Protocols and encryption	7, 11
- Wi-Fi Protected Access 2 (WPA2)	
- WPA3	
- Temporal Key Integrity Protocol (TKIP)	
- Advanced Encryption Standard (AES)	
Authentication	7, 11
- Remote Authentication Dial-In User Service (RADIUS)	
- Terminal Access Controller Access-Control System (TACACS+)	
- Kerberos	
- Multifactor	

I Introduction

Objective	Chapter(s)
2.4 Summarize types of malware and tools/methods for detection, removal, and prevention.	7, 11
Malware	7, 11
- Trojan	
- Rootkit	
- Virus	
- Spyware	
- Ransomware	
- Keylogger	
- Boot sector virus	
- Cryptominers	
- Stalkerware	
- Fileless	
Adware	7, 11
- Potentially unwanted program (PUP)	
Tools and methods	7, 11
- Recovery Console/environment/modes	
- Endpoint detection and response (EDR)	
- Managed detection and response (MDR)	
- Extended detection and response (XDR)	
- Antivirus	
- Anti-malware	
- Email security gateway	
- Software firewalls	
- User education regarding common threats	
- Antiphishing training	
- OS reinstallation	

Objective	Chapter(s)
2.5 Compare and contrast common social engineering attacks, threats, and vulnerabilities.	7, 11
Social engineering	7, 11
- Phishing <ul style="list-style-type: none">- Vishing- Smishing- QR code phishing- Spear phishing- Whaling	
- Shoulder surfing	
- Tailgating	
- Impersonation	
- Dumpster diving	
Threats	7, 11
- Denial of service (DoS)	
- Distributed denial of service (DDoS)	
- Evil twin	
- Zero-day attack	
- Spoofing	
- On-path attack	
- Brute-force attack	
- Dictionary attack	
- Insider threat	
- Structured Query Language (SQL) injection	
- Cross-site scripting (XSS)	
- Business email compromise (BEC)	
- Supply chain/pipeline attack	

Objective	Chapter(s)
Vulnerabilities	7, 11
- Non-compliant systems	
- Unpatched systems	
- Unprotected systems (missing antivirus/missing firewall)	
- EOL	
- Bring your own device (BYOD)	
2.6 Given a scenario, implement procedures for basic small office/home office (SOHO) malware removal.	7, 11
1. Investigate and verify malware symptoms.	7, 11
2. Quarantine infected system.	7, 11
3. Disable System Restore in Windows Home.	7, 11
4. Remediate infected systems.	7, 11
5. Update anti-malware software.	7, 11
6. Scan and removal techniques (e.g., safe mode, preinstallation environment).	7, 11
7. Reimage/reinstall.	7, 11
8. Schedule scans and run updates.	7, 11
9. Enable System Restore and create a restore point in Windows Home.	7, 11
10. Educate the end user.	7, 11
2.7 Given a scenario, apply workstation security options and hardening techniques.	7, 11
Data-at-rest encryption	7, 11
Password considerations	7, 11
- Length	
- Character types	
- Uniqueness	
- Complexity	
- Expiration	

Objective	Chapter(s)
Basic input/output system (BIOS)/Unified Extensible Firmware Interface (UEFI) passwords	7, 11
End-user best practices	7, 11
- Use screensaver locks	
- Log off when not in use	
- Secure/protect critical hardware (e.g., laptops)	
- Secure personally identifiable information (PII) and passwords	
- Use password managers	
Account management	7, 11
- Restrict user permissions	
- Restrict log-in times	
- Disable guest account	
- Use failed attempts lockout	
- User timeout/screen lock	
- Apply account expiration dates	
Change default administrators user account/password	7, 11
Disable AutoRun	7, 11
Disable Unused services	7, 11
2.8 Given a scenario, apply common methods for securing mobile devices.	7, 11
Hardening techniques	7, 11
- Device encryption	
- Screen locks	
- Facial recognition	
- Pin Codes	
- Fingerprint	
- Pattern	
- Swipe	
- Configuration profiles	

Objective	Chapter(s)
Patch management	7, 11
- OS updates	
- Application updates	
Endpoint security software	7, 11
- Antivirus	
- Anti-malware	
- Content Filtering	
Locator applications	7, 11
Remote wipes	7, 11
Remote backup applications	7, 11
Failed log-in attempts restrictions	7, 11
Policies and procedures	7, 11
- MDM	
- BYOD vs. corporate owned devices	
- Profile security requirements	
2.9 Compare and contrast common data destruction and disposal methods.	7, 11
Physical destruction	7, 11
- Drilling	
- Shredding	
- Degaussing	
- Incinerating	
Recycling or repurposing best practices	7, 11
- Erasing/wiping	
- Low-level formatting	
- Standard formatting	
Outsourcing concepts	7, 11
- Third-party vendor	
- Certification of destruction/recycling	
Regulatory and environmental requirements	7, 11

Objective	Chapter(s)
2.10 Given a scenario, apply security settings on small office/home office (SOHO) wireless and wired networks.	7, 11
Router settings	7, 11
- Change default passwords	
- IP filtering	
- Firmware updates	
- Content filtering	
- Physical placement/secure locations	
- Universal Plug and Play (UPnP)	
- Screened subnet	
- Configure secure management access	
Wireless specific	7, 11
- Changing the service set identifier (SSID)	
- Disabling SSID broadcast	
- Encryption settings	
- Configuring guest access	
Firewall settings	7, 11
- Disabling unused ports	
- Port forwarding/mapping	
2.11 Given a scenario, configure relevant security settings in a browser.	7, 11
Browser download/installation	7, 11
- Trusted sources	
- Hashing	
- Untrusted sources	
Browser patching	7, 11
Extensions and plug-ins	7, 11
- Trusted sources	
- Untrusted sources	
Password managers	7, 11
Secure connections/sites – valid certificates	7, 11

Objective	Chapter(s)
Settings	7, 11
- Pop-up blocker	
- Clearing browsing data	
- Clearing cache	
- Private-browsing mode	
- Sign-in/browser data synchronization	
- Ad blockers	
- Proxy	
- Secure DNS	
Browser feature management	7, 11
- Enable/disable	
- Plug-ins	
- Extensions	
- Features	

3.0 Software Troubleshooting

3.1 Given a scenario, troubleshoot common Windows OS issues.	8, 11
Blue screen of death (BSOD)	8, 11
Degraded performance	8, 11
Boot issues	8, 11
Frequent shutdowns	8, 11
Services not starting	8, 11
Applications crashing	8, 11
Low memory warnings	8, 11
USB controller resource warnings	8, 11
System instability	8, 11
No OS found	8, 11
Slow profile load	8, 11
Time drift	8, 11

Objective	Chapter(s)
3.2 Given a scenario, troubleshoot mobile OS and application issues.	8, 11
Application fails to launch	8, 11
Application fails to close/crashes	8, 11
Application fails to update	8, 11
Application fails to install	8, 11
Slow to respond	8, 11
OS fails to update	8, 11
Battery life issues	8, 11
Randomly reboots	8, 11
Connectivity issues	8, 11
- Bluetooth	
- Wi-Fi	
- Near-field communication (NFC)	
Screen does not autorotate	
3.3 Given a scenario, troubleshoot common mobile OS and application security issues.	8, 11
Security concerns	8, 11
- Application source/unofficial application stores	
- Developer mode	
- Root access/jailbreak	
- Unauthorized/malicious application	
- Application spoofing	
Common symptoms	8, 11
- High network traffic	
- Degraded response time	
- Data-usage limit notification	
- Limited Internet connectivity	
- No Internet connectivity	
- High number of ads	
- Fake security warnings	
- Unexpected application behavior	
- Leaked personal files/data	

Objective	Chapter(s)
3.4 Given a scenario, troubleshoot common personal computer (PC) security issues.	8, 11
Common symptoms	8, 11
- Unable to access the network	
- Desktop alerts	
- False alerts regarding antivirus protection	
- Altered system or personal files	
- Missing/renamed files	
- Inability to access files	
- Unwanted notifications within the OS	
- OS updates failures	
Browser-related symptoms	8, 11
- Random/frequent pop-ups	
- Certificate warnings	
- Redirection	
- Degraded browser performance	
4.0 Operational Procedures	
4.1 Given a scenario, implement best practices associated with documentation and support systems information management.	9, 11
Ticketing systems	9, 11
- User information	
- Device information	
- Description of issues	
- Categories	
- Severity	
- Escalation levels	
- Clear, concise written communication	
- Issue description	
- Progress notes	
- Issue resolution	

Objective	Chapter(s)
Asset management	9, 11
- Inventory lists	
- Configuration management database (CMDB)	
- Asset tags and IDs	
- Procurement life-cycle	
- Warranty and licensing	
- Assigned users	
Types of documents	9, 11
- Incident reports	
- Standard operating procedures (SOPs)	
- Software package custom installation procedure	
- New user/onboarding setup checklist	
- User off-boarding checklist	
- Service-level agreements (SLAs)	
- Internal	
- External/third-party	
- Knowledge base/articles	
4.2 Given a scenario, apply change management procedures.	9, 11
Documented business processes	9, 11
- Rollback plan	
- Backup plan	
- Sandbox testing	
- Responsible staff members	

Objective	Chapter(s)
Change management	9, 11
- Request forms	
- Purpose of the change	
- Scope of the change	
- Change type	
- Standard change	
- Normal change	
- Emergency change	
- Date and time of change	
- Change freeze	
- Maintenance windows	
- Affected systems/impact	
- Risk analysis	
- Risk level	
- Change board approvals	
- Implementation	
- Peer review	
- End-user acceptance	
4.3 Given a scenario, implement workstation backup and recovery methods.	9, 11
Backup	9, 11
- Full	
- Incremental	
- Differential	
- Synthetic full	
Recovery	9, 11
- In-place/overwrite	
- Alternative location	
Backup testing	9, 11
- Frequency	

Objective	Chapter(s)
Backup rotation schemes	9, 11
- Onsite vs. offsite	
- Grandfather-father-son (GFS)	
- 3-2-1 backup rule	
4.4 Given a scenario, use common safety procedures.	9, 11
Electrostatic discharge (ESD) straps	9, 11
ESD mats	9, 11
Electrical safety	9, 11
- Equipment grounding	
Proper component handling and storage	9, 11
Cable management	9, 11
Antistatic bags	9, 11
Compliance with government regulations	9, 11
Personal safety	9, 11
- Disconnect power before repairing PC	
- Lifting techniques	
- Fire safety	
- Safety goggles	
- Air filtration mask	
4.5 Summarize environmental impacts and local environment controls.	9, 11
Material safety data sheet (MSDS)/documentation for handling and disposal	9, 11
- Proper battery disposal	
- Proper toner disposal	
- Proper disposal of other devices and assets	
Temperature, humidity-level awareness, and proper ventilation	9, 11
- Location/equipment placement	
- Dust cleanup	
- Compressed air/vacuums	

Objective	Chapter(s)
Power surges, under-voltage events, and power losses	9, 11
- Uninterruptible power supply (UPS)	
- Surge suppressor	
4.6 Explain the importance of prohibited content/activity and privacy, licensing, and policy concepts.	9, 11
Incident response	9, 11
- Chain of custody	
- Inform management/law enforcement as necessary	
- Copy of drive (data integrity and preservation)	
- Incident documentation	
- Order of volatility	
Licensing/digital rights management (DRM)/end-user license agreement (EULA)	9, 11
- Valid licenses	
- Perpetual license agreement	
- Personal-use license vs. corporate-use license	
- Open-source license	
Non-disclosure agreement (NDA)/mutual non-disclosure agreement (MNDA)	9, 11
Regulated data	9, 11
- Credit card payment information	
- Personal government-issued information	
- Personally identifiable information (PII)	
- Healthcare data	
- Data retention requirements	
Acceptable use policy (AUP)	9, 11
Regulatory and business compliance requirements	9, 11
- Splash screens	
4.7 Given a scenario, use proper communication techniques and professionalism.	9, 11

Objective	Chapter(s)
Present a professional appearance and wear appropriate attire.	9, 11
- Match the required attire of the given environment. <ul style="list-style-type: none">- Formal- Business casual	
Use proper language and avoid jargon, acronyms, and slang, when applicable.	9, 11
Maintain a positive attitude/project confidence.	9, 11
Actively listen and avoid interrupting the customer.	9, 11
Be culturally sensitive.	9, 11
- Use appropriate professional titles and designations, when applicable.	
Be on time (if late, contact the customer).	9, 11
Avoid distractions.	9, 11
- Personal calls	
- Texting/social media sites	
- Personal interruptions	
Appropriately deal with difficult customers or situations.	9, 11
- Do not argue with customer and/or be defensive.	
- Avoid dismissing customer issues.	
- Avoid being judgmental.	
- Clarify customer statements (i.e., ask open-ended questions to narrow the scope of the issue, restate the issue, or question to verify understanding).	
- Use discretion and professionalism when discussing experiences/encounters.	
Set and meet expectations/timeline and communicate status with the customer.	9, 11
- Offer repair/replacement options, as needed.	
- Provide proper documentation on the services provided.	
- Follow up with customer/user at a later date to verify satisfaction.	
Appropriately handle customers' confidential and private materials.	9, 11
- Located on a computer, desktop, printer, etc.	

Objective	Chapter(s)
4.8 Explain the basics of scripting.	9, 11
Script file types	9, 11
- .bat - .ps1 - .vbs - .sh - .js - .py	
Use cases for scripting	9, 11
- Basic automation - Restarting machines - Remapping network drives - Installation of applications - Automated backups - Gathering of information/data - Initiating updates	
Other considerations when using scripts	9, 11
- Unintentionally introducing malware - Inadvertently changing system settings - Browser or system crashes due to mishandling of resources	
4.9 Given a scenario, use remote access technologies.	9, 11
Methods/tools	9, 11
- RDP - VPN - Virtual network computer (VNC) - Secure Shell (SSH) - Remote monitoring and management (RMM) - Simple Protocol for Independent Computing Environments (SPICE) - Windows Remote Management (WinRM) - Third-party tools - Screen-sharing software - Videoconferencing software - File transfer software - Desktop management software	

Objective	Chapter(s)
Security considerations of each access method	9, 11
4.10 Explain basic concepts related to artificial intelligence (AI).	9, 11
Application integration	9, 11
Policy	9, 11
- Appropriate use	
- Plagiarism	
Limitations	9, 11
- Bias	
- Hallucinations	
- Accuracy	
Private vs. public	9, 11
- Data security	
- Data source	
- Data privacy	



Exam objectives are subject to change at any time without prior notice and at CompTIA's sole discretion. Please visit the certification page of CompTIA's website at www.comptia.org for the most current listing of exam objectives.



Where the term *Windows* is used in the text, it refers to both Windows 10 and Windows 11, which are the two Microsoft operating systems on this version of the CompTIA A+ exam. Where necessary, differences between the two versions of the operating system are noted. Keep in mind that like the CompTIA A+ exam objectives, Microsoft operating systems are subject to change at their discretion.

COMPTIA A+

CORE 1 EXAM

220-1201

PART

I



- Mobile Devices
- Networking
- Hardware
- Virtualization and Cloud Computing
- Hardware and Network Troubleshooting

Chapter

1



Mobile Devices

THE COMPTIA A+ 220-1201 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

✓ **1.1 Given a scenario, monitor mobile device hardware and use appropriate replacement techniques.**

- Battery
- Keyboard/keys
- Random-Access Memory (RAM)
- Hard Disk Drive (HDD)/Solid-State Drive (SSD)
- Wireless cards
- Physical privacy and security components
 - Biometrics
 - Near-field scanner features
- Wi-Fi antenna connector/placement
- Camera/webcam
- Microphone

✓ **1.2 Compare and contrast accessories and connectivity options for mobile devices.**

- Connection methods
 - Universal Serial Bus (USB)/USB-C/MicroUSB/MiniUSB
 - Lightning
 - Near-Field Communication (NFC)
 - Bluetooth
 - Tethering/hotspot
- Accessories
 - Stylus
 - Headsets



- Speakers
- Webcam
- Docking station
- Port replicator
- Trackpad/drawing pad/track points

✓ **1.3 Given a scenario, configure basic mobile device network connectivity and provide application support.**

- Wireless/cellular data network (enable/disable)
 - 3G/4G/5G
 - Hotspot
 - Wi-Fi
 - Subscriber Identity Module (SIM)/eSIM
- Bluetooth
 - Enable Bluetooth
 - Enable pairing
 - Find a device for pairing
 - Enter the appropriate Personal Identification Number (PIN) code
 - Test connectivity
- Location services
 - Global Positioning System (GPS) services
 - Cellular location services
- Mobile Device Management (MDM)
 - Device configurations
 - Corporate
 - Bring Your Own Device (BYOD)
 - Policy Enforcement
 - Corporate applications



- Mobile device synchronization
 - Recognizing data caps
 - Calendar
 - Contacts
 - Business applications
 - Mail
 - Cloud storage

1. You have been asked to purchase a new camera for the company photographer. Some of the cameras are marketed as “smart” cameras. What key feature does this likely mean the camera includes?
 - A. Wi-Fi
 - B. RJ-45
 - C. Separate video processor
 - D. Internal hard drive
2. Your client is a manager at a construction site. They often walk around with a tablet computer, making notes with their finger on the screen as they see issues that need to be addressed. They have been having some trouble getting the computer to recognize what they are writing because their fingers are large and often dirty from working. What is the most cost-effective solution you can suggest that they purchase to make the job easier?
 - A. Stylus
 - B. Trackpad
 - C. Digitizer
 - D. Special gloves
3. Your friend works for a popular rideshare service. Their phone interacts with the service and the passenger so that both know how far away the driver is. What technology needs to be enabled on a cellphone to track where they are?
 - A. GPS
 - B. MDM
 - C. Location Services
 - D. MAM
4. Your company is concerned about how laptops and other remote devices can be secured when they are used by employees at home or on the road. Which of the following can be used to enforce policies and remove corporate applications remotely? (Choose two.)
 - A. GSM
 - B. CDMA
 - C. MAM
 - D. MDM
5. You’re at a friend’s house and want to use their Wi-Fi with your iPhone. You go into Settings, then Wi-Fi, but don’t see their network in your available list. Which of the following will you ask them to do? (Choose two.)
 - A. Provide their security type and password.
 - B. Add your IP address to their network.
 - C. Provide the name of their network.
 - D. Add your MAC address to their router.

6. Your friend's iPhone 13 will no longer charge. They have tried replacing the charging block and cable with compatible ones, cleaning the charging port, and testing the wall outlet. What should be done next?
 - A. Purchase a new phone.
 - B. Purchase a new battery.
 - C. Take the phone to a repair shop.
 - D. Use a wireless charging pad.
7. Your customer brought you a laptop with an internal battery that will no longer charge. You have told them that replacing the battery will be no problem at all. Which of the following will you need to do first?
 - A. Remove the back cover.
 - B. Remove the keyboard.
 - C. Disconnect the external power.
 - D. Disconnect the LCD panel.
8. A coworker is having a problem with their laptop and has asked you to fix it. When an external keyboard is plugged in, the laptop works just fine, but without it, strange characters appear on the screen when typing. Which of the following are likely causes? (Choose two.)
 - A. The driver is corrupted and needs to be updated/replaced.
 - B. The ribbon cable connecting the keyboard to the motherboard is partially disconnected and needs to be reseated.
 - C. The operating system needs to be reinstalled.
 - D. There is debris under the keys.
9. You're working as the IT support person at an accounting firm. One of the accountants dropped their laptop, and the number 5 key is broke-off. This is a critical problem for an accountant. What is the most cost-effective way to get them up and running again?
 - A. Replace the laptop with a new one.
 - B. Replace the entire laptop keyboard.
 - C. Replace the missing key.
 - D. Give them a desktop computer to use.
10. Your client is frustrated that their Bluetooth earpiece, which was working yesterday, is no longer working, and they've asked for your help. What is the most likely source of the problem?
 - A. The earpiece has paired to a different device.
 - B. The earpiece is broken.
 - C. The Wi-Fi signal is weak.
 - D. Bluetooth connectivity was lost.

11. Your boss has asked you to maximize the RAM in their laptop computer. You check the specifications and discover that the maximum system RAM is 32 GB of DDR5 RAM. The laptop currently has 16 GB of onboard RAM and one empty slot. Which of the following RAM modules should you purchase?
 - A. One 16 GB SODIMM
 - B. One 32 GB SODIMM
 - C. One 16 GB DIMM
 - D. One 32 GB DIMM
12. A friend is trying to install an update on their iPad, but they're receiving a message about insufficient space. They want to know if you can upgrade their storage. What will you tell them?
 - A. Sure, bring it over later today.
 - B. Storage can't be upgraded. You'll need to buy a new iPad.
 - C. Storage can't be upgraded, but you might be able to offload some apps that you no longer use.
 - D. Just purchase more space on iCloud; it's the same thing.
13. You need to replace a failed Serial Advanced Technology Attachment (SATA) hard drive on a 10-year-old laptop. The user has asked that the new drive be as fast as possible, regardless of disk space or cost. What type of drive should you install?
 - A. SSD
 - B. Magnetic
 - C. Hybrid
 - D. HDD
14. You need to replace a failed hard drive in a user's laptop, and it's a model with which you are unfamiliar. You look at the bottom of the laptop and see no obvious entrance points. Which component will you most likely need to remove to access the hard drive bay?
 - A. Wi-Fi card
 - B. Battery
 - C. System board
 - D. Keyboard
15. Which mobile connection type enables you to share your cellular Internet connection with a Wi-Fi-enabled device?
 - A. Hotspot
 - B. NFC
 - C. Bluetooth
 - D. RFID

- 16.** Which cellular communication technology is known as LTE?
- A.** Wi-Fi 6
 - B.** 3G
 - C.** 4G
 - D.** 5G
- 17.** Your friend wants to be able to use their phone to pay for purchases at a popular coffee shop. They noticed that the phone needs to be about 4 inches from the coffee shop's reader. What radio-wave communication type do you need to configure for your friend?
- A.** NFC
 - B.** Wi-Fi
 - C.** Hotspot
 - D.** Bluetooth
- 18.** You're working from a home office and need to be able to type on your keyboard while talking with clients, so you purchase a wireless headset. What wireless technology will you need to enable on your laptop, to ensure that the headset and laptop can communicate with each other?
- A.** Wi-Fi
 - B.** Hotspot
 - C.** Bluetooth
 - D.** NFC
- 19.** You are wearing your smartwatch, which enables you to make payments as you would when using a credit or debit card. What type of connection technology does this service use?
- A.** Bluetooth
 - B.** NFC
 - C.** Wi-Fi
 - D.** Hotspot
- 20.** You're upgrading the Wi-Fi card in a manager's laptop and notice that the antenna cable is frayed, so you need to replace it. What will you likely need to do to replace the antenna?
- A.** Wrap the antenna with electrical tape.
 - B.** Open the display to replace the cable.
 - C.** Attach a dongle for the new cable.
 - D.** Just install the new card, because the antenna is part of the card.
- 21.** Your boss has asked you to make sure that each of the company's laptops has a biometric scanner as an extra measure of security. Which of the following are biometric device technologies that are commonly found and can be configured on laptops? (Choose two.)
- A.** ID card scanner
 - B.** Face ID

- C. Fingerprint reader
 - D. Retina scanner
- 22.** Your company is producing posters for an upcoming public relations campaign. The project leader wants to embed information into an NFC Type 4 tag in the poster. How much information can this tag hold?
- A. 16 KB
 - B. 32 KB
 - C. 1.4 MB
 - D. 2.4 MB
- 23.** Your customer has an iPhone 8 and wants to read and write NFC tags with it. What advice will you give them? (Choose two.)
- A. Their iPhone will only work with Apple Pay.
 - B. They need to upgrade to an iPhone X to write NFC tags.
 - C. With iOS 13 or better on their device, they'll be able to read and write NFC tags using a third-party app.
 - D. iPhone 12 and iPhone 13 can read NFC tags simply by holding the phone over the tag.
- 24.** You've been asked by the company president what can be done with NFC, in addition to paying for coffee. What will you tell them? (Choose three.)
- A. Securely share data with someone you're having lunch with.
 - B. Beam data to someone 10 feet away.
 - C. Transfer files, photos, and videos.
 - D. Add information or URLs to business cards, making it easier for customers to learn about your products or services.
- 25.** Which two components of a laptop or other mobile device are the most useful when making a videoconference call? (Choose two.)
- A. Digitizer
 - B. Webcam
 - C. Microphone/speaker
 - D. Number pad
- 26.** Of the following laptop components, which one is least likely to be built into the display?
- A. Wi-Fi antenna
 - B. Speakers
 - C. Webcam
 - D. Digitizer

- 27.** What types of networking will smart cameras most often have built into them? (Choose two.)
- A.** Bluetooth
 - B.** IrDA
 - C.** RJ-45
 - D.** Wi-Fi
- 28.** What component or characteristic on most mobile phones has its ability measured in megapixels?
- A.** Brightness
 - B.** Contrast
 - C.** Camera
 - D.** Digitizer
- 29.** One of your coworkers has purchased an external Bluetooth trackpad to use with their tablet. They've turned to you, the company IT person, to install and configure it for them. What actions do you need to take? (Choose two.)
- A.** Plug the device into the tablet's USB port.
 - B.** Install the trackpad's drivers.
 - C.** Put the device in pairing mode, open Settings > Bluetooth and Devices, and then tap the trackpad or choose Add Device.
 - D.** Go to Settings to configure the trackpad's speed and scrolling features.
- 30.** What type of connection are you using if you use a USB cable to connect your laptop to your cellphone to use the cellular wireless connection from the laptop?
- A.** Hotspot
 - B.** Tethering
 - C.** USB networking
 - D.** Phoning
- 31.** The company president misplaced their charging cable for their iPhone 14. You tell them it's no problem and then hand them a new one. What type of connector does this iPhone use for charging?
- A.** Thunderbolt
 - B.** Lightning
 - C.** ApplePower
 - D.** USB-C

32. What type of mobile device connector is shown here?



- A. USB-C
 - B. Lightning
 - C. MicroUSB
 - D. Thunderbolt
33. Your significant other just purchased a new car and wants you to configure their cellphone to work through the car using voice commands. You must initiate pairing on the phone and choose to search for pairing devices on the car. What protocol is being used by the car and the device?
- A. 802.11a
 - B. Lightning
 - C. Bluetooth
 - D. Wi-Fi Enabled
34. A laptop user wants to have a full-sized display and keyboard as well as an external hard drive and speakers available to them at their desk. Which accessory can they purchase to avoid plugging each of these devices separately into their laptop every time they return to the desk? (Choose two.)
- A. KVM switch
 - B. Port replicator
 - C. Desktop station
 - D. Docking station
35. A user needs ports for external devices in addition to what their laptop has available. The user would like these devices to have connectivity with each other even when the laptop isn't there. Which of the following will provide that option?
- A. Docking station
 - B. Port replicator

- C. KVM switch
 - D. Docking port
36. You've been handed a device to install. The cable looks like the one shown here. What type of connector does this device use?



- A. USB-C
 - B. MiniUSB
 - C. MicroUSB
 - D. Thunderbolt 3
37. You're configuring a new laptop for a user. What devices can you plug into the port shown here? (Choose two.)



- A. Speaker
- B. Headset
- C. Webcam
- D. Stylus

- 38.** A technician has a failed Lenovo laptop and suspects the motherboard is bad. They have several other laptops available from which they can harvest parts. Which of the following statements is most likely true regarding the replacement motherboard that is selected?
- A. The motherboard is not replaceable.
 - B. Any laptop motherboard will work.
 - C. A motherboard from any other Lenovo laptop will work.
 - D. Only a motherboard from that same model of Lenovo laptop will work.
- 39.** You will be traveling to another country for work and will have a 10-hour airplane flight. You need to work on your laptop while flying, but your battery won't last that long. What should you have on hand to enable you to use the auxiliary power outlets on the airplane?
- A. AC adapter
 - B. DC adapter
 - C. Power inverter
 - D. Docking station
- 40.** The AC adapter for your laptop is not working properly, and you are searching for a replacement. Which two factors are most important when selecting a new AC adapter? (Choose two.)
- A. Polarity
 - B. Same wattage as the original
 - C. Brand of the adapter
 - D. Size of the adapter's transformer
- 41.** How do modern docking stations connect to laptops? (Choose two.)
- A. USB 2
 - B. USB-C
 - C. Thunderbolt 3 or 4
 - D. HDMI
- 42.** You have enabled the GPS service in your tablet. What is the minimum number of GPS satellites your tablet needs to be in contact with to determine its location?
- A. One
 - B. Two
 - C. Three
 - D. Four
- 43.** A technician needs to replace a failed laptop hard drive. Which of the following form factors could the laptop require? (Choose two.)
- A. M.2
 - B. 2.0-inch

- C. 2.5-inch
 - D. 3.5-inch
44. You were given an older laptop, which has 4 GB of system RAM and an integrated video card. The default setting specifies 512 MB of video memory. How much RAM is available for the processor to use?
- A. 4 GB
 - B. 3.5 GB
 - C. 3 GB
 - D. It's variable
45. Oculus, Samsung, and HTC are manufacturers of what specific type of wearable technology devices?
- A. Smart glasses
 - B. Smart headsets
 - C. Smart watches
 - D. VR/AR headsets
46. What type of connectors are the two shown in the center here?



- A. Lightning
 - B. Thunderbolt
 - C. DisplayPort
 - D. PCIe x 1
47. What type of device could use a Lightning connector to charge and transfer data?
- A. Samsung smartphone
 - B. Fitbit watch
 - C. Intel-based laptop
 - D. Apple iPhone
48. What is the likely type of Wi-Fi antenna connector you will find as an external connector on a laptop?
- A. SMA-female-RP
 - B. N-male
 - C. SMA-male-RP
 - D. N-female

- 49.** After enabling your device for communication using the IEEE 802.15.1 standard, what is the next step?
- A.** Enter the PIN code.
 - B.** Find a device for pairing.
 - C.** Enable pairing.
 - D.** Open port 802.15.1.
- 50.** You've enabled Bluetooth on your new headset and laptop, and enabled pairing on both. They have discovered each other, so what is the typical next step?
- A.** Pressing and holding a Bluetooth button
 - B.** Entering the Bluetooth password
 - C.** Entering the Bluetooth PIN code
 - D.** Exiting out of any running Bluetooth applications
- 51.** What service is built into Apple-developed devices and permits users and subscribers to store documents, media, and contact information in a remote location?
- A.** iStore
 - B.** OneDrive
 - C.** iCloud
 - D.** CloudOnline
- 52.** Which configuration settings are commonly used when setting up email from an online provider on a device?
- A.** Active Directory domain name
 - B.** Port and TLS settings
 - C.** Email server name
 - D.** Username and password
- 53.** Which number that is a part of the GSM system is hardcoded into the phone and identifies your physical phone hardware to the cellular tower?
- A.** PRI
 - B.** IMSI
 - C.** IMEI
 - D.** MAC
- 54.** Which unique component identifies you as a user and is coded into a phone by the user or service provider?
- A.** IMSI
 - B.** eSIM

- C. IMEI2
 - D. SIM
55. What best practice can save someone from losing data, such as calendar entries and contacts on their mobile device, if their device is lost?
- A. Synchronization
 - B. VPN
 - C. Encryption
 - D. Updating
56. A user wants their calendars to be readily available on multiple devices, including their laptop, desktop, and cellphone. What is the best option?
- A. Email appointments to self.
 - B. Send links to a URL-shortening service.
 - C. Synchronize calendars.
 - D. Synchronize bookmarks.
57. When two parents want to share appointment dates and times between their devices, what is their best option?
- A. Synchronize their calendars.
 - B. Share calendar passwords.
 - C. Text the calendar data to each other.
 - D. Email calendar invites to each other.
58. Your user needs to synchronize their contact list between their work computer and their smartphone. What Windows app is used to synchronize data between a user's mobile devices like smartphones and their desktop computers?
- A. MSync
 - B. ActiveSync
 - C. SyncTime
 - D. Timewarp
59. You're installing Bluetooth speakers in a conference room and just entered the PIN to connect the two devices. What is your next step?
- A. Enable pairing.
 - B. Search for the Bluetooth device.
 - C. Enable Bluetooth.
 - D. Test connectivity.

- 60.** The owner of a company that provides transportation from an airport to various hotels wants to employ software that will tell them where every vehicle is at all times. All the vehicles use satellite-based navigation systems. What technology is most likely being used to track where they are?
- A.** GPS
 - B.** MDM
 - C.** Cellular location services
 - D.** MAM
- 61.** You're going hiking this weekend in unfamiliar territory and have installed an application on your phone to show you where you are on the map in relation to the trails and surrounding areas. What two types of location technology might this app use? (Choose two.)
- A.** GPS
 - B.** MDM
 - C.** Cellular location services
 - D.** RFID
- 62.** Your coworker wants to be able to use maps with their phone but is unhappy that other applications are also tracking their physical location. They ask for your help. Which of the following is *not* true?
- A.** If location services are turned off for one application, they are turned off for all applications.
 - B.** When you're installing an application, most likely it will ask you when it is allowed to use location services.
 - C.** Some applications won't work without location services.
 - D.** You can turn location services on or off for applications in the settings of your device.
- 63.** You're at home binging on a popular Internet movie service and suddenly notice that the spinning wheel is showing up often, taking more time to download the movie than normal. What is likely the problem?
- A.** Your router needs to be reset.
 - B.** You have reached your data cap.
 - C.** Your laptop is overheating.
 - D.** The service is overwhelmed with requests.
- 64.** The executives at your company are concerned about employees using their personal devices for work. They worry that someone may leave and take proprietary information with them. You calm their fears by telling them that there are settings in place on the Bring Your Own Device (BYOD) policy that protect company data accessed by employees. What are those settings called? (Choose two.)
- A.** MAM
 - B.** MDM

- C. GSM
 - D. CDMA
65. Which cellular communication technology is projected to be able to reach transmission rates up to 20 Gbps?
- A. 3G
 - B. 4G
 - C. 5G
 - D. Wi-Fi 6
66. An employee will be using their own device to work on company projects while they are at home. What are your two most likely options for providing access to corporate applications? (Choose two.)
- A. Install a corporate-licensed copy on their device that is managed remotely by MDM or MAM software.
 - B. Purchase a single-user license for the software to install on their device.
 - C. Provide cloud access to the application.
 - D. Force them to use a corporate-owned device.

Chapter 2



Networking

THE COMPTIA A+ 220-1201 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

- ✓ **2.1 Compare and contrast Transmission Control Protocol (TCP) and User Datagram Protocol (UDP) ports, protocols, and their purposes.**

- Ports and Protocols
 - 20–21—File Transfer Protocol (FTP)
 - 22—Secure Shell (SSH)
 - 23—Telnet
 - 25—Simple Mail Transfer Protocol (SMTP)
 - 53—Domain Name System (DNS)
 - 67/68—Dynamic Host Configuration Protocol (DHCP)
 - 80—Hypertext Transfer Protocol (HTTP)
 - 110—Post Office Protocol 3 (POP3)
 - 137–139—Network Basic Input/Output System (NetBIOS)/NetBIOS over TCP/IP (NetBT)
 - 143—Internet Mail Access Protocol (IMAP)
 - 389—Lightweight Directory Access Protocol (LDAP)
 - 443—Hypertext Transfer Protocol Secure (HTTPS)
 - 445—Server Message Block (SMB)/Common Internet File System (CIFS)
 - 3389—Remote Desktop Protocol (RDP)
 - TCP vs. UDP

- ✓ **2.2 Explain wireless networking technologies.**

- Frequencies
 - 2.4GHz
 - 5GHz
 - 6GHz



- Channels
 - Regulations
 - Channel Selection
 - Widths
 - Frequencies
 - Bands
- Bluetooth
- 802.11 standards
- NFC
- Radio-Frequency Identification (RFID)

✓ **2.3 Summarize services provided by networked hosts.**

- Server roles
 - DNS
 - DHCP
 - Fileshare
 - Print servers
 - Mail servers
 - Syslog
 - Web servers
 - Authentication, Authorization, and Accounting (AAA)
 - Database Servers
 - Network Time Protocol (NTP)
 - Internet appliances
 - Spam gateways
 - Unified threat management (UTM)
 - Load balancers
 - Proxy servers
- Legacy/Embedded systems
- Supervisory Control and Data Acquisition (SCADA)
- Internet of Things (IoT) devices



✓ **2.4 Explain common network configuration concepts.**

- DNS
 - A
 - AAAA
 - Canonical Name (CNAME)
 - Mail Exchanger (MX)
 - Text (TXT)
 - Spam management
 - DomainKeys Identified Mail (DKIM)
 - Sender Policy Framework (SPF)
 - Domain-based Message Authentication, Reporting, and Conformance (DMARC)
- DHCP
 - Leases
 - Reservations
 - Scope
 - Exclusions
 - Virtual LAN [Local Area Network] (VLAN)
 - Virtual Private Network (VPN)

✓ **2.5 Compare and contrast common networking hardware devices.**

- Routers
- Switches
 - Managed
 - Unmanaged
- Access points
- Patch Panel
- Firewall
- Power over Ethernet (PoE)
- Injectors
- Switch



- PoE standards
- Cable modem
- Digital Subscriber Line (DSL)
- Optical Network Terminal (ONT)
- Network Interface Card (NIC)
- Physical Media Access Control (MAC) address

✓ **2.6 Given a scenario, configure basic wired/wireless Small Office/Home Office (SOHO) networks.**

- Internet Protocol (IP) addressing
 - IPv4
 - Private addresses
 - Public addresses
 - IPv6
- Automatic Private IP Addressing (APIPA)
- Static
- Dynamic
- Subnet mask
- Gateway

✓ **2.7 Compare and contrast Internet connection types, network types, and their characteristics.**

- Internet connection types
 - Satellite
 - Fiber
 - Cable
 - DSL
 - Cellular
 - Wireless Internet Service Provider (WISP)
- Network types
 - LAN
 - Wide Area Network (WAN)
 - Personal Area Network (PAN)



- Metropolitan Area Network (MAN)
- Storage Area Network (SAN)
- Wireless Local Area Network (WLAN)

✓ **2.8 Explain networking tools and their purposes.**

- Crimper
- Cable stripper
- Wi-Fi analyzer
- Toner probe
- Punchdown tool
- Cable tester
- Loopback plug
- Network tap

1. You are installing a fiber-optic cable between two buildings. To install the cable, you must run it through a conduit between the buildings, and access to the conduit is not easy. Before you run the cable, you want to ensure that it's working properly. Which tool should you use?

 - A. Cable tester
 - B. Multimeter
 - C. Loopback plug
 - D. Tone generator and probe
2. Which TCP/IP protocol, designed to download email, enables multiple clients to be simultaneously connected to the same mailbox?

 - A. SMTP
 - B. POP3
 - C. IMAP
 - D. SMB
3. You are using your laptop on the company network. In your web browser, you type in `www.google.com` and press Enter. The computer cannot find Google. You open the browser on your phone, and using your cellular connection, you can open Google without a problem. Your laptop finds internal servers and can print without any issues. What is the most likely reason you can't open Google?

 - A. DNS server problem
 - B. DHCP server problem
 - C. Missing subnet mask
 - D. Duplicate IP address
4. Which one of the following TCP/IP protocols was designed as a replacement for Telnet?

 - A. SMB
 - B. SSH
 - C. SFTP
 - D. FTPS
5. What feature of 802.11ac, 802.11ax, and 802.11be enables them to effectively double their available bandwidth?

 - A. QoS
 - B. QAM
 - C. PoE
 - D. EoP

6. Which of the following TCP/IP protocols is connection-oriented and attempts to guarantee packet delivery?
 - A. IP
 - B. TCP
 - C. UDP
 - D. ICMP
7. Which TCP/IP protocol enables a user to log in to a remote computer and manage files as if they were logged in locally?
 - A. FTP
 - B. SFTP
 - C. SMB
 - D. RDP
8. Which of the following Wi-Fi standards is the fastest, operating in both the 2.4 and 5 GHz frequencies?
 - A. 802.11a
 - B. 802.11ac
 - C. 802.11ax
 - D. 802.11n
9. Bob has a device that operates at 5 GHz. He is unable to connect his device to a LAN that he hasn't accessed before, although he has verified that he has the correct password. What type of network might pose this problem?
 - A. 802.11g
 - B. 802.11n
 - C. 802.11ac
 - D. 802.11ax
10. Which TCP/IP protocol is used to provide shared access to files and printers on the network?
 - A. FTP
 - B. SSH
 - C. SMB
 - D. SMTP
11. Which deprecated protocol enables a user to log in to another machine and “see” the remote computer in a window on their screen?
 - A. SSH
 - B. FTP
 - C. Telnet
 - D. SMTP

- 12.** You have just installed a wireless 802.11ac network for a client. The IT manager is concerned about competitors intercepting the wireless signal from outside the building. Which tool is designed to test how far your wireless signal travels?
- A.** Tone generator and probe
 - B.** Protocol analyzer
 - C.** Packet sniffer
 - D.** Wi-Fi analyzer
- 13.** Some of your network users are concerned about submitting confidential information to an online website. What should you tell them?
- A.** It's fine, because all Internet traffic is encrypted.
 - B.** If the website address starts with `TLS://`, it should be OK to submit confidential information to a trusted site.
 - C.** If the website address starts with `HTTPS://`, it should be OK to submit confidential information to a trusted site.
 - D.** Don't ever submit confidential information to any online website.
- 14.** Which of these standards operate in the 2.4, 5, and 6 GHz frequencies? (Choose two.)
- A.** 802.11ac
 - B.** 802.11ax
 - C.** 802.11g
 - D.** 802.11be
- 15.** Which type of IPv6 address identifies a single node on the network?
- A.** Multicast
 - B.** Anycast
 - C.** Unicast
 - D.** Localcast
- 16.** What type of network covers large geographical areas and may support thousands of users, often using lines owned by other entities?
- A.** LAN
 - B.** WAN
 - C.** PAN
 - D.** MAN
- 17.** Which TCP/IP protocol, developed by Microsoft, uses port 3389 to connect to a remote computer?
- A.** RDP
 - B.** SMB

- C. CIFS
 - D. Telnet
- 18.** What port does the SSH protocol use?
- A. 21
 - B. 22
 - C. 23
 - D. 25
- 19.** Which of the following IP addresses is not routable on the Internet?
- A. 10.1.1.1
 - B. 11.1.1.1
 - C. 12.1.1.1
 - D. 13.1.1.1
- 20.** Which network connectivity device does not forward broadcast messages, thereby creating multiple broadcast domains?
- A. Hub
 - B. Switch
 - C. Bridge
 - D. Router
- 21.** What type of address does a router use to get data to its destination?
- A. IP
 - B. MAC
 - C. Memory
 - D. Loopback
- 22.** You have a desktop computer that is behaving erratically on the network. The wired connection will often disconnect without warning. Which tool should you use to troubleshoot the network adapter?
- A. Multimeter
 - B. Tone generator and probe
 - C. Loopback plug
 - D. Cable tester
- 23.** You are a network administrator. Currently, there is no wireless access to the business network, but the company is purchasing tablets and wireless printers so employees can work as they move around the facility. What name is given to the network created when you install a device to create network access for the wireless devices?
- A. WLAN
 - B. Proxy

- C. WAP
 - D. An NFC hub
- 24.** You want to ensure that client computers can download email from external email servers regardless of the protocol their email client uses. Which ports do you open on the firewall to enable this? (Choose two.)
- A. 23
 - B. 25
 - C. 110
 - D. 143
- 25.** You manage a network consisting of 500 nodes. Manually configuring the IP addresses of these computers and devices by yourself would be a daunting task. What can you do instead?
- A. Ask the human resources department to hire help.
 - B. Keep detailed records and configure them yourself.
 - C. Assign static IP addresses.
 - D. Assign dynamic IP addresses.
- 26.** Which networking device is capable of reading IP addresses and forwarding packets based on the destination IP address?
- A. Hub
 - B. Switch
 - C. NIC
 - D. Router
- 27.** Which network device is designed to be a security guard, blocking malicious data from entering your network?
- A. PoE injector
 - B. EoP device
 - C. Firewall
 - D. Router
- 28.** You are manually configuring TCP/IP hosts on the network. Which configuration parameter specifies the internal address of the router that enables Internet access?
- A. Subnet mask
 - B. DHCP server
 - C. DNS server
 - D. Gateway

- 29.** Which of the following devices will be found in a telecommunications room and provides a means to congregate horizontal wiring, terminating each run in a female port?
- A.** Patch panel
 - B.** Multiplexer
 - C.** Rack U
 - D.** Demarcation point
- 30.** What type of network is most commonly associated with Bluetooth devices, such as wireless keyboards, mice, and headphones, and covers a small area?
- A.** LAN
 - B.** WAN
 - C.** PAN
 - D.** MAN
- 31.** When troubleshooting a network connectivity issue, you discover that the local computer has an IPv4 address of 169.254.2.2. What do you immediately know about this local computer? (Choose two.)
- A.** It is using an APIPA address.
 - B.** It can't find a DHCP server.
 - C.** It isn't on the network.
 - D.** It has an invalid IP address.
- 32.** Which of the following IPv6 addresses is automatically assigned by the host when it boots and is only usable on the broadcast domain in which it exists?
- A.** 2000::/3
 - B.** FC00::/7
 - C.** FE80::/10
 - D.** FF00::/8
- 33.** You need to configure a wireless router for an office network. The office manager wants new devices to be able to automatically join the network and announce their presence to other networked devices. Which service should you enable to allow for this?
- A.** DHCP
 - B.** NAT
 - C.** QoS
 - D.** UPnP
- 34.** You are troubleshooting a computer with only one IPv6 address, which is in the FE80::/10 range. Which of the following statements are true? (Choose two.)
- A.** The computer will not be able to get on the Internet using that IP address.
 - B.** The computer will be able to get on the Internet using that IP address.

- C. The computer is configured with a link-local unicast address.
 - D. The computer is configured with a global unicast address.
- 35.** You have set up your web server to function as an FTP server as well. Users on the Internet complain that they are not able to access the server using FTP clients. What port should they be trying to access the server on?
- A. 21
 - B. 22
 - C. 23
 - D. 80
- 36.** Which TCP/IP protocol enables you to access data such as employee phone numbers and email addresses that are stored within an information directory?
- A. SNMP
 - B. SMTP
 - C. CIFS
 - D. LDAP
- 37.** What port is associated with the LDAP protocol?
- A. 22
 - B. 139
 - C. 389
 - D. 3389
- 38.** You are configuring network hosts with static IP addresses. You have chosen to use a class B network address. What is the default subnet mask that you should configure on the hosts?
- A. 255.0.0.0
 - B. 255.255.0.0
 - C. 255.255.255.0
 - D. 255.255.255.255
- 39.** You are installing a new network and working in a telecommunications room. You need to attach several network cables to a 110 block. Which tool should you use to perform this task?
- A. Crimper
 - B. Cable stripper
 - C. Cable tester
 - D. Punchdown tool
- 40.** Which of the following Internet connection types offers the fastest download speeds?
- A. Cable
 - B. DSL

- C. Fiber-optic
 - D. Satellite
- 41.** Which of the following are public IPv4 addresses? (Choose two.)
- A. 69.252.80.71
 - B. 144.160.155.40
 - C. 172.20.10.11
 - D. 169.254.1.100
- 42.** Which TCP/IP protocol uses port 445?
- A. FTP
 - B. SSH
 - C. SMB
 - D. SNMP
- 43.** What rendition of SMB was used by Windows servers and NAS servers but is no longer often used?
- A. CIFS
 - B. Samba
 - C. NFS
 - D. SMB3
- 44.** For IPv6, which of the following statements are true? (Choose two.)
- A. Each IPv6 interface can have only one address.
 - B. Each IPv6 interface is required to have a link-local address.
 - C. IPv6 addresses are incompatible with IPv4 networks.
 - D. IPv6 does not use broadcasts.
- 45.** In a DNS system, what type of record is used to resolve the domain name to IPv4 addresses?
- A. An A address
 - B. An AAAA address
 - C. A MAC address
 - D. An MX address
- 46.** What type of entry in DNS can be used to store bits of information like a verification line for the domain or information on updates?
- A. A
 - B. TXT
 - C. CNAME
 - D. MX

- 47.** Which of the following IPv6 addresses is equivalent to 127.0.0.1 in IPv4?
- A.** ::0
 - B.** ::1
 - C.** ::127
 - D.** 2000::/3
- 48.** You are asked to perform consulting work for a medium-sized company that is having network connectivity issues. When you examine the patch panel, you notice that none of the dozens of UTP cables are labeled. Which tool can you use to identify which cable goes to which workstation?
- A.** Cable tester
 - B.** Loopback plug
 - C.** Punchdown tool
 - D.** Toner probe
- 49.** Which TCP/IP protocol is responsible for dynamically assigning IP addresses to client computers?
- A.** DNS
 - B.** DHCP
 - C.** RDP
 - D.** LDAP
- 50.** Which networking device has multiple ports, each of which is its own collision domain, and uses the MAC address in the header of an incoming packet to determine which port the packet gets sent to?
- A.** WAP
 - B.** Switch
 - C.** Bridge
 - D.** Router
- 51.** Which TCP/IP port will an email client use to push email to its email server?
- A.** 23
 - B.** 25
 - C.** 110
 - D.** 143
- 52.** A technician is going to set up a Wi-Fi network using a standard omnidirectional antenna. Because of the building configuration, transmitting signals for the greatest distance is the technician's primary criterion. Which standard should they choose?
- A.** 802.11a
 - B.** 802.11g

- C. 802.11n
 - D. 802.11ac
53. You are troubleshooting an intermittently failing Cat 6 network connection. You suspect that there is a short in the connection. Which tool can you use to determine this?
- A. Toner probe
 - B. Loopback plug
 - C. Cable tester
 - D. Crimper
54. What marks the boundary of an IPv4 broadcast domain?
- A. Ethernet extender
 - B. Switch
 - C. Router
 - D. Modem
55. Which DNS feature uses public and private keys to verify that an email originated from where it claims?
- A. DKIM
 - B. SPF
 - C. DMARC
 - D. AAAA
56. Which Internet connection type, once popular for home use, offers asymmetrical download and upload speeds and is implemented over common phone lines?
- A. POTS
 - B. Cable
 - C. DSL
 - D. ISDN
57. You are installing an 802.11n Wi-Fi network with five wireless access points. The access points are placed so their ranges overlap. To avoid communications issues, which principle should you follow when configuring them?
- A. Configure all access points to use the same channel.
 - B. Configure all access points to use adjacent channels.
 - C. Configure all access points to use nonoverlapping channels.
 - D. Channel configuration will not cause communications issues.
58. You need to configure email settings for use with IMAP. Which port will you be configuring?
- A. 25
 - B. 80

- C. 110
 - D. 143
- 59.** Which of the following technologies will enable you to install networking devices that need power to function, in a location that has no power outlets?
- A. EoP
 - B. PoE
 - C. WAP
 - D. Hub
- 60.** You have been asked to install a Wi-Fi network in a building approximately 100 meters long and 25 meters wide. Because of cost considerations, you will be using 802.11ac. At a minimum, how many wireless access points will you need?
- A. Two
 - B. Three
 - C. Four
 - D. Six
- 61.** What two tools do you need to connect an RJ-45 connector to an appropriate cable? (Choose two.)
- A. Punchdown tool
 - B. Network tap
 - C. Crimper
 - D. Cable stripper
- 62.** What feature of DNS requires that a sender's email be from the same domain as the DNS domain and can be set to reject any email that isn't?
- A. DKIM
 - B. SPF
 - C. DMARC
 - D. A
- 63.** You need to install a wireless access point in a drop ceiling where there is no access to a power source. Which technology will enable you to get power to that device?
- A. EoP
 - B. PoE
 - C. Hub
 - D. Repeater/extender

- 64.** Which of the following IP addresses is not a private address and therefore is routable on the Internet?
- A. 10.1.2.3
 - B. 172.18.31.54
 - C. 172.168.38.155
 - D. 192.168.38.155
- 65.** You have two servers and a printer, which you want to use IP addresses that are in the beginning of your IP address range. What do you need to configure in the DHCP server?
- A. Leases
 - B. Scope
 - C. Reservations
 - D. Exclusions
- 66.** If you are connecting to a website that encrypts its connection using TLS, on what port does that traffic travel?
- A. 21
 - B. 80
 - C. 143
 - D. 443
- 67.** Your network is currently running a mix of 802.11b and 802.11g devices. At the end of the year, you have remaining budget funds to upgrade some, but not all, of the wireless infrastructure. You want to upgrade to the newest technology possible but still maintain backward compatibility. Which standard should you choose?
- A. 802.11g
 - B. 802.11ac
 - C. 802.11ax
 - D. 802.11be
- 68.** What type of network spans multiple buildings or offices, possibly even crossing roads, but is confined to a relatively small geographical area?
- A. LAN
 - B. WAN
 - C. PAN
 - D. MAN
- 69.** Which of the following shorthand notations corresponds to the CIDR subnet mask 255.255.224.0?
- A. /19
 - B. /20

- C.** /21
 - D.** /22
- 70.** You are configuring hosts on a network running IPv4. Which elements are required for the computer to connect to the network?
- A.** IP address
 - B.** IP address and subnet mask
 - C.** IP address, subnet mask, and default gateway
 - D.** IP address, subnet mask, default gateway, and DNS server address
- 71.** You work at a tech support company, and a customer calls, reporting that they received an error—something about a duplicate IP address. Why are they getting this message? (Choose two.)
- A.** All hosts on a network must have a unique IP address.
 - B.** A PC is manually configured with an IP that is in the DHCP scope.
 - C.** A PC is manually configured with an IP that is not in the DHCP scope.
 - D.** None of the PCs have been manually configured.
- 72.** You’re setting up a network for a customer. The network uses a DHCP server, but the customer needs an IP address for their print server that does not change. What are two possible solutions? (Choose two.)
- A.** Let the DHCP server assign a number, because once assigned, it will not change.
 - B.** Manually configure the print server to have a static IP address.
 - C.** Configure a reserved IP address on the DHCP server for the print server.
 - D.** Static and dynamic IP addresses can’t exist on the same network. You’ll have to manually configure everything.
- 73.** Telnet is a depreciated protocol that enables remote viewing of a computer’s desktop. What is Telnet’s port number?
- A.** 20
 - B.** 22
 - C.** 23
 - D.** 25
- 74.** Which port is used by the DNS protocol?
- A.** 53
 - B.** 67/68
 - C.** 110
 - D.** 137

- 75.** Because of a recent security breach, your IT team shut down several ports on the external firewall. Now, users can't get to websites by using their URLs, but they can get there by using IP addresses. What port(s) does the IT team need to open back to enable Internet access via URLs?
- A.** 20/21
 - B.** 53
 - C.** 67/68
 - D.** 80
- 76.** All your network hosts are configured to use DHCP. Which IP address would indicate that a host has been unable to locate a DHCP server?
- A.** 192.168.1.1
 - B.** 10.1.1.1
 - C.** 172.16.1.1
 - D.** 169.254.1.1
- 77.** You have reason to believe that several network users are actively browsing prohibited content on unsecured Internet sites. Which port can you disable on the firewall to immediately stop access to these websites?
- A.** 53
 - B.** 67
 - C.** 80
 - D.** 443
- 78.** Which TCP/IP protocol is designed to help resolve hostnames to IP addresses?
- A.** ARP
 - B.** RARP
 - C.** DHCP
 - D.** DNS
- 79.** You need to install an Internet connection for a forest ranger outlook tower located far from electrical lines. Which option would be best for broadband Internet access?
- A.** Cable
 - B.** DSL
 - C.** Fiber
 - D.** Satellite
- 80.** Your customer will be moving their small office to a remote mountain village where there is no cable Internet access. They have heard that there is a wireless option available in the area, which is faster than satellite but requires an antenna and line-of-sight to a tower. What option have they heard about?
- A.** Satellite
 - B.** DSL

- C. WISP
 - D. Cellular hotspot
- 81.** Which TCP/IP host-to-host protocol makes its best effort to deliver data but does not guarantee it?
- A. IP
 - B. TCP
 - C. UDP
 - D. ICMP
- 82.** What type of network is typically defined as being contained within a single office or building?
- A. LAN
 - B. WAN
 - C. PAN
 - D. MAN
- 83.** You are installing a wireless network for a small company. The management wants to have 1 Gbps or better wireless transmission rates. Which of the following standards will enable you to provide this? (Choose two.)
- A. 802.11n
 - B. 802.11ax
 - C. 802.11b
 - D. 802.11be
- 84.** Which of these standards operate in both the 2.4 and 5 GHz frequencies? (Choose two.)
- A. 802.11ac
 - B. 802.11ax
 - C. 802.11g
 - D. 802.11n
- 85.** What legacy network protocol enables NetBIOS-dependent computer applications to communicate over TCP/IP?
- A. TFTP
 - B. HTTPS
 - C. NetBT
 - D. BGP
- 86.** Which of the following features does not require a managed network switch?
- A. Priority of traffic
 - B. VLAN configuration

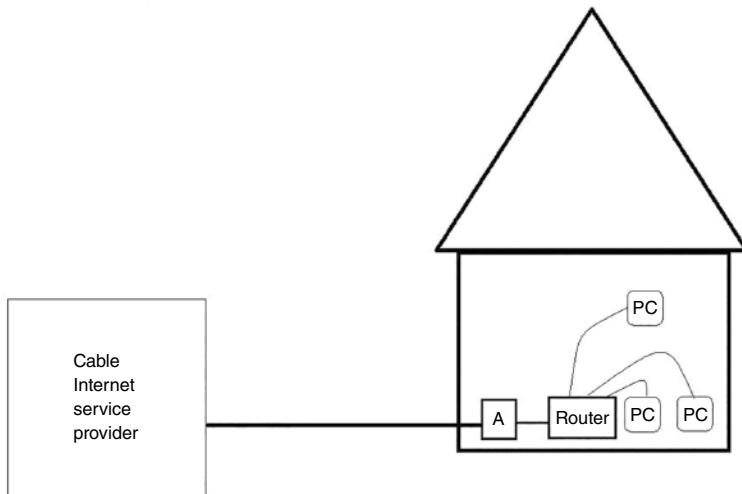
- C. Direct packets out the proper port
 - D. Port mirroring
87. In the United States, what groups are responsible for approving wireless channel uses? (Choose two.)
- A. OSHA
 - B. FCC
 - C. IANA
 - D. IEEE
88. What port(s) does DHCP use?
- A. 67/68
 - B. 137–139
 - C. 80
 - D. 445
89. What is the maximum distance allowed between a PoE injector and the PoE compatible Ethernet device running on a 1000BaseT network?
- A. 50 meters
 - B. 100 meters
 - C. 250 meters
 - D. 450 meters
90. Which of the following protocols uses ports 137–139?
- A. DNS
 - B. SMB
 - C. NetBT
 - D. SSH
91. When setting up a SOHO network, how do the end-user devices know what IP address they need to use to connect with the network? (Choose two.)
- A. The network switch broadcasts configuration settings.
 - B. Devices utilize ARP.
 - C. The NIC is configured with a static address.
 - D. The NIC is configured to receive a DHCP address.
92. You've been asked to set up a wireless network for a SOHO that will only enable five specific devices to connect. How do you accomplish this based on each device's NIC?
- A. Disable the router's SSID.
 - B. Configure port forwarding.

- C. Set a DHCP scope with only five addresses.
 - D. Configure MAC address filtering.
- 93.** What is the most likely way for a homeowner's IoT devices to connect to their wireless network using a dynamic address assigned by a server?
- A. DNS
 - B. AD
 - C. SSO
 - D. DHCP
- 94.** What type of radio wave communication technology is being used at a fast-food restaurant when a customer places their phone next to a device to pay for their purchase?
- A. RFID
 - B. NFC
 - C. Wi-Fi
 - D. HAV
- 95.** What communication technology enables low-power passive reading of a small tag or patch on an object that may be a few feet to dozens of feet away?
- A. RFID
 - B. NFC
 - C. Wi-Fi
 - D. RFI
- 96.** What type of server provides Internet access to company-provided information, such as how to contact a company, products or services for sale, and other information?
- A. FTP server
 - B. Proxy server
 - C. File server
 - D. Web server
- 97.** A friend is showing you how they can control their home's thermostat from their cellphone while at work. What type of device do they have at home?
- A. IoT
 - B. SQL
 - C. DoS
 - D. EFS
- 98.** What server would function as a central repository of documents and provide network shared file storage for internal users?
- A. FTP server
 - B. Proxy server

- C. Fileshare
 - D. Web server
- 99.** You work as a network administrator for a school district. The district is required to provide access to the Internet for students but also required to protect the network and the students from malicious network traffic and inappropriate websites. What type of server do you need to configure?
- A. FTP server
 - B. Proxy server
 - C. File server
 - D. Web server
- 100.** What type of server can host files for easy access and fast downloading across the Internet, like how a web server serves web pages?
- A. FTP server
 - B. Proxy server
 - C. File server
 - D. DNS server
- 101.** You're a network administrator and just added a device to your network that enables multiple users to access several printers. What have you attached to the network?
- A. Syslog server
 - B. DNS server
 - C. Print server
 - D. Authentication server
- 102.** What server is used to resolve domain names to IP addresses to facilitate web browsing or locating a directory resource on the network?
- A. Syslog server
 - B. DNS server
 - C. Print server
 - D. Authentication server
- 103.** What server is accessed each time it's necessary to challenge and validate a user's credentials, enabling the user to access a network resource?
- A. Syslog
 - B. DNS
 - C. Print
 - D. AAA

- 104.** What type of server can collect and journal all the system-generated messages produced by servers and network devices?
- A. Syslog
 - B. DNS
 - C. Print
 - D. AAA
- 105.** You're configuring your phone to download email from and upload it to your company's server. What type of server are you configuring your phone to use?
- A. Web
 - B. AAA
 - C. Mail
 - D. FTP
- 106.** Which of the following are connection-oriented protocols? (Choose two.)
- A. DHCP
 - B. TFTP
 - C. HTTPS
 - D. SSH
- 107.** What type of service will you install for a company that wants to monitor network traffic and host system behavior so the service can identify suspect activity? (Choose two.)
- A. Proxy server
 - B. IDS
 - C. UTM
 - D. ATM
- 108.** What is the primary difference between IDS and IPS?
- A. IDS works on both a host and a network.
 - B. IDS will not actively alert on suspect activity.
 - C. IPS works in pairs.
 - D. IPS will actively react to suspect activity.
- 109.** Managing security on your growing network has become difficult, so you ask your peers what they are doing to manage their networks. They recommend a device that will enable you to manage your security in one place. What have they recommended?
- A. IDS
 - B. IPS
 - C. UTM
 - D. UTP

- 110.** What wireless frequency is used by the Bluetooth protocol?
- A.** 2.4 GHz
 - B.** 5 GHz
 - C.** 6 GHz
 - D.** 60 GHz
- 111.** Your cousin is a nature photographer, traveling the country and living in their Class A motorhome. Much of the time, their motorhome is parked in a national park, but seldom is Wi-Fi available. Your cousin uploads photos from their camera to a laptop, modifies them, and needs to upload them to their publisher, various magazines, and their website on a regular basis. What is a viable networking option for your cousin?
- A.** Satellite
 - B.** Cellular
 - C.** WISP
 - D.** DSL
- 112.** Based on the illustration shown, what is the device labeled A?



- A.** Switch
- B.** Hub
- C.** Cable modem
- D.** Cable multiplexer

113. What is the device in the image used for?



- A. It multiplexes several signals into one.
 - B. It's a network cable tester.
 - C. It's for attaching RJ-45 connectors to cable.
 - D. It's for testing Wi-Fi signal strength.
- 114.** You're considering a Bluetooth 5.0 headset. What is the maximum distance that headset can reach?
- A. 1 meter
 - B. 10 meters
 - C. 100 meters
 - D. 200+ meters
- 115.** Last weekend, you configured, installed, and booted several new computers to be added to your company's network, ready for Monday morning. On Monday morning, as the company's employees sit down to work, they let you know that they cannot log in. Their desktops don't seem to want to connect to the network. You investigate and find that each faulty workstation has a 169.254.x.x IP address. What might you look at next?
- A. DHCP scope
 - B. LAN connector broken
 - C. Windows patch unable to install
 - D. Corrupted registry

- 116.** Which network segmentation technique reduces broadcast domains and provides a layer of security between users on the same network?
- A. VPN
 - B. VLAN
 - C. UPS
 - D. SQL
- 117.** One of your network users must work remotely from their office on an extremely confidential project. Their team is concerned about security, so they call you, the IT department head, to see what can be done. What will you set up between this network user and the company server so that the communications are secure?
- A. VPN
 - B. SDN
 - C. VLAN
 - D. SRAM
- 118.** Which of the following components is not typically found in a wireless LAN (WLAN)?
- A. WLAN router
 - B. WLAN gateway
 - C. WLAN server
 - D. WLAN client
- 119.** You need to configure dynamic IP addressing on your network to cut down on management time. How can you do this? (Choose two.)
- A. Enable DHCP settings on the router.
 - B. Configure each NIC to obtain an IP address automatically.
 - C. Configure each NIC to a specific IP address.
 - D. Configure each NIC to obtain DNS server addresses automatically.
- 120.** Your network admin needs to add a computer with a routable address to an IPv6 subnet. Which of the following IPv6 addresses is on the same subnet as 2601:0:0:1f:1a:308c:2acb:fee2?
- A. 2601::of:308c:47:4321
 - B. 2601::1f:ab:cd:123:4a
 - C. fe80:ab:bc:1f:1a:308c:2abc:fee5
 - D. 2601:0:0:1x::2acb:ac01
- 121.** A friend is troubleshooting their IPv4 network. The network's subnet mask is 255.255.192.0. Which of the following IP addresses is *not* on the same network as the others?
- A. 130.200.65.5
 - B. 130.200.130.1

- C. 130.200.100.4
 - D. 130.200.125.5
- 122.** Which of the following is a PoE standard?
- A. 802.3bt
 - B. 802.3b
 - C. 802.11
 - D. 802.11ax
- 123.** Your friend has purchased a PoE device for their home. It is a Type 2 device. Which of the following PoE switches will be compatible with this device? (Choose two.)
- A. 802.3af-compliant switch
 - B. 802.3at-compliant switch
 - C. 802.3bt-compliant switch
 - D. 802.11b-compliant switch
- 124.** Which of the following is true of an ONT? (Choose two.)
- A. It stands for Optical Network Terminator.
 - B. It converts fiber-optic light signals to electrical (Ethernet) signals.
 - C. It is end-user installed.
 - D. It requires external power to work properly.
- 125.** Networking technologies have a group of frequencies they can operate on: for example, in what is called the 5 GHz band, the frequency can be anywhere between 5.15 GHz (5.15 billion cycles per second) and 5.85 GHz (5.85 billion cycles per second). That band is further divided into specific groups of frequencies, such as 5.17 to 5.19 GHz. What names are given to those smaller groups of frequencies? (Choose two.)
- A. Range
 - B. Channel
 - C. Band
 - D. Multiplexer
- 126.** Which type of WISP radio frequencies have the advantages of no fees, less expensive equipment, and a wide pool of practical knowledge so help is easier to find?
- A. Licensed
 - B. Unlicensed
 - C. Limited
 - D. Unlimited

- 127.** You are working with your customer, a doctor's office, to develop a network that will enable the doctor's staff to work with their tablet PCs in any room of the office without having to worry about network cabling. What type of network will you establish for the doctor's office?
- A. LAN
 - B. VLAN
 - C. WLAN
 - D. WAN
- 128.** Which of the following is a network of storage devices that a server can access as if it were a locally connected drive?
- A. NAS
 - B. SAS
 - C. SAN
 - D. WAN
- 129.** Which of the following are true of a network TAP? (Choose two.)
- A. TAP stands for Terminal Access Point.
 - B. It is solely used by hackers to intercept packets.
 - C. It is part of a router.
 - D. It enables network admins to monitor network traffic.
- 130.** What software runs on a machine where data files to be accessed are housed and where that software controls access to those files as requested by a client?
- A. CAL
 - B. Fileshare server
 - C. Fileshare client
 - D. SAN
- 131.** A friend is having some issues with the wireless network in their apartment. It's dropping the connection or running very slowly. What tool can be used to determine the best channel to use?
- A. WAP
 - B. Wi-Fi analyzer
 - C. Toner probe
 - D. Cable tester
- 132.** In the United States, the Federal Communications Commission (FCC) imposes rules that govern radio communications. What is the maximum EIRP (watts) that can be transmitted in the 2.4 GHz band for a point-to-multipoint WISP connection?
- A. 2 watts
 - B. 4 watts

- C. 158 watts
 - D. 125 mw
- 133.** Which Wi-Fi channel range does not require that your router has DFS and TPC built in?
- A. Channels 36 to 48
 - B. Channels 52 to 64
 - C. Channels 100 to 144
 - D. Channels 149 to 165
- 134.** Which broadband network communications technology became more competitive with other types of service when, in 2021, the FCC ruled to include it in the OTARD rule, which protects the rights of those organizations to place antennas where they are needed?
- A. Fios
 - B. WISPs
 - C. DSL
 - D. Satellite
- 135.** What is the host number in an IP address of 192.168.2.200 and a subnet mask of 255.255.255.0?
- A. 192.168
 - B. 192.168.2
 - C. 2.200
 - D. 200
- 136.** What are the three As employed by authentication servers?
- A. Authentication, Activation, Acceptance
 - B. Authorization, Access, Allocation
 - C. Accept, Access, Accounting
 - D. Authentication, Authorization, Accounting
- 137.** Which Internet appliance is used to distribute incoming traffic over resources such as multiple web servers?
- A. Proxy server
 - B. Spam gateway
 - C. Load balancer
 - D. UTM device

- 138.** What type of system, consisting of both hardware and software, is used to control and monitor industrial machines and processes?
- A. SCADA
 - B. IrDA
 - C. UTM
 - D. RADIUS
- 139.** Your friend owns a restaurant and provides free Wi-Fi to their clientele. Lately, they have been receiving complaints that the Wi-Fi isn't working. It seems to work for customers already connected but not for people trying to connect. What can be configured on the router to release an IP address and make it available for other users after a couple of hours?
- A. MAC address filtering
 - B. Port forwarding
 - C. DHCP lease duration
 - D. SSID broadcast
- 140.** What type of address is known as a DNS AAAA address?
- A. IPv4
 - B. IPv6
 - C. MAC
 - D. Physical
- 141.** What type of entry in a DNS record can be used for load-balancing incoming mail?
- A. MX
 - B. DX
 - C. AAAA
 - D. TXT
- 142.** What type of DNS technique contains a list of users (i.e., IP addresses) that are authorized to send email on behalf of a domain?
- A. DKIM
 - B. SPF
 - C. DMARC
 - D. A
- 143.** What is the interface ID of the IP address 2001::1a3:f1a:308:833?
- A. 2001:0:0:0:
 - B. 2001
 - C. 1a3:f1a:308:833
 - D. 833

- 144.** Which two terms identify an ISP that uses point-to-point millimeter-wave or microwave links as the backbone between its towers while using point-to-multipoint wireless connections to provide Internet access between its towers and its customers? (Choose two.)
- A. WISP
 - B. Multimode
 - C. Demarcation point
 - D. Long-range fixed wireless
- 145.** Your friend is again considering the network configuration in their apartment. They've asked you to explain the difference between channels on the 2.4 and 5 GHz networks that are available on their Internet connection. What will you tell them? (Choose two.)
- A. If they are using the 2.4 GHz network, they should choose Channel 1, 6, or 11 because they don't overlap each other.
 - B. The 5 GHz network channels provide greater bandwidth, so data could be transferred faster, but they may have more interference with their neighbors.
 - C. The 5 GHz frequency is considered obsolete, so the 2.4 GHz frequency should be used.
 - D. All the 5 GHz frequencies overlap, so there will be greater interference.
- 146.** What type of server is used to synchronize the time on various network devices?
- A. SQL
 - B. Fileshare
 - C. DHCP
 - D. NTP
- 147.** What does an SQL server do?
- A. Provide access to databases.
 - B. Provide file downloads to users.
 - C. Assign IP addresses to network devices.
 - D. Synchronize time between devices.
- 148.** What is the job of a spam gateway?
- A. Permit spam in.
 - B. Keep spam out.
 - C. Filter network packets.
 - D. Provide multiple resources for mitigating malware.

Chapter

3



Hardware

THE COMPTIA A+ 220-1201 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

- ✓ **3.1 Compare and contrast display components and attributes.**

- Types
 - Liquid Crystal Display (LCD)
 - In-Plane Switching (IPS)
 - Twisted Nematic (TN)
 - Vertical Alignment (VA)
 - Organic Light-Emitting Diode (OLED)
 - Mini Light-Emitting Diode (Mini-LED)
- Touchscreen/digitizer
- Inverter
- Attributes
 - Pixel density
 - Refresh rates
 - Screen resolution
 - Color gamut

- ✓ **3.2 Summarize basic cable types and their connectors, features, and purposes.**

- Network cables
 - Copper
 - Categories
 - T568A/T568B standards
 - Coaxial
 - Shielded Twisted Pair
 - Direct burial
 - Unshielded Twisted Pair



- Plenum-rated
- Optical
 - Single-mode
 - Multimode
- Peripheral cables
 - USB 2.0
 - USB 3.0
 - Serial
 - Thunderbolt
- Video cables
 - High-Definition Multimedia Interface (HDMI)
 - DisplayPort
 - Digital Visual Interface (DVI)
 - Video Graphics Array (VGA)
 - USB-C
- Hard drive cables
 - Serial Advanced Technology Attachment (SATA)
 - External SATA (eSATA)
- Adapters
- Connector types
 - RJ-11
 - RJ-45
 - F-type
 - StraightTip (ST)
 - Subscriber Connector (SC)
 - Lucent Connector (LC)
 - Punchdown block
 - MicroUSB
 - MiniUSB
 - USB-C
 - Molex



- Lightning

- DB9

✓ **3.3 Compare and contrast RAM characteristics.**

- Form factors
 - Small Outline Dual in-line Memory Module (SODIMM)
 - Dual In-line Memory Module (DIMM)
 - Double Data Rate (DDR) Iterations
 - Error-Correcting Code (ECC) vs. non-ECC RAM
 - Channel configurations

✓ **3.4 Compare and contrast storage devices.**

- Hard drives
 - Spindle speeds
 - Form factors
 - 2.5-inch
 - 3.5-inch
- Solid-State Drives (SSDs)
 - Communications interfaces
 - Non-Volatile Memory Express (NVMe)
 - SATA
 - Peripheral Component Interconnect Express (PCIe)
 - Serial Attached SCSI [Small Computer System Interface] (SAS)
 - Form factors
 - M.2
 - Mini-Serial Advanced Technology Attachment (mSATA)
 - Drive configurations
 - Redundant Array of Independent Disks (RAID) 0, 1, 5, 6, 10
 - Removable storage
 - Flash drives
 - Memory cards
 - Optical drives



✓ **3.5 Given a scenario, install and configure motherboards, Central Processing Units (CPUs), and add-on cards.**

- Motherboard form factors
 - Advanced Technology eXtended (ATX)
 - microATX
 - Information Technology eXtended (ITX)
- Motherboard connector types
 - Peripheral Component Interconnect (PCI)
 - PCIe
 - Power connectors
 - SATA
 - eSATA
 - SAN
 - Headers
 - M.2
- Motherboard compatibility
 - CPU socket types
 - Advanced Micro Devices, Inc. (AMD)
 - Intel
 - Multisocket
 - BIOS/Unified Extensible Firmware Interface (UEFI) settings
 - Boot options
 - USB permissions
 - Trusted Platform Module (TPM) security features
 - Fan considerations
 - Secure Boot
 - Boot password
 - BIOS password
 - Temperature monitoring
 - Virtualization support
 - Encryption



- TPM
- Hardware Security Module (HSM)
- CPU Architecture
 - X86/x64
 - Advanced RISC (Reduced Instruction Set Computer) Machine (ARM)
- Core configurations
- Expansion cards
- Sound card
- Video card
- Capture card
- Network Interface Card (NIC)
- Cooling
 - Fans
 - Heat sink
 - Thermal paste/pads
 - Liquid

✓ **3.6 Given a scenario, install the appropriate power supply.**

- Input 110–120 VAC vs. 220–240 VAC
- Output 3.3V vs. 5V vs. 12V
- 20+4 pin motherboard connector
- Redundant power supply
- Modular power supply
- Wattage rating
- Energy efficiency

✓ **3.7 Given a scenario, deploy and configure multifunction devices/printers and settings.**

- Properly unbox device and consider set-up location
- Use appropriate drivers for a given operating system
 - Printer Control Language (PCL) vs. PostScript
- Firmware



- Device connectivity
 - USB
 - Ethernet
 - Wireless
- Public/shared devices
 - Printer share
 - Print server
- Configuration settings
 - Duplex
 - Orientation
 - Tray settings
 - Quality
- Security
 - User authentication
 - Badging
 - Audit logs
 - Secured prints
- Network scan services
 - Email
 - SMB
 - Cloud services
- Automatic Document Feeder (ADF)/flatbed scanner

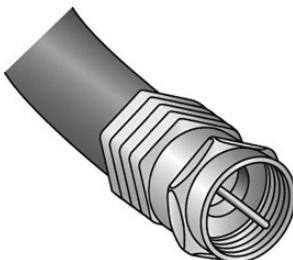
✓ **3.8 Given a scenario, perform appropriate printer maintenance.**

- Laser
 - Maintenance: Replace toner, apply maintenance kit, calibrate, and clean
- Inkjet
 - Ink cartridge, printhead, roller, and feeder
 - Maintenance: Clean printheads, replace cartridges, calibrate, and clear jams



- Thermal
 - Feed assembly
 - Special thermal paper
 - Maintenance: Replace paper, clean heating element, and remove debris
- Impact
 - Multipart paper
 - Maintenance: Replace ribbon, printhead, and paper

1. Identify the cable connector in the picture. It is threaded and screws into place.



- A. F-type
 - B. BNC
 - C. SC
 - D. FC
2. Of the following fiber connectors, which are used for duplex (two strands instead of one)? (Choose two.)
- A. ST
 - B. SC
 - C. FC
 - D. LC
3. What twisted pair connectors are commonly used with telephone wire?
- A. RJ-45
 - B. Coaxial
 - C. RJ-11
 - D. FC
4. Using the T568B wiring standard on both ends of a cable would produce what type of network cable?
- A. T568B on both ends is not a working network cable.
 - B. T568B is a telephone-wiring standard.
 - C. T568B on both ends is a crossover network cable.
 - D. T568B on both ends is a straight-through network cable.
5. You're looking at a connector that has eight wires with colors in the order of green stripe, green, orange stripe, blue, blue stripe, orange, brown stripe, and brown. What type of cable do you have?
- A. Twisted pair, T568A standard
 - B. Twisted pair, T568B standard
 - C. LC
 - D. SC

6. You need to install a memory upgrade in a laptop computer. The computer's documentation says that the laptop uses DDR4 SODIMMs. How many pins will be on the SODIMM?
 - A. 262
 - B. 200
 - C. 204
 - D. 260
7. The most common RAM slots used in desktop and laptop computers, respectively, are what?
 - A. SODIMM and DIMM
 - B. Micro-DIMM and DIMM
 - C. DIMM and Mini-DIMM
 - D. DIMM and SODIMM
8. Which laptop expansion port was designed as an industry standard to replace VGA and DVI ports and is backward compatible with both standards?
 - A. DisplayPort
 - B. VideoPort
 - C. Thunderbolt
 - D. HDMI
9. You have a MacBook Pro computer with a Thunderbolt 4 port. What is the maximum throughput of a device plugged into this port?
 - A. 5 Gbps
 - B. 10 Gbps
 - C. 20 Gbps
 - D. 40 Gbps
10. Which motherboard form factor measures 4.7" × 4.7"?
 - A. Mini-ITX
 - B. Nano-ITX
 - C. Pico-ITX
 - D. Mobile-ITX
11. What term do technicians use to refer to the size and specific placement of components on a circuit board?
 - A. ATX
 - B. Array
 - C. Orientation
 - D. Form factor

12. You have been asked to design a new network for a client and will be using fiber-optic cable. Which type of optical cable is more expensive but can send a signal over a much greater distance?
 - A. Multimode
 - B. Single mode
 - C. Cat 7
 - D. RG6
13. You need to update a twisted pair cable that runs between two networking closets. The total distance is only 20 meters, and it must run at 10 Gbps. What is the lowest category of cable that you can replace it with?
 - A. Cat 6
 - B. Cat 6a
 - C. Cat 7
 - D. Cat 8
14. A technician is considering whether to buy a new LCD. Which type of LCD has faster response times than the others?
 - A. TN
 - B. VA
 - C. IPS
 - D. OLED
15. What encryption device is a part of a computer system, can be either hardware or software, and will encrypt all data on a specific device so it can't be accessed unless it is present?
 - A. HSM
 - B. BIOS
 - C. ITX
 - D. TPM
16. You need to share printers on your network with multiple client operating systems, such as Windows, macOS, and Linux. Which of the following services will best meet your needs?
 - A. Bonjour
 - B. Cloud printing
 - C. TCP printing
 - D. Virtual printing
17. Which one of the following connector types are you most likely to find on the end of a Cat 6a cable?
 - A. RJ-11
 - B. RJ-45

- C. BNC
- D. SATA

18. Identify the video connector shown here.



- A. DVI
- B. VGA
- C. HDMI
- D. Composite

19. What type of printer technology uses a roll of paper as opposed to individual sheets?

- A. Inkjet
- B. Thermal
- C. Laser
- D. Fax machine

20. Which of the following types of printers does not require the replacement of some sort of ink or toner?

- A. Laser
- B. Thermal
- C. Impact
- D. Inkjet

21. You are working on repairing a defective laser printer. Which of the following is a true statement regarding the imaging drum in a laser printer?

- A. It can hold a high negative charge only when it's not exposed to light.
- B. It can hold a high negative charge only when it's exposed to light.
- C. It can hold a high negative charge regardless of light exposure.
- D. It is not required to hold a charge.

- 22.** What are the dimensions of a Mini-ITX motherboard?
- A.** 12" × 9.6"
 - B.** 9.6" × 9.6"
 - C.** 6.7" × 6.7"
 - D.** 3.9" × 2.8"
- 23.** When discussing video displays, what is the term used to describe the number of pixels that can be displayed by a device, width by height?
- A.** Refresh rate
 - B.** Pixel density
 - C.** Aspect ratio
 - D.** Resolution
- 24.** You have three hard disks, each 1 TB in size. After installing them as a RAID-5 array in a computer, how much usable storage space will you have?
- A.** 1.5 TB
 - B.** 2 TB
 - C.** 2.5 TB
 - D.** 3 TB
- 25.** What hardware device is used to store encryption keys, making them safer because they are never directly loaded into a server's memory?
- A.** HSM
 - B.** BIOS
 - C.** ITX
 - D.** TPM
- 26.** You need to enable clients to scan documents and place them in network accessible storage, regardless of the MFD's location worldwide. Which service will best suit your needs?
- A.** Bonjour
 - B.** TCP printing
 - C.** Virtual printing
 - D.** Cloud services
- 27.** What is the most important consideration when installing a network-connected multifunction device that is capable of directly scanning to email?
- A.** Print quality
 - B.** Duplexing
 - C.** Security
 - D.** Speed

28. What protocol is often used when scanning documents from a large multifunction device and sending them to the corporate server?

- A. TPM
- B. HSM
- C. SNMP
- D. SMB

29. Identify the computer component shown here.



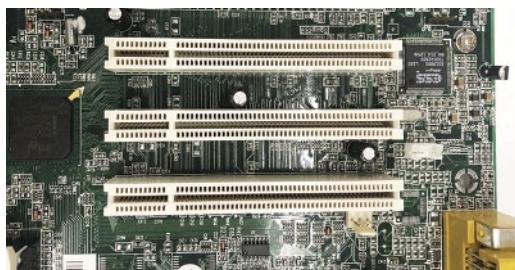
- A. CPU heat sink and fan
 - B. Passive CPU heat sink
 - C. Power supply fan
 - D. Secondary cooling fan
- 30.** What features are included in modern networked MFDs? (Choose all that apply.)
- A. Email
 - B. Scanning
 - C. Printing
 - D. Faxing
- 31.** Which of the following connectors transmit analog signals? (Choose two.)
- A. VGA
 - B. RJ-45
 - C. RJ-11
 - D. HDMI

32. Your partner wants to know what this port is on the back of their computer. What will you tell them?



- A. eSATA
 - B. DisplayPort
 - C. DVI port
 - D. HDMI port
33. You have a motherboard that supports up-plugging. Which of the following statements regarding PCIe are true? (Choose two.)
- A. You can put an x1 card into an x8 slot.
 - B. You can put an x8 card into an x16 slot.
 - C. You can put an x8 card into an x1 slot.
 - D. You can put an x16 card into an x8 slot.
34. A technician needs to increase the fault tolerance of their computer's storage system, and they have two hard drives available. Which of the following options is their best choice?
- A. Install both drives and configure them as separate volumes.
 - B. Install both drives and implement RAID-0.
 - C. Install both drives and implement RAID-1.
 - D. Install both drives and implement RAID-5.
35. Your friend is an artist and wants an LCD monitor with the best image depth and contrast. Which of the following should they choose?
- A. OLED
 - B. VA
 - C. IPS
 - D. TN
36. Which type of smartphone display has fewer layers, thereby providing more flexibility, a better viewing angle, and excellent color as compared to other technologies?
- A. IPS
 - B. OLED
 - C. LED
 - D. TN

- 37.** The motherboard in your desktop computer supports dual-channel memory. Which of the following statements regarding RAM in this motherboard are true? (Choose two.)
- A.** The RAM will work only if it's installed in pairs.
 - B.** The RAM will work only if it's installed in pairs or if one double-sided RAM module is used.
 - C.** The RAM will work if only one module is installed but not in dual-channel mode.
 - D.** The RAM will work in dual-channel mode if two identical modules are installed.
- 38.** A customer wants you to upgrade their motherboard so that they can have the fastest video connection possible. They want to know how fast PCIe 4 is. What will you tell them the data rate of a single lane of PCIe 4 is?
- A.** 250 MBps
 - B.** 500 MBps
 - C.** 1 GBps
 - D.** 2 GBps
- 39.** A technician needs to replace a failed power supply in a desktop computer. When choosing a replacement power supply, which two specifications are most important to consider? (Choose two.)
- A.** Wattage
 - B.** Multiple rail
 - C.** Dual voltage options
 - D.** Number and type of connectors
- 40.** You've been asked to replace the old magnetic hard drive in your manager's laptop with a high-speed, high-capacity drive. What are the most common issues associated with this request? (Choose two.)
- A.** Increased battery usage
 - B.** Increased heat production
 - C.** Decreased component life span
 - D.** Decreased space for other peripherals
- 41.** You have a motherboard with a white expansion slot, which has a divider closer to the center of the motherboard than the outside, and looks like the three shown here. What type of expansion slot is this?



- A. PCIe x1
 - B. SATA
 - C. PCI
 - D. eSATA
- 42.** A designer from the corporate office is visiting your field office. They try to print from their MacBook Pro to a networked printer, but it does not work. Local users in the office are able to print to the device using their Windows computers. What would most likely solve the problem?
- A. Select the Enable Mac Printing option in the print server configuration settings.
 - B. Select the Enable Bonjour option in the print server configuration settings.
 - C. Install a macOS printer driver on the print server.
 - D. Stop and restart the print spooler service.
- 43.** A user whom you support needs to replace a cable. What type of peripheral connector, shown here, will you be looking for?



- A. USB Type A
 - B. USB Type B
 - C. USB Standard mini-B
 - D. Thunderbolt
- 44.** Which of the following are advantages of using a CPU liquid cooling system over an air-based system? (Choose two.)
- A. Easier to install and maintain
 - B. More efficient
 - C. Quieter
 - D. Safer for internal components

- 45.** You need to perform preventive maintenance on an impact printer. What area should you examine that you would not need to examine on an inkjet printer?
- A. Printhead
 - B. Ink cartridges
 - C. Output tray
 - D. Tractor-feed mechanism
- 46.** Which expansion bus technology uses lanes, which are switched point-to-point signal paths between two components?
- A. PCI
 - B. PCI-X
 - C. PCIe
 - D. Mini-PCI
- 47.** A large display with a wide viewing angle is needed for a small conference room. Which type of LCD would be best?
- A. VA
 - B. IPS
 - C. LED
 - D. OLED
- 48.** You’re considering purchasing a new display. Which of the following display lighting technologies can produce a million-to-one contrast ratio, in addition to providing excellent picture quality and no burn-in?
- A. IPS
 - B. OLED
 - C. mini-LED
 - D. VA
- 49.** Your motherboard has three PCIe x16 v 4.0 slots and does not support up-plugging for PCIe adapter cards. Which of the following statements is true?
- A. You can’t put an x8 card into an x16 slot.
 - B. You can put an x8 card into an x16 slot, but it will run at x1 speed.
 - C. You can put an x8 card into an x16 slot, and it will run at x8 speed.
 - D. You can put an x8 card into an x16 slot, and it will run at x16 speed.
- 50.** Which system component enables the use of Secure Boot technology?
- A. BIOS
 - B. UEFI
 - C. AMI
 - D. SATA

- 51.** Motherboard documentation for a desktop computer mentions 240-pin DIMM slots. What type of DIMM is used on this motherboard?
 - A.** DDR3
 - B.** DDR4
 - C.** DDR5
 - D.** SODIMM
- 52.** DDR4 and DDR5 DIMMs have the same number of pins. How can you tell the difference between the two?
 - A.** Placement of the module key (notch).
 - B.** Color of the module.
 - C.** Size of the module.
 - D.** DDR5 have heat sinks; DDR4 don't.
- 53.** Which CPU technology facilitates the assignment of two logical cores for every physical core present?
 - A.** Multicore
 - B.** 32-bit vs. 64-bit
 - C.** Integrated GPU
 - D.** Multithreading
- 54.** You are adding paper to a printer that uses tractor-feed paper, which requires lining up the holes in the paper with the pins on the paper-forwarding mechanism. What type of printer are you maintaining?
 - A.** Impact
 - B.** Thermal
 - C.** Laser
 - D.** Inkjet
- 55.** Which motherboard form factor is common in desktop computers and measures 12" × 9.6"?
 - A.** ATX
 - B.** MicroATX
 - C.** Mini-ITX
 - D.** ITX
- 56.** An inkjet printer doesn't seem to be moving the printhead to the right area. Which two of the following could be keeping the printhead from moving and need to be replaced or removed? (Choose two.)
 - A.** Debris in the printer
 - B.** The roller
 - C.** The feeder
 - D.** The carriage motor or belt

- 57.** You need to configure Hyper-V on one of your Windows-based desktop computers with an Intel processor. Which of the following must be true? (Choose three.)
- A.** The CPU must have SLAT.
 - B.** The CPU must have Intel VR.
 - C.** The processor must be 64-bit.
 - D.** You need to enable virtualization in the BIOS/UEFI.
- 58.** An analog LCD is most likely to have what type of connector?
- A.** DisplayPort
 - B.** RCA
 - C.** VGA
 - D.** BNC
- 59.** You have a peripheral that needs a data speed of 20 Gbps and 9 W of power to be supplied by the connection to the PC. Which PC peripheral connection type is it most likely to use?
- A.** Thunderbolt
 - B.** USB 3.0
 - C.** eSATA
 - D.** DisplayPort
- 60.** You have recently purchased a laptop computer with a touchscreen. It enables you to draw images on the screen and save them on your computer. Which device is responsible for converting the input into the image that you see and save?
- A.** Inverter
 - B.** Touchpad
 - C.** Digitizer
 - D.** Touchscreen
- 61.** What are the two power requirements that a PCI expansion bus may have in a desktop computer? (Choose two.)
- A.** 1.7 V
 - B.** 3.3 V
 - C.** 5 V
 - D.** 6.6 V
- 62.** Which of the following is a standard for a secure cryptoprocessor that can secure hardware (and the system boot process) using cryptographic keys?
- A.** TPM
 - B.** LoJack
 - C.** Secure Boot
 - D.** BitLocker

63. Which device, whether external or a component of a laptop, can take input from a stylus or your finger, depending on the sensor type, and convert it to mouse movements on a screen?

- A.** Rectifier
- B.** Touchscreen
- C.** Digitizer
- D.** Inverter

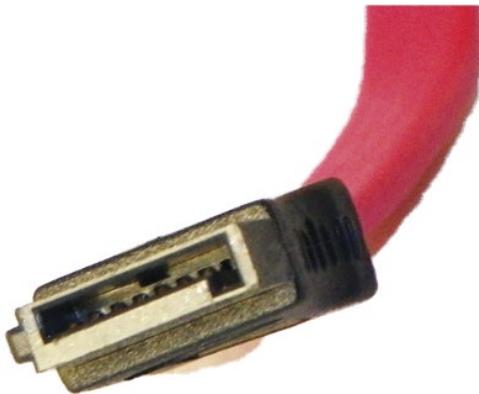
64. What type of power connector is shown here?



- A.** P1
 - B.** SATA
 - C.** PCIe
 - D.** ATX
- 65.** A technician has installed a printer driver on a Windows client computer. What is the best next step the technician can take to ensure that the printer is installed properly?
- A.** Ping the printer's IP address.
 - B.** Check the printer status and ensure that it says "Ready."
 - C.** Stop and restart the spooler service.
 - D.** Print a test page.
- 66.** You just replaced the toner cartridge on the laser printer in your office. Now you're getting an error message displayed on the screen. What should you try first?
- A.** Call the printer company's tech support.
 - B.** Remove and reinsert the toner cartridge.
 - C.** Install a maintenance kit.
 - D.** Replace the printer.
- 67.** You have been asked to install and configure a RAID-10 storage array for a computer. What is the minimum number of hard disks required for this configuration?
- A.** Two
 - B.** Three

- C. Four
- D. Five

68. Identify the peripheral connector shown here.



- A. HDMI
- B. PATA
- C. SATA
- D. eSATA

69. A graphic designer in your office needs two displays to do their work. Which of the following could you install to set up their desktop computer for this configuration? (Choose two.)

- A. A video splitter
- B. A second video driver
- C. A second video card
- D. An adapter with two outputs

70. You have a motherboard designed to hold DDR3 1600 memory. What will happen if you attempt to install DDR4 2400 memory into the motherboard?

- A. It won't fit.
- B. It will operate at 667 MHz.
- C. It will operate at 1133 MHz.
- D. It will operate at 1600 MHz.

71. Which display component is capable of discharging energy and causing severe injuries to technicians?

- A. Touchscreen
- B. Backlight
- C. Inverter
- D. LCD

- 72.** One of your users needs to print several copies of a 20-page document. They want to ensure that the document's pages are printed on both sides of the paper to conserve paper. Which option do they need to set properly in their printer configuration settings?
- A.** Duplexing
 - B.** Collating
 - C.** Print Quality
 - D.** Orientation
- 73.** A technician needs to install an optical disk system with the capacity to burn disks, storing about 60 GB of data at one time. What is the minimum technology required to get over this threshold?
- A.** DVD-10
 - B.** DVD-18
 - C.** Triple BDXL
 - D.** Quad BDXL
- 74.** It appears that the feeder mechanism in your inkjet printer isn't working because paper is not being fed into the printer. Which of the following might be causing this? (Choose two.)
- A.** Excessive humidity
 - B.** Faulty printhead
 - C.** Width guide too tight
 - D.** Faulty toner cartridge
- 75.** You have been asked to purchase new RAM for three workstations. The workstations call for DDR4 3600 chips. What throughput will these modules support?
- A.** 450 Mbps
 - B.** 1800 Mbps
 - C.** 3600 Mbps
 - D.** 28,800 Mbps
- 76.** A technician needs to purchase new RAM for a motherboard. The motherboard specifications call for 5200 MHz DDR5 RAM. The supplier only shows a PC rating for RAM. Which RAM modules should the technician use?
- A.** PC 5200
 - B.** PC 41600
 - C.** PC5 41600
 - D.** PC5 5200
- 77.** On your network, users want to print easily from their iPads and iPhones. Which service supports this?
- A.** Bonjour
 - B.** AirPrint

- C. TCP printing
 - D. Virtual printing
78. You have a new computer that needs to communicate with other computers on a wireless network. What type of expansion card do you need to install?
- A. WAP
 - B. NIC
 - C. KVM
 - D. WPA
79. When printing, which component is responsible for converting the data being printed into the format that the printer can understand?
- A. PDL
 - B. Printer driver
 - C. Print queue
 - D. Print spooler
80. You're installing a new printer and notice that the manufacturer has provided two drivers with the printer. One is a PostScript driver, and the other is a PCL driver. The user will mainly be printing graphics. Which driver should you install?
- A. Permit Windows to install its default driver.
 - B. Install the PCL driver.
 - C. Install the PostScript driver.
 - D. Either driver will work equally well.
81. What type of printer driver is best to use if you will be printing mostly documents and want to have the PC released to do other jobs more quickly?
- A. Permit Windows to install its default driver.
 - B. Install the PCL driver.
 - C. Install the PostScript driver.
 - D. Driver choice won't have an effect.
82. You notice that a fan on a power supply has stopped turning, and you will need to replace it. Which of the following statements best describes the function of a typical power supply fan?
- A. It cools the power supply by blowing in air from outside the case.
 - B. It cools the power supply by blowing hot air out the back of the power supply.
 - C. It cools the computer by blowing in air from outside the case, through the power supply, and into the computer.
 - D. It cools the computer by pulling hot air from inside the case, through the power supply, and blowing it out the back of the power supply, which in turn draws cooler air in through vents in the case.

- 83.** A technician needs to install a new hard drive for their client. Access speed is far more important to this client than disk space. What type of hard drive is best suited for this client?
- A.** SSD
 - B.** HDD
 - C.** SD
 - D.** BD-R
- 84.** What is the maximum data rate for a USB 3.0 connection?
- A.** 12 Mbps
 - B.** 480 Mbps
 - C.** 5 Gbps
 - D.** 10 Gbps
- 85.** A technician has been asked to install and configure a RAID-10 array in a working computer that contains one hard drive. How many additional hard drives, at a minimum, do they need to bring to the job?
- A.** One
 - B.** Two
 - C.** Three
 - D.** Four
- 86.** You've been tasked with making a system faster, so you implement a RAID solution that does only that. What level of RAID will you implement?
- A.** RAID-0
 - B.** RAID-1
 - C.** RAID-5
 - D.** RAID-10
- 87.** Which CPU architecture term describes a CPU with multiple physical processor dies in the same package?
- A.** Multicore
 - B.** 64-bit
 - C.** Integrated GPU
 - D.** Multiprocessor
- 88.** Which of the following optical disk standards provides the highest capacity?
- A.** DVD-R SS, SL
 - B.** DVD-R DS, SL
 - C.** DVD-R SS, DL
 - D.** DVD-R SS, TL

- 89.** Your company recently shipped five desktop computers from Germany to the United States. After switching the power cord to an American-style plug, you try to power one on, and it doesn't work. You try the others, and none of them power on either. What is the most likely cause?
- A.** All the computers were damaged during shipping.
 - B.** German power supplies work only with German power cords.
 - C.** The power supplies won't work because they expect 50 Hz frequency from the wall outlet, and the US standard is 60 Hz.
 - D.** The power supply voltage switch needs to be moved from 220 to 120.
- 90.** What are the dimensions of a mobile-ITX motherboard?
- A.** 9.6" x 9.6"
 - B.** 6.7" x 6.7"
 - C.** 3.9" x 2.8"
 - D.** 2.4" x 2.4"
- 91.** Which of the following printer types is an impact printer?
- A.** Laser
 - B.** Inkjet
 - C.** Dot-matrix
 - D.** Thermal
- 92.** Which two of the CPUs listed here are Intel processors? (Choose two.)
- A.** Xeon Silver
 - B.** Epyc 9004
 - C.** Core i9
 - D.** Ryzen Threadripper Pro
- 93.** You are discussing data storage needs with a client who is a videographer and media producer. They need to store dozens of large files and need immediate access to them for editing. What is the most appropriate storage technology for them to use?
- A.** NAS
 - B.** SSD
 - C.** SD
 - D.** BD-R
- 94.** You are searching for a new display on the Internet and find a used digital LCD for sale. What are the two most likely types of connectors you will find on this display? (Choose two.)
- A.** DVI-A
 - B.** DVI-D
 - C.** HDMI
 - D.** VGA

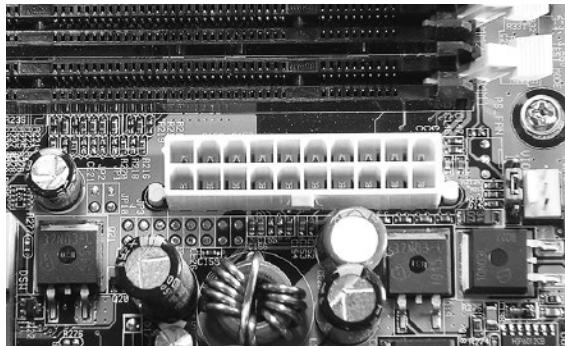
- 95.** Which of the following are typical formats supported by virtual printing? (Choose three.)
- A.** Print to PDF
 - B.** Print to XPS
 - C.** Print to DOC
 - D.** Print to image
- 96.** A PCIe x1 v 3.0 lane provides how much data throughput?
- A.** 250 MBps
 - B.** 500 MBps
 - C.** 1 GBps
 - D.** 2 GBps
- 97.** Which display type enables a user to complete tasks on their computer without the use of a keyboard?
- A.** Touchscreen
 - B.** Touchpad
 - C.** Inverter
 - D.** LCD
- 98.** Which CPU socket is capable of supporting Intel Core Ultra 9 processors?
- A.** PGA 132
 - B.** LGA 1851
 - C.** AM5
 - D.** TR4
- 99.** You are installing two new RAM modules into a dual-channel motherboard and want it to work in dual channel mode. Which of the following is true?
- A.** Both RAM modules need to have the same parameters.
 - B.** The RAM modules can be different sizes but must be the same speed.
 - C.** The RAM modules can be different speeds but must be the same size.
 - D.** The RAM modules can have different speeds and sizes, as long as they are the same type.
- 100.** You're comparing two displays with the same resolution. One is 27 inches, and the other is 36 inches. Because they have the same resolution, what would be a way to compare the number of dots of color that will be displayed on each?
- A.** Refresh rate
 - B.** Pixel density
 - C.** Aspect ratio
 - D.** Density independence

- 101.** A gamer friend is complaining that their screen seems to react slowly to what they’re doing in their game. They want to get a new display. What would you suggest they make sure has a higher number than their present screen to address the performance issue?
- A. Refresh rate
 - B. Pixel density
 - C. Aspect ratio
 - D. Resolution
- 102.** You’re having trouble installing a new 2.5-inch SATA SSD in a server and either need a longer cable or need to move the drive. For maximum air flow in the case, the path that the cable needs to take is 33 inches long. You have a cable that is 18 inches long. What do you do?
- A. Move the drive; cables are limited to 18 inches.
 - B. Purchase a 1-meter cable.
 - C. Purchase a cable extender.
 - D. Buy a new M.2 drive instead.
- 103.** A user on your network has a laser printer that is several years old with no Ethernet connection. It’s connected to their computer and shared on the network for others to use. Now, the user no longer wants the printer, but others still need to use it on the network. What would be the best upgrade to install in this printer to enable others to send print jobs to it directly over the network?
- A. A network card
 - B. A print server
 - C. TCP/IP printing
 - D. AirPrint
- 104.** A technician needs to perform maintenance on an inkjet’s dirty paper pickup rollers. What should they use to clean them?
- A. Rubbing alcohol
 - B. Mild soap and water
 - C. A dry, lint-free cloth
 - D. Compressed air
- 105.** A friend asks what the numbers are that they see advertised on displays, such as 1366×768 or 1920×1080 . Which of the following terms will you explain to them?
- A. Refresh rate
 - B. Pixel density
 - C. Aspect ratio
 - D. Resolution

106. You are installing and configuring a magnetic hard drive and have several models from which to choose. Which hard drive is most likely to have the highest data throughput rates?

- A. 500 GB, 7200 rpm
- B. 750 GB, 5400 rpm
- C. 750 GB, 10,000 rpm
- D. 1 TB, 7200 rpm

107. Identify the white connector on the section of motherboard shown here.



- A. RAM
- B. PATA
- C. Mini-PCI
- D. Main power connector

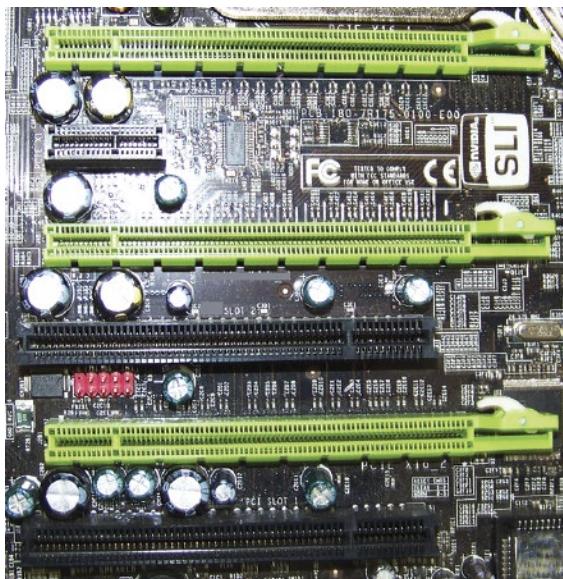
108. Your manager tells you to buy a high-capacity magnetic hard drive with the highest data transfer rate possible. Which hard drive parameter do manufacturers modify to increase hard drive data transfer rates?

- A. Read/write head size
- B. Connector size
- C. Spin rate (rpm)
- D. Platter size

109. Three of these four motherboard form factors can be mounted in the same style of case. Which ones are they? (Choose three.)

- A. ATX
- B. MicroATX
- C. Mini-ITX
- D. Nano-ITX

- 110.** Which RAM feature can detect and possibly fix errors within memory?
- A. Parity
 - B. Non-parity
 - C. ECC
 - D. Non-ECC
- 111.** You have a client who needs a hot-swappable, nonvolatile, long-term storage technology that lets them conveniently carry data from one location to another in their pocket. Which technologies can you recommend? (Choose two.)
- A. USB flash drive
 - B. Hybrid SSD
 - C. SATA
 - D. SD
- 112.** What type of expansion slots are the first, third, and fifth slots (from the top down) on the motherboard shown here?



- A. PCIe x1
- B. PCIe x8
- C. PCIe x16
- D. PCI

- 113.** You have been asked to assemble 20 new desktop PCs for a client. When you look at the first motherboard, you see eight memory slots. Four of them are blue, and four of them are white. You have four identical RAM modules to install. Which of the following statements are true? (Choose two.)
- A.** This is a quad-channel motherboard.
 - B.** This is a dual-channel motherboard.
 - C.** For optimal performance, you should install two RAM modules into the blue slots and two into the white slots.
 - D.** For optimal performance, you should install RAM modules into the same-color slots.
- 114.** You have a computer running Windows 11. Every time you boot, the computer insists on trying to boot from the USB drive. Where can you change the setting to have the system boot to the hard drive first?
- A.** BIOS/UEFI
 - B.** Windows Configuration
 - C.** System Manager
 - D.** Device Manager
- 115.** Which of the following types of connectors are generally found on the front or top panel of the computer? (Choose two.)
- A.** SATA
 - B.** PCIe
 - C.** Power button
 - D.** USB
- 116.** Your manager is excited because they just purchased a fast USB 3.2 Gen 2x2 external hard drive for their team. They want to set it in the middle of the cubicles, allowing everyone to have access to it. Some of the cubicles are about 15 feet away from each other. What is the recommended maximum cable length for this type of device?
- A.** 3 meters
 - B.** 5 meters
 - C.** 10 meters
 - D.** 15 meters
- 117.** There are new features for your printer that you've read about recently and would like to deploy. How will you install these new features on your printer?
- A.** Add them to the printer settings of your operating system.
 - B.** Turn the printer off and back on.
 - C.** Upgrade the printer's firmware.
 - D.** Stop and restart the spooler service.

- 118.** A medical office needs to make all old records available electronically. What device can they install on their printer to make scanning hundreds of documents go more quickly?
- A.** High-capacity paper tray
 - B.** Flatbed scanner
 - C.** Duplexing assembly
 - D.** Automatic document feeder
- 119.** You have a desktop computer with three PCI expansion slots. What will happen when you mix cards of different speeds on the same motherboard?
- A.** The cards will operate at their original speeds.
 - B.** None of the cards will function.
 - C.** The cards will all operate at the faster speed.
 - D.** The cards will all operate at the slower speed.
- 120.** You're working with an artist who creates digital art and wants your input on purchasing a new display. What factor will most likely be the most important in rendering accurate colors?
- A.** Color gamut
 - B.** Pixel density
 - C.** Aspect ratio
 - D.** Resolution
- 121.** Which of the following is the defining characteristic of a passive heat sink cooling system for a CPU?
- A.** It uses water.
 - B.** It uses heat pipes.
 - C.** It uses liquid nitrogen or helium.
 - D.** It does not require a fan or power.
- 122.** Which of the following system settings are configurable in the UEFI? (Choose three.)
- A.** Date and time
 - B.** Enabling and disabling services
 - C.** CPU fan speeds
 - D.** Power-on password
- 123.** Which level of cache is typically the smallest and closest to the processor die in a computer?
- A.** L1
 - B.** L2
 - C.** L3
 - D.** L4

124. Why does this power connector have a 20-pin and a 4-pin connector on the side?



- A. To support ATX or ATX12V motherboards
 - B. To provide power to a hard drive
 - C. To power the expansion cards
 - D. To power a secondary case fan
- 125.** Which of the following are types of CPU sockets? (Choose two.)
- A. LGA2066
 - B. CGA
 - C. Pentium
 - D. TR4
- 126.** Your office has a laser printer, and your manager asks if it can be upgraded to print on both sides of the paper. What type of device can add this functionality?
- A. Flipping assembly
 - B. Dual-paper feed assembly
 - C. Duplexing assembly
 - D. Automatic document feed assembly
- 127.** You're looking at the A end of a USB cable, and the connector is blue. You want to use it to plug in a USB 2.0 device. The cable is about 2 meters long. Which of the following statements are true? (Choose two.)
- A. The cable is compatible with your device.
 - B. The maximum length of the connection is 3 meters.
 - C. The connection will run slower than it should.
 - D. The cable is likely a 3.0 cable.

128. What types of RAM modules are shown here, from top to bottom?



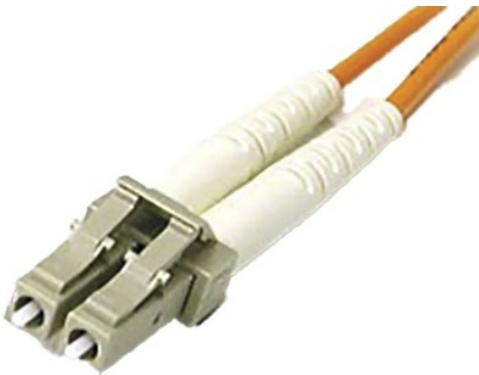
- A. DDR3 and DDR4
 - B. DDR5 and DDR3
 - C. DDR4 and DDR3
 - D. DDR4 and DDR5
- 129.** The Acme company has a laser printer in its Chicago office that has been used for three months. A technician needs to ship the printer to the Detroit office for use there. What, if any, preparations should be made for the toner cartridge?
- A. No preparations are needed for the toner cartridge before shipping.
 - B. Insert a toner blocker into the toner cartridge before shipping.
 - C. Seal the toner cartridge with tape before shipping.
 - D. Remove the toner cartridge from the printer before shipping.
- 130.** A client wants you to upgrade their desktop computer to have two video cards. You want to ensure that this computer can support the extra adapter. What type of open internal expansion slot should you look for?
- A. PCIe
 - B. ISA
 - C. VGA
 - D. DVI
- 131.** You're unable to boot your computer and are getting an error from BitLocker that no TPM is found. What would most likely solve the problem? (Choose two.)
- A. Update the TPM firmware.
 - B. Remove and reinstall the RAM.
 - C. Turn on TPM in the UEFI settings.
 - D. Reinstall the operating system.

- 132.** Which of the following are services created by Apple to enable the automatic discovery of printers on local networks? (Choose two.)
- A. Bonjour
 - B. AirPrint
 - C. TCP printing
 - D. Virtual printing
- 133.** After installing a new print cartridge in an inkjet printer, what process must be run before printing to the device?
- A. Degaussing
 - B. Driver installation
 - C. Rasterizing
 - D. Calibration
- 134.** Which type of printing technology might require replacing or cleaning debris from a heating element if it is no longer making images on waxy paper?
- A. Laser
 - B. Inkjet
 - C. Thermal
 - D. 3D printer
- 135.** You have a laser printer that is displaying the message “Perform user maintenance.” What should you do to resolve this situation?
- A. Apply a maintenance kit, and clear the message.
 - B. Use compressed air to blow out the inside of the printer, and clear the message.
 - C. Turn the printer off and back on again to clear the message.
 - D. Replace the toner cartridge, and clear the message.
- 136.** Identify the connectors shown here, from left to right.



- A. ST and SC
- B. SC and ST
- C. RJ-45 and RJ-11
- D. RJ-11 and RJ-45

137. Identify the connector shown here.



- A. ST
- B. SC
- C. LC
- D. MFF

138. You need to create several UTP cables from a roll of bulk cable. Your company uses the T568B standard. What is the correct order for wires in the connectors?

- A. White/orange, orange, white/green, blue, white/blue, green, white/brown, brown
- B. White/orange, orange, white/green, green, white/blue, blue, white/brown, brown
- C. White/orange, green, white/green, blue, white/blue, orange, white/brown, brown
- D. Orange, white/orange, white/green, blue, white/blue, green, white/brown, brown

139. You are installing a coaxial network cable that will support digital cable television signals. What type of cable should you install?

- A. RG-6
- B. RG-59
- C. UTP
- D. STP

- 140.** You need to replace a faulty 250-foot section of RG-6 cable, but all you have available is RG-59. Which of the following statements is true?
- A. The replacement cable will not work because the distance exceeds RG-59 specifications.
 - B. The replacement cable will not work because RG-6 and RG-59 use different connectors.
 - C. The replacement cable will not work because RG-6 and RG-59 have different impedances.
 - D. If the replacement cable works, it won't work as well. RG-6 should be purchased.
- 141.** You have been asked to design a new network that requires 10 Gbps transmission speeds. Which cable types will meet the minimum specifications? (Choose two.)
- A. MMF
 - B. Cat 5
 - C. Cat 5e
 - D. Cat 6a
- 142.** What characteristic differentiates STP from UTP?
- A. STP uses RJ-45s connectors instead of RJ-45.
 - B. STP follows the T568A wiring standard.
 - C. STP does not produce poisonous gas when burned.
 - D. STP has a layer of foil shielding inside the cable insulation.
- 143.** You are investigating remnants of a network setup in an unused building. At the end of a conduit, all you see are the connectors shown here. What type of cable do you expect these connectors to be attached to?



- A. Coaxial
- B. STP
- C. UTP
- D. Fiber-optic

144. Identify the connector shown here.



- A.** ST
 - B.** SC
 - C.** LC
 - D.** MMF
- 145.** While cleaning out a storage room, a technician finds several rolls of Cat 5e network cable. The technician thinks they might be able to use it to create replacement cables for their network. What is the maximum speed that this cable will support?
- A.** 100 Mbps
 - B.** 1 Gbps
 - C.** 10 Gbps
 - D.** 20 Gbps
- 146.** You are replacing cabling in a network. The existing cable was only capable of 100 Mbps maximum speed. What type of cable are you replacing?
- A.** Cat 5
 - B.** Cat 5e
 - C.** Cat 6a
 - D.** Single mode

- 147.** You are installing UTP network cable for a client. The client's policies require that network cables do not produce poisonous gas when burned. What type of cable do you need to install?
- A. Plenum
 - B. PVC
 - C. STP
 - D. Cat 5e or higher
- 148.** You're working to create an enterprise storage system and need to determine the best option. You're considering whether SATA or SAS drives would be the better choice. Which of the following is not true regarding SAS technology?
- A. SAS is cost effective for desktop use.
 - B. SAS supports 12 Gbps or more data speeds.
 - C. SAS supports up to 64,000 connections.
 - D. SAS operates in full duplex.
- 149.** A technician has a tablet whose documentation says it can connect to an HDMI display. However, the tablet has a port far smaller than HDMI. What type of video connection would be typical for this small-form-factor device?
- A. USB-C
 - B. RS-232
 - C. DB-9
 - D. Mini-HDMI
- 150.** What was the connectivity port/cable end Apple used to replace the 30-pin dock connector beginning in 2012?
- A. RS-232
 - B. Mini-HDMI
 - C. MicroUSB
 - D. Lightning
- 151.** With what connection standard is the Apple Thunderbolt 3 cable fully compatible?
- A. USB-C
 - B. Mini-HDMI
 - C. MicroUSB
 - D. DB9
- 152.** Which of the following connection types can be inserted or first flipped over and inserted?
- A. DB9
 - B. RS-232
 - C. MicroUSB
 - D. USB-C

- 153.** What serial connector type was commonly used for communication, keyboards, mice, or game controllers before USB became popular?
- A.** SCSI
 - B.** PS/2
 - C.** DB9
 - D.** Lightning
- 154.** Which of the following does not apply to triple channel memory?
- A.** Triple the 64-bit communication path to the CPU
 - B.** Triple the speed with which memory is accessed
 - C.** Requires installation of three matched memory modules
 - D.** Triple the memory access latency
- 155.** What form factor for solid-state drives (SSDs) measures 22 mm wide, with lengths varying between 30 mm, 42 mm, 60 mm, and longer?
- A.** NVMe
 - B.** SATA
 - C.** PCIe
 - D.** M.2
- 156.** What form factor for solid-state hard (SSH) drives has dimensions that mirror the older, platter-type magnetic drives?
- A.** M.2
 - B.** mSATA
 - C.** 2.5-inch
 - D.** NVMe
- 157.** You want to connect a 3.5-inch external hard drive to your computer. What port is used to connect external drives to the SATA bus?
- A.** NVMe
 - B.** eSATA
 - C.** M.2
 - D.** mSATA
- 158.** You want to protect your system from someone not authorized to start the OS. What is your best option?
- A.** Password-protect the lock screen.
 - B.** Password-protect in the BIOS/UEFI settings.
 - C.** Encrypt the hard drive.
 - D.** Use a 12-character login password.

- 159.** What is used to ensure an efficient and effective heat exchange into a heat sink and away from the CPU?
- A. Thermal paste
 - B. High-tension clamps to heat sink
 - C. Dihydrogen monoxide coolant
 - D. Lower CPU speeds
- 160.** A coworker has asked you to upgrade their computer. You research the model number and see x86 in the listing. Which of the following are true about this computer? (Choose two.)
- A. The computer has a 64-bit processor.
 - B. The computer has a 32-bit processor.
 - C. The computer supports 86 GB of RAM.
 - D. The maximum RAM supported is 4 GB.
- 161.** You attempt to plug a professional-level headphone jack into a computer but can't find the 3.5-mm jack. The headphones don't support Bluetooth or Wi-Fi. What are your best options? (Choose two.)
- A. Install a sound card.
 - B. Buy a new professional headset.
 - C. Cut the jack off and replace it with a USB end.
 - D. Purchase a USB-C-to-3.5-mm adapter.
- 162.** You need to purchase RAM for a computer. Which factors determine the speed of memory you should purchase? (Choose two.)
- A. CPU speed
 - B. RAM speed supported by the motherboard
 - C. RAM speed supported by the processor
 - D. RAM speed supported by the TPM chip
- 163.** You installed a new motherboard because the previous one failed. Your new motherboard doesn't have a VGA display port; it has onboard HDMI. Your display only uses VGA. What is the least expensive option to resolve this dilemma?
- A. Purchase a new display.
 - B. Return the motherboard, and choose a different one.
 - C. Purchase a video card with a VGA port on it.
 - D. Purchase an HDMI-to-VGA adapter.
- 164.** You need to replace an older, inefficient power supply on a desktop computer with a newer, more efficient one. Your manager has asked you to find one that is at least 90% efficient with a 50% load. Which of the following 80 Plus efficiency ratings would be appropriate? (Choose two.)

- A. Bronze
 - B. Gold
 - C. Silver
 - D. Titanium
- 165.** A new technician is tasked with replacing power supplies in 10 computers. They ask you why, because the computers seem to be working fine. What will you tell them the advantages of a new, more efficient power supply are? (Choose two.)
- A. More space in the case.
 - B. Reduced heat.
 - C. Lower cost to run.
 - D. They're noiseless.
- 166.** You've been asked to replace some UTP network cable with other UTP cable that is capable of 10 Gbps. The longest drop is 75 meters (246 feet) from the network rack. What is the lowest category of cable that can meet your needs?
- A. Cat 5
 - B. Cat 5e
 - C. Cat 6
 - D. Cat 6a
- 167.** Which of the following steps might not be necessary when setting up a printer share?
- A. Share a printer that's installed on a network.
 - B. Install a printer sharing app.
 - C. Add the printer to the PrintShare app, and configure it with a sharename and or IP address.
 - D. Install a printer driver.
- 168.** Your friend wants to run cable for a Power over Ethernet (PoE) WAP in their workshop, which is about 100 feet (about 30 meters) from the network connection in their house. They're not sure how to go about it, but they know that they don't want to have wires overhead. They also want to make sure it is shielded. What type of cable can you suggest that can go that far and has superior insulation and a water blocking layer?
- A. Cat 7
 - B. Direct burial STP
 - C. UTP Cat 10
 - D. Cat 6e

- 169.** What are advantages of UTP over STP? (Choose two.)
- A. UTP is more flexible.
 - B. UTP can run faster.
 - C. UTP can be buried.
 - D. UTP is less expensive.
- 170.** What type of network cable uses pulses of light to transmit data instead of an electrical charge?
- A. STP
 - B. Coaxial
 - C. Plenum
 - D. Fiber-optic
- 171.** You're setting up a datacenter and need a nonproprietary cable that will operate at 40 Gbps for 20 meters. Which category of cable should you choose?
- A. Cat 6
 - B. Cat 6a
 - C. Cat 7
 - D. Cat 8
- 172.** What type of connector is shown here?
- 
- A. SATA
 - B. eSATA
 - C. HDMI
 - D. SATAe
- 173.** An employee called the help desk because they're printing a document and it always gets cut off on the sides of the page. What settings will you guide this employee to change?
- A. Duplexing
 - B. Collating

- C. Print Quality
 - D. Orientation
- 174.** You have a motherboard that has 16 RAM slots. It is a quad-channel, with four RAM slots for each channel. The slots are all black, but they are labeled A1, A2, A3, A4, B1, B2, B3, B4, and so on. To take advantage of the quad-channel feature, how will you install the RAM modules?
- A. Any four slots will work for quad channel.
 - B. Install them all in the A slots.
 - C. Install them in A1, B2, C3, and D4.
 - D. Install them in A1, B1, C1, and D1.
- 175.** One of the users you support is using a great deal of ink, although they print less than some other users. What setting will you change for this user?
- A. Duplexing
 - B. Collating
 - C. Print Quality
 - D. Orientation
- 176.** What network connectivity device is shown here?



- A. Hub
 - B. Switch
 - C. Router
 - D. Punchdown block
177. What is the purpose of a Molex connector?
- A. Parallel data communications
 - B. Serial data communications
 - C. Power connections
 - D. Fan connectors on the motherboard
178. You just purchased a network-enabled MFD for a secure environment. Several users will be using this same printer, and you want to ensure that print jobs won't be output to a tray unless the user is at the printer. Which of the following security practices will not meet your needs?
- A. Badging
 - B. PINs
 - C. Audit logs
 - D. Biometric authentication
179. What are the two types of connectors shown here, left to right?



- A. MicroUSB, MiniUSB
 - B. MiniUSB, MicroUSB
 - C. USB-A, USB-B
 - D. USB-C, USB4
- 180.** What type of drive is likely to be a 15,000-rpm drive?
- A. NVMe
 - B. SSD
 - C. Blu-ray
 - D. Magnetic
- 181.** What type of hard drives are not available in a 3.5-inch form factor?
- A. SSD
 - B. mSATA
 - C. SATA
 - D. HDD
- 182.** What keys are used for M.2 slots? (Choose two.)
- A. A
 - B. B
 - C. E
 - D. M
- 183.** Which version of SATA ties SATA drives into the PCIe bus on the motherboard, boosting the data throughput far beyond 600 Mbps?
- A. SATA 1
 - B. SATA 2
 - C. SATA 3.2
 - D. SATA 4
- 184.** Which of the following are AMD socket types? (Choose two.)
- A. Socket AM4
 - B. LGA 1200
 - C. Socket TR4
 - D. LGA 2066 Socket R4

185. What connects in the motherboard socket shown here?



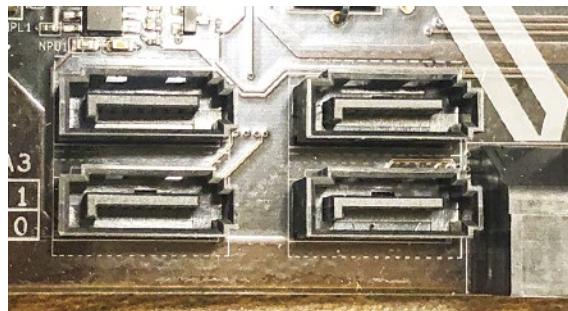
- A. M.2 drive
- B. Hard drive
- C. RAM
- D. TPM

186. The server motherboard shown here has a processor (with a heat sink) on the right and a location for a second processor to be inserted on the left. What term describes this type of motherboard?



- A. Multicore
 - B. Multithreaded
 - C. Coprocessor
 - D. Multisocket
- 187.** What type of motherboard may have multiple processors, multiple power supplies, and plenty of ECC RAM and can sometimes be found mounted in a networking rack?
- A. Server
 - B. Workstation
 - C. Desktop
 - D. Mobile
- 188.** Which of the following processors are you more likely to find in a server than a workstation? (Choose two.)
- A. Intel Atom
 - B. Intel Xeon
 - C. AMD EPYC
 - D. AMD Ryzen 3
- 189.** What type of motherboard is designed to be very compact and is generally proprietary?
- A. Server
 - B. Workstation
 - C. Desktop
 - D. Mobile
- 190.** Which of the following are true about ARM architecture? (Choose two.)
- A. It's licensed by ARM Holdings to many chip manufacturers.
 - B. It uses Complex Instruction Set Computing (CISC).
 - C. It uses Reduced Instruction Set Computing (RISC).
 - D. It is only found in smartphones.
- 191.** You work in a secure environment, and it's your responsibility to ensure that no data leaves the network. You've just received a batch of new computers. What can you do in the UEFI to help ensure that users can't copy data to a USB drive?
- A. Look for a setting to disable USB ports, and disable them.
 - B. Put USB ports first in the boot options.
 - C. Remove USB from the boot options.
 - D. Look for a setting to enable USB ports, and enable them.

192. What are the four motherboard connectors shown here?



- A.** USB
 - B.** SATA data
 - C.** SATA power
 - D.** M.2 drives
- 193.** You're building a SAN for your company. Which of the following will you most likely need to install in your server to attach the server to the SAN?
- A.** NIC
 - B.** Modem
 - C.** Fibre Channel HBA
 - D.** WAP
- 194.** Your friend is looking over your shoulder as you work on a computer. They ask what all the pins sticking up are. Some are labeled USB1, some USB2, and others are labeled "front panel." What is the generic term for these pins on the motherboard?
- A.** Ports
 - B.** Pins
 - C.** Standoffs
 - D.** Headers
- 195.** You're receiving a "Low Toner" message from your printer. What type of printer are you using?
- A.** Laser
 - B.** Thermal
 - C.** Impact
 - D.** Inkjet

- 196.** What advantage does RAID-6 have over RAID-5?
- A.** Striping
 - B.** Parity
 - C.** Fewer disks needed
 - D.** Double parity
- 197.** You need a PC solution that can accept video footage from a gaming console or video camera and save it to a file. You also want to ensure that it won't skip, lag, or freeze. Which of the following would be the best solution?
- A.** Webcam
 - B.** FireWire card
 - C.** Capture card
 - D.** Screen-capture software
- 198.** A business has a PC that a user needs to work with in a room that is not air-conditioned. The PC keeps shutting down because the processor is overheating. You've checked the cooler and thermal paste, and it's fine. What can you do to this PC to help it run cool enough?
- A.** Add case fans.
 - B.** Add heat-monitoring software.
 - C.** Remove the chassis cover.
 - D.** Set it inside a refrigerator.
- 199.** You are replacing the power supply in a computer system that uses a 24-pin P1 connector. You have a few power supplies in the closet from which to choose. Which of the following connections will work? (Choose two.)
- A.** 20-pin P1 connector and P4 connector
 - B.** 20-pin+4-pin P1 connector
 - C.** An ATX12V PSU
 - D.** An ATX12VO power supply
- 200.** You're considering a power supply with interchangeable output cables that plug into and out of the power supply so that you can have exactly the connectors you need and not have extra cables taking up space in the case. What type of power supply is this?
- A.** ATX
 - B.** ATX12V
 - C.** Molex
 - D.** Modular

- 201.** You're setting up a server that can't possibly have downtime. Which of the following items do you need to ensure that you have connected to it?
- A. HBA
 - B. Redundant power supply
 - C. Display
 - D. Dual-rail power supply
- 202.** Your new tech is unboxing a new printer, and you see them open the top, flip the box upside-down, and then pull the box off the printer. What will you say? (Choose two.)
- A. Great job; that's exactly how I would do it.
 - B. That's not the right way to unbox a printer.
 - C. It's better to lay the box on its side and pull the materials out.
 - D. Please use a box cutter next time to cut the corners from top to bottom.
- 203.** You just purchased a network-enabled MFD. Which one of the following connection types is likely not built into it?
- A. Bluetooth
 - B. Wi-Fi
 - C. Ethernet
 - D. RFID
- 204.** You have a client who wants to use carbonless, multipart forms with their new printer. What type of printer will you recommend for them?
- A. Laser
 - B. Inkjet
 - C. Impact
 - D. Thermal
- 205.** Your company's administrative assistant needs to be able to choose between printing on letterhead or plain paper for each print job. You're training them how to do it. What settings will you be showing them?
- A. Orientation
 - B. Duplexing
 - C. Quality
 - D. Tray settings
- 206.** Which types of printers require calibration as a part of maintenance? (Choose two.)
- A. Laser
 - B. Thermal
 - C. Impact
 - D. Inkjet

- 207.** What printer feature will store documents on the printer and not print them until the user enters a password or scans an ID card on the print device?
- A. Secured prints
 - B. Snap prints
 - C. User authentication
 - D. Auditing
- 208.** What type of connectivity device is used to terminate network runs in a telecommunications closet?
- A. Punchdown block
 - B. Switch
 - C. Router
 - D. Terminator
- 209.** Which of the following is appropriate for cleaning the thermal paper feed assembly on a thermal printer?
- A. Compressed air can
 - B. Clean, lint-free cloth
 - C. Water
 - D. Vacuum cleaner
- 210.** What are three communication interfaces that are used by SSDs to send data across a motherboard? (Choose three.)
- A. NVMe
 - B. SATA
 - C. PCIe
 - D. IDE
- 211.** What is the (approximate) maximum theoretical bandwidth of a PCIe x16 slot, version 5.0?
- A. 500 MBps
 - B. 1000 MBps
 - C. 64 GBps
 - D. 128 GBps
- 212.** What are important considerations when replacing thermal printer paper? (Choose two.)
- A. Be sure to align the feed holes correctly.
 - B. Make sure you have the right cleaning card.
 - C. Use only the paper specified by the printer.
 - D. Ensure that the paper is oriented correctly.

- 213.** Which of the following is not a valid way to clean a thermal printer's printhead and heating element?
- A. Cleaning card.
 - B. Cleaning paper.
 - C. Wet a cloth with water.
 - D. Cleaning pen.
- 214.** Which of the following type of printers requires replacing an inked ribbon when the printout becomes unreadable?
- A. Laser
 - B. Thermal
 - C. Impact
 - D. Inkjet
- 215.** You need to clean a laser printer of debris in the print path. Which of the following are appropriate to use? (Choose two.)
- A. Canned compressed air.
 - B. Cleaning paper.
 - C. Wet a cloth with water.
 - D. Vacuum cleaner.
- 216.** What may need cleaning on an inkjet printer? (Choose two.)
- A. Toner cartridges
 - B. Paper feeder rollers
 - C. Printheads
 - D. Thermal unit
- 217.** You're receiving a message that your printer's ink cartridge is low. What type of printer are you using?
- A. Laser
 - B. Thermal
 - C. Impact
 - D. Inkjet
- 218.** While replacing a toner cartridge in a laser printer, a technician spilled toner on and around the printer. What should be used to clean up the spill?
- A. A damp cloth
 - B. Compressed air
 - C. A toner vacuum
 - D. Denatured alcohol



Chapter **4**

Virtualization and Cloud Computing

**THE COMPTIA A+ 220-1120 TOPICS COVERED
IN THIS CHAPTER INCLUDE THE FOLLOWING:**

✓ **4.1 Explain virtualization concepts.**

- Purpose of virtual machines
 - Sandbox
 - Test development
 - Application virtualization
 - Legacy software/OS
 - Cross-platform virtualization
- Requirements
 - Security
 - Network
 - Storage
- Desktop Virtualization
 - Virtual Desktop Infrastructure (VDI)
- Containers
- Hypervisors
 - Type 1
 - Type 2

✓ **4.2 Summarize cloud computing concepts.**

- Common cloud models
 - Private cloud
 - Public cloud
 - Hybrid cloud
 - Community cloud



- Infrastructure as a Service (IaaS)
- Software as a Service (SaaS)
- Platform as a Service (PaaS)
- Cloud Characteristics
 - Shared resources vs. dedicated resources
 - Metered utilization
 - Ingress/egress
 - Elasticity
 - Availability
 - File synchronization
 - Multitenancy

- 1.** What type of cloud service offers the best security?
 - A.** Community
 - B.** Private
 - C.** Public
 - D.** Hybrid

- 2.** Your manager tells you to purchase cloud-based services. Your network needs extra processing power and file storage. What type of service should you purchase?
 - A.** PaaS
 - B.** IaaS
 - C.** SaaS
 - D.** FWaaS

- 3.** Your company has decided to purchase cloud services from Google. It will be getting infrastructure with on-demand computing services, including processing power, storage, and bandwidth over the Internet. Anyone can purchase these same services from Google, and a third party is responsible for maintaining and managing the hardware. What type of cloud is Google providing for your company?
 - A.** Public
 - B.** Private
 - C.** Hybrid
 - D.** Community

- 4.** Your company produces software and employs about 20 developers. They need to program apps for different OSs. You decide to purchase cloud-based services to support the development team. What type of service should you purchase so they can develop their programs and then test them in environments other than where they were developed?
 - A.** IaaS
 - B.** SaaS
 - C.** PaaS
 - D.** NaaS

- 5.** Which type of cloud service provides your company with application hosting, such as productivity applications, calendaring software, and development tools, which the employees can access over the Internet from wherever they are?
 - A.** PaaS
 - B.** FWaaS
 - C.** IaaS
 - D.** SaaS

6. Which feature of cloud service enables you to instantly obtain additional storage space or processing power as your company needs it?
 - A. Ubiquitous access
 - B. Elasticity
 - C. Resource pooling
 - D. Metering
7. You are installing virtualization on a workstation that needs to support multiple OSs. Which type of hypervisor is best suited for this environment?
 - A. Type 1
 - B. Type 2
 - C. Either Type 1 or Type 2 will function in the same way
 - D. Virtual machine manager
8. You are configuring desktop virtualization on an existing Windows 11 64-bit workstation. You will be running an installation of Windows 10 in the virtual environment as a test system. The bare minimum RAM requirements are 2 GB for Windows 10 and 4 GB for Windows 11. Windows 10 needs 20 GB of disk space, and Windows 11 requires 64 GB of disk space. What are the absolute minimum hardware requirements for this workstation?
 - A. 4 GB RAM, 64 GB disk space
 - B. 4 GB RAM, 84 GB disk space
 - C. 6 GB RAM, 64 GB disk space
 - D. 6 GB RAM, 84 GB disk space
9. You are setting up virtualization on a server that will be running four instances of Windows Server 2019. Four different departments will be using one instance each, and all departments have been promised 32 GB RAM. Using resource pooling and using a bare-metal hypervisor, what is the minimum amount of physical RAM needed on the server?
 - A. 32 GB
 - B. 64 GB
 - C. 128 GB
 - D. 16 GB
10. Your company has an application developer who creates programs for Windows 10, Windows 11, and various distributions of Linux. What is the most cost-effective solution for them to be able to test their programs in multiple OSs as quickly as possible?
 - A. Buy workstations for each of the OSs they will be writing code in.
 - B. Set up their workstation to multi-boot.
 - C. Set up their workstation with virtual machines.
 - D. Create one version of each application that will run in all three OSs.

11. Your company wants to begin transferring services to the cloud, but the team's migration schedule will cover several months. Management wants to pay for cloud computing based on usage, not a fixed flat fee. What payment model would you recommend?
 - A. On-demand
 - B. Resource pool
 - C. Metered utilization
 - D. Shared resources
12. A client complains about the occupied space, abundant power usage, and hardware costs of the multiple machines used in its small datacenter. Still, the client does not want to lose control over any of the machines. What might you recommend to the client to resolve all those issues?
 - A. Establish clusters for high availability.
 - B. Create virtual machines.
 - C. Outsource to an IaaS provider.
 - D. Shut down the nonessential machines.
13. Which term describes the physical and virtual servers, storage, and software that are used by multiple clients in a cloud computing environment?
 - A. Measured resources
 - B. Shared resources
 - C. Private cloud
 - D. Community cloud
14. What are potential problems associated with the shared resource structure of public cloud computing? (Choose two.)
 - A. Security and confidentiality
 - B. Flexibility
 - C. Poor application performance
 - D. Increased hardware costs
15. Network control and security management of cloud assets is the difference between what two types of shared resources?
 - A. Internal vs. external
 - B. Private vs. public
 - C. Hybrid vs. community
 - D. Synchronized vs. unsynchronized
16. A company using cloud services wants to better prepare for surges of what it needs. What sort of capacity provisioning by its cloud provider should the company ask for?
 - A. Rapid metering
 - B. Infrastructure as a service

- C. Metered utilization
 - D. Resource pooling
17. You're setting up a virtual machine for one of your customers who needs a legacy OS to run software for a paper-cutting machine in an envelope factory. Windows 10 64-bit is the host OS. The legacy client OS requires a minimum of 1 GB of RAM, and the software running on it requires a minimum of 2 GB of RAM. What is the absolute minimum RAM needed on the virtual machine?
- A. 1 GB
 - B. 4 GB
 - C. 5 GB
 - D. 10 GB
18. The company's sales manager wants to ensure that the laptop files of its traveling sales engineers stay consistent with the files on the company cloud. What sort of applications could assist with that business need?
- A. File security monitoring
 - B. File virtualization
 - C. File emulator
 - D. File synchronization
19. What service enables a user to access a virtual OS, either in the cloud using a browser or client on their local devices, or from a local virtualization server?
- A. DOD
 - B. BAD
 - C. VDI
 - D. DTI
20. An employee travels between multiple offices, using a desktop system in each office. What technology would ensure that the employee's desktop icons, files, and applications remain uniform across systems in all the offices?
- A. On-demand desktop
 - B. VDI in the cloud
 - C. Desktop emulation
 - D. Synchronized folders
21. When running a hypervisor, what enables a guest machine to connect to a network?
- A. Cat 5 network cable
 - B. Guest applications
 - C. Virtual NIC
 - D. Host OS

- 22.** How can an organization permit employees who need to run an application on one mobile device to instead run it from multiple devices?
- A.** Application virtualization
 - B.** Wrapping
 - C.** Binary application desktop
 - D.** On-demand desktop
- 23.** In setting up and configuring desktop virtualization, what must you consider before purchasing computing and storage hardware?
- A.** Resource requirements
 - B.** Management response
 - C.** Resale value
 - D.** Physical size
- 24.** What must be defined when wanting to maintain confidentiality, integrity, and availability of system resources and should be a part of the decision when considering a virtual machine or cloud solution?
- A.** Scalability
 - B.** Emulation
 - C.** Elasticity
 - D.** Security
- 25.** In setting up and configuring desktop virtualization, what is necessary to consider before configuring a VLAN?
- A.** Network requirements
 - B.** Emulation demands
 - C.** Cloud service providers
 - D.** Storage capacity
- 26.** Your IT team is developing an application that must be able to run in any environment, including Windows, Linux, and macOS. What is the best way to achieve this?
- A.** Write three separate programs.
 - B.** Run it in a VM.
 - C.** Deploy it using a container.
 - D.** Run it on a cloud server.
- 27.** Which of the following is not considered to be a major category of cloud computing?
- A.** SaaS
 - B.** PaaS
 - C.** IaaS
 - D.** XaaS

- 28.** Which of the cloud computing models combines on-premises infrastructure and Internet-accessed resources?
- A.** Private cloud
 - B.** Public cloud
 - C.** Hybrid cloud
 - D.** Combined cloud
- 29.** With today's more mobile workforce, what technology provides the benefits of centralized security, ease of configuring new desktops for remote workers, and scalability regardless of where a user is or works from? (Choose the best answer.)
- A.** IaaS
 - B.** SaaS
 - C.** VDI in the cloud
 - D.** VDI on-premises
- 30.** A group of real estate agents has realized that they have similar computing resource needs. Collectively, they've reached out to your IT services company and asked if there is a solution that will let them pool their resources, save money, and possibly share industry-specific software but still have their servers and information held securely and locally. What would you recommend?
- A.** Community cloud
 - B.** Public cloud
 - C.** Private cloud
 - D.** VDI in the cloud
- 31.** Which of the following options is a benefit of cloud computing that means the information is available constantly, regardless of location?
- A.** Shared resources
 - B.** High availability
 - C.** Rapid elasticity
 - D.** File synchronization
- 32.** A graphic artist at your company needs to manipulate files in both Linux and Windows environments. You, as the IT support person, want as few physical machines to support as possible. What technology enables both OSs to run on a single machine?
- A.** File sharing.
 - B.** Cross-platform virtualization.
 - C.** Dual-boot system.
 - D.** It can't be done.

- 33.** You've received a file from a salesperson who recently separated from your company. You want to open this file and see what it contains without subjecting your computer to possible malicious content. What Windows feature can you turn on that will create a protected environment for opening this file?
- A.** Shared Files
 - B.** System Information
 - C.** Sandbox
 - D.** File Manager
- 34.** Your friend is a software developer. They have Windows 11 Pro installed on their SOHO computer. They are creating an application that needs to run smoothly on both Windows and Linux machines, so it will need to be tested in both environments. What is the best solution for your friend?
- A.** Windows 11 Sandbox
 - B.** Dual-boot system
 - C.** Two separate machines
 - D.** Virtual machines on their PC
- 35.** A manufacturing client has a piece of equipment that is running on Windows 7 OS. The equipment-specific software won't run on any other OS, and the client is concerned about what they will do when the Windows 7 computer inevitably crashes. Cost is always a concern. What is a viable, cost-effective solution for your client?
- A.** Have the programmers rewrite the code to run on Windows 10.
 - B.** Migrate the software to a Windows 7 VM.
 - C.** Wait until the hardware crashes, and then shut the equipment down permanently.
 - D.** Tell the client they need to upgrade their manufacturing equipment to something more modern as soon as possible.
- 36.** Why would a company prefer to run multiple applications each on its own VM rather than on a single server?
- A.** Security
 - B.** Scalability
 - C.** Less maintenance
 - D.** Less cost
- 37.** Which of the following would essentially be the same, whether running an OS on a virtual server or a physical server? (Choose two.)
- A.** Security configuration
 - B.** Hardware
 - C.** Licensing
 - D.** Portability

- 38.** Which cloud model offers the greatest control over data and security?
- A.** Private cloud
 - B.** Public cloud
 - C.** Hybrid cloud
 - D.** Community cloud
- 39.** You are a manager in a call center that employs 300 people who may be working any of three shifts on any given day, taking whichever of your 100 seats is available. Company regulations require that all information remain hosted locally. What technology can you use so that their files, folders, and desktop icons all appear the same regardless of what computer they log in to?
- A.** On-demand desktop
 - B.** VDI in the cloud
 - C.** Desktop emulation
 - D.** VDI on-premises
- 40.** Which of these is not an advantage of cloud computing?
- A.** Reduced capital expenditures
 - B.** Frees IT employees' time for other needs
 - C.** Complete control over data
 - D.** Rapid elasticity (i.e., dynamic growth)
- 41.** You need to set up a hypervisor to run multiple OSs, but the computer you'll be installing it on has just enough resources for the VMs. What is your best, most expedient option? (Choose two.)
- A.** Use a bare-metal hypervisor.
 - B.** Use a Type 1 hypervisor.
 - C.** Use a Type 2 hypervisor.
 - D.** Upgrade the computer hardware.
- 42.** Your client is a government contractor that has highly sensitive data. They need to be able to access it via the cloud, so that it can be accessed from anywhere in the world. Of course, security is a concern, so they don't want anyone else using space on, or having access to, the hardware that houses their information. Which of these will they request from the cloud provider?
- A.** Metered egress
 - B.** Metered ingress
 - C.** Shared resources
 - D.** Dedicated resources

- 43.** Your company just received an unexpectedly high bill for services from the cloud provider. You explain to the accounting department that it's because you were running a special on a downloadable book, and there was a great deal of data downloaded from your site. What type of utilization are you being billed for?
- A.** Metered egress
 - B.** Metered ingress
 - C.** Shared resources
 - D.** Dedicated resources
- 44.** You're explaining to your company's board how cloud computing works and that, although other companies will be using the same hardware and infrastructure, your data will be separated. What is this concept called? (Choose two.)
- A.** Multitenancy
 - B.** Sandbox
 - C.** Shared resources
 - D.** Dedicated resources
- 45.** You're configuring a test environment using virtual machines to see how a software update will work with your systems before you deploy it in a live environment. Which of these are you using?
- A.** Multitenancy
 - B.** Sandbox
 - C.** Shared resources
 - D.** Dedicated resources

Chapter **5**

Hardware and Network Troubleshooting

THE COMPTIA A+ 220-1201 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

- ✓ **5.1 Given a scenario, troubleshoot motherboards, RAM, CPUs, and power.**

- Common symptoms
 - Power-on self-test (POST) beeps
 - Proprietary crash screens
 - Blank screen
 - No power
 - Sluggish performance
 - Overheating
 - Burning smell
 - Random shutdown
 - Application crashes
 - Unusual noise
 - Capacitor swelling
 - Inaccurate system date/time

- ✓ **5.2 Given a scenario, troubleshoot drive and RAID issues.**

- Common symptoms
 - Light-Emitting Diode (LED) status indicators
 - Grinding noises
 - Clicking sounds
 - Bootable device not found
 - Data loss/corruption



- RAID failure
- Self-monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) failure
- Extended read/write times
- Low performance Input/Output Operations Per Second (IOPS)
- Missing drives in OS
- Array missing
- Audible alarms

✓ **5.3 Given a scenario, troubleshoot video, projector, and display issues.**

- Common symptoms
- Incorrect input source
- Physical cabling issues
- Burnt-out bulb
- Fuzzy image
- Display burn-in
- Dead pixels
- Flashing screen
- Incorrect color display
- Audio issues
- Dim image
- Intermittent projector shutdown
- Sizing issues
- Distorted image

✓ **5.4 Given a scenario, troubleshoot common mobile device issues.**

- Common symptoms
- Poor battery health
- Swollen battery
- Broken screen
- Improper charging
- Poor/no connectivity



- Liquid damage
- Overheating
- Digitizer issues
- Physically damaged ports
- Malware
- Cursor drift/touch calibration
- Unable to install new applications
- Stylus does not work
- Degraded performance

✓ **5.5 Given a scenario, troubleshoot network issues.**

- Common symptoms
- Intermittent wireless connectivity
- Slow network speeds
- Limited connectivity
- Jitter
- Poor Voice over Internet Protocol (VoIP) quality
- Port flapping
- High latency
- External interference
- Authentication failures
- Intermittent Internet connectivity

✓ **5.6 Given a scenario, troubleshoot printer issues.**

- Lines down the printed pages
- Garbled print
- Paper jams
- Faded prints
- Paper not feeding
- Multipage misfeed
- Multiple prints pending in queue
- Speckling on printed pages
- Double/echo images on the print



- Grinding noise
- Finishing issues
 - Staple jams
 - Hole punch
- Incorrect page orientation
- Tray not recognized
- Connectivity issues
- Frozen print queue

1. A Linux user calls the IT help desk in a panic because they have a BSOD on the screen. What would be a good first step to resolve the BSOD? (Choose two.)

 - A. Try rebooting the system.
 - B. Refresh the operating system.
 - C. Reinstall the operating system.
 - D. Scan the QR code with a smartphone.
2. A user approaches you and asks for a CPU upgrade so their Lenovo laptop will run faster. What is most likely the easiest way to meet this user's needs?

 - A. Remove the CPU, and replace it with a faster one that fits the same socket.
 - B. Replace the laptop with one that has a faster CPU.
 - C. Replace the motherboard with a generic laptop motherboard with a faster processor.
 - D. Replace the motherboard with a Lenovo laptop motherboard with a faster processor.
3. You're at the doctor's office, and the nurse is using a tablet to enter data. You notice that they are hitting the screen repeatedly with their finger, obviously getting annoyed. You tell them that you work in IT and may be able to help. They tell you that when they touch one spot, it thinks they're touching somewhere else. In addition, it sometimes thinks they touched the screen when they didn't, causing the wrong data to be selected. What will you tell the nurse that might fix this problem quickly and at no cost? (Choose two.)

 - A. Replace the digitizer.
 - B. Clean the screen with a microfiber cloth.
 - C. Calibrate the display.
 - D. Reinstall the operating system.
4. You have decided to start playing video-intensive games on your laptop computer. The video appears jumpy and slow to respond. What should you do first to try to increase the performance during game play?

 - A. Upgrade the video card.
 - B. Install additional video memory.
 - C. Use the Windows Control Panel to increase the amount of video memory available.
 - D. Use the system BIOS/UEFI to increase the amount of video memory available.
5. A guest presenter plugs an external projector into their laptop using the HDMI port on the back of the laptop. They then use the Fn key and video toggle switch; the projector displays the presentation, but the laptop screen goes dark. What should they do if they want to see the presentation on both the projector and laptop?

 - A. Install a second video driver, and then use the video toggle key to switch the video output to both screens.
 - B. Unplug the projector, and then plug it back in to synchronize it with the laptop.

- C. Unplug the projector, use the video toggle key to switch the video output, and then plug the projector back in.
 - D. Press the video toggle key again until the presentation is shown on both screens.
6. A user has a laptop that is intermittently locking up. Initial diagnostics indicate that the processor is overheating. What can you do to try to remediate the issue? (Choose two.)
- A. Leave the case open while the system is running to allow for better airflow and cooling.
 - B. Lower the CPU voltage in the system BIOS/UEFI.
 - C. Lower the CPU clock speed in the system BIOS/UEFI.
 - D. Run the laptop on AC power instead of battery power.
7. A client has a laptop with an integrated video card. The system seems to boot but produces no video, even with an external display hooked up. What can you do to fix this?
- A. Add an external USB video card, and connect the display to it.
 - B. Remove the existing video card, and replace it with a new internal video card.
 - C. Replace the motherboard.
 - D. Leave the existing card in the system, and add an internal Mini-PCIe video card.
8. A user has brought their older laptop to you because the screen is unusually dim. Which display component is most likely causing this?
- A. Backlight
 - B. LCD
 - C. Screen
 - D. Inverter
9. A purchasing agent ordered replacement printer paper that is a thicker caliper than recommended by the printer manufacturer. What is the biggest risk in using this paper?
- A. Images will not print.
 - B. Paper will not feed.
 - C. Paper will jam.
 - D. Images print normally.
10. You have an OLED display that you just plugged into a desktop computer. One of your coworkers changes the resolution from 1920×1080 to 1920×1200, but then the image looks highly distorted. What is the most likely cause of this?
- A. The video driver does not support 1920×1200 resolution.
 - B. The display has a native resolution of 1920×1080.
 - C. The video adapter has a native resolution of 1920×1080.
 - D. The monitor is plugged into the wrong display interface to support the new resolution.

11. A user has an LCD display that flashes a black screen every few seconds. What is likely set incorrectly and causing the problem?
 - A. Refresh rate
 - B. Frame rate
 - C. Native resolution
 - D. Aspect ratio
12. A friend who plays video games has asked you how they can fix tearing on their display. What will you tell them?
 - A. They need a new display.
 - B. The refresh rate is set too low.
 - C. The screen's refresh rate is set too high.
 - D. It's a software defect.
13. What is the name of the boot routine that verifies the size and integrity of the system memory, among other tasks, and will produce error messages as beeps before the video is available?
 - A. RAMCheck
 - B. BIOS
 - C. UEFI
 - D. POST
14. Which of the following are considered improper charging, which could result in damage to a battery, or possibly a fire starting? (Choose two.)
 - A. Charging the battery over 100%
 - B. Fully charging a battery
 - C. Letting a battery charge drop to zero
 - D. Using a charger that isn't approved for this device
15. You moved a projector from an old conference room to a new one. The projector was working fine in the other room, but the image seems to be dim in the new room. Before you purchase a new projector, which of the following should you try?
 - A. Increase the frame rate.
 - B. Lower the native resolution.
 - C. Adjust the aspect ratio.
 - D. Turn the brightness up.
16. Your friend has just finished building a computer. After installing the operating system, all seems fine except that they found that flash drives placed in the USB ports on the top of the case do not get noticed by the OS. What do you suspect the problem is?
 - A. Outdated device drivers
 - B. Misconfigured USB settings

- C. Disconnected motherboard internal USB connector
 - D. System clock
17. You are troubleshooting a Mac running macOS. Intermittently, the computer will completely lock up and display a rotating pinwheel instead of the mouse cursor. It happens when different applications are running. What is most likely causing this problem?
- A. CPU
 - B. RAM
 - C. Motherboard
 - D. Faulty application
18. You're at a friend's house when you notice a burning smell from their computer. What is the first thing you should do?
- A. Grab a fire extinguisher.
 - B. Unplug the computer.
 - C. Call the fire department.
 - D. Tell your friend to get a new computer.
19. You are troubleshooting a desktop computer that is prone to unexpected shutdowns. They seem to happen randomly, sometimes shortly after the computer starts and other times after several minutes. The user reports that no error messages appear before the computer shuts down. Which two of the following things are most likely to cause this type of problem? (Choose two.)
- A. Failing hard drive
 - B. Bad RAM
 - C. BIOS/UEFI misconfiguration
 - D. Improperly seated chips
20. You're troubleshooting a computer that the user says shuts down after 10 minutes of use every time they start the computer. If they wait a few minutes and restart it, the same thing happens. What is most likely the problem?
- A. RAM
 - B. Hard drive
 - C. Processor
 - D. Motherboard
21. A computer user calls the IT help desk in a panic because they have a BSOD on the screen. You ask them if there is a specific error message displayed and if they have installed any hardware or software lately. They haven't. What would be a good first step to resolve the BSOD?
- A. Try rebooting the system; Windows will try to fix it.
 - B. Refresh the OS.

- C. Reinstall the OS.
 - D. Restore to the previous OS version.
22. You have just replaced faulty RAM in a desktop computer. You reboot the computer, and after a few seconds it beeps once. What does this indicate?
- A. The RAM is faulty.
 - B. The motherboard needs to be replaced.
 - C. The system BIOS detected an error in the POST routine.
 - D. The system BIOS completed the POST routine normally.
23. You are troubleshooting a computer that will not boot. It tells you that there is no bootable device. You check the BIOS, and it does not show any installed hard drives. What should you do next?
- A. Run bootrec /fixmbr.
 - B. Replace the hard drive with an external drive.
 - C. Flash the BIOS.
 - D. Check the hard drive connections.
24. A technician just replaced a failed internal hard drive in a desktop computer with an empty hard drive. They need to boot to the network to connect to an imaging server to restore the computer. How should they do this?
- A. During boot, press the F2 key to boot to the network.
 - B. During boot, enter the BIOS/UEFI, and change the boot sequence to boot to the network.
 - C. Let the boot complete normally. When the UEFI does not find a bootable partition on the hard drive, it will boot from the network.
 - D. During boot, press the F7 key to edit the boot sequence menu.
25. A user's laptop computer does not show anything on the screen, although the power light and other indicator lights are on. You plug in an external display, which does not show an image either. Which component is most likely causing the problem?
- A. Inverter
 - B. Backlight
 - C. Screen
 - D. Integrated video
26. You are troubleshooting a computer making a loud whining noise. Looking at the exhaust fan, you see a thick dust coating. What should you do next?
- A. Use compressed air to clean the fan.
 - B. Use a computer vacuum to clean the fan.
 - C. Use a damp cloth to clean the fan.
 - D. Replace the power supply.

- 27.** A user reports that their laptop battery does not charge when the laptop is plugged into an AC outlet. What is the best solution to try first?
- A.** Replace the battery.
 - B.** Replace the AC adapter.
 - C.** Reseat the battery connection.
 - D.** Drain the battery completely, and then recharge it.
- 28.** A technician has determined that they need to replace a laptop's motherboard. Which of the following procedures should be followed? (Choose two.)
- A.** Never use a power screwdriver with a laptop.
 - B.** Document and label screw locations.
 - C.** Refer to the manufacturer's instructions.
 - D.** Remove the keyboard before removing the motherboard.
- 29.** You are troubleshooting a desktop computer that has been randomly rebooting, and now it refuses to boot properly. While it's booting, you receive one long beep and three short beeps but no video on the screen. What tool should you use to troubleshoot the situation?
- A.** Multimeter
 - B.** Power supply tester
 - C.** Loopback plug
 - D.** POST card
- 30.** You are troubleshooting a computer that has been randomly rebooting, and now it refuses to boot properly. Upon booting, you receive one long beep and three short beeps but no video on the screen. You don't have a POST diagnostic card that will work with this motherboard. What tool should you use to troubleshoot the situation?
- A.** Motherboard documentation
 - B.** Power supply tester
 - C.** Multimeter
 - D.** Loopback plug
- 31.** Over time, the HDD performance of your computer has gotten slower. A quick check of Performance Monitor shows that your disk read/writes are slower than the baseline. What should you do to resolve this issue?
- A.** Run Optimize, and defragment the drive.
 - B.** Format the hard drive, and restore the data.
 - C.** Delete the partition, create a new one, and restore the data.
 - D.** Run chkdsk.

- 32.** A user’s computer has failed. When you try to boot it up, you hear a loud, rhythmic clicking sound, and the system does not boot properly. What is most likely the issue?
- A. HDD failure
 - B. SSD failure
 - C. RAM failure
 - D. Power supply fan failure
- 33.** A laser printer you are working with consistently produces images with white streaks running down the page. What can you do first to resolve this issue?
- A. Clean the transfer corona wires.
 - B. Clean the EP drum.
 - C. Clean the fusing assembly.
 - D. Gently shake or replace the toner cartridge.
- 34.** The laser printer in your office recently started creasing papers and producing paper jams. Which of the following are likely to cause these problems? (Choose three.)
- A. Bits of paper in the paper path
 - B. Paper tension settings
 - C. Using the wrong paper
 - D. Damaged rollers
- 35.** You power on a desktop computer and hear the fan spinning. However, you do not see any indicator lights or get a POST beep. Which component is likely causing the problem?
- A. CPU
 - B. RAM
 - C. PSU
 - D. HDD
- 36.** Your computer is making an intermittent grinding noise. What component is most likely failing?
- A. Magnetic hard drive
 - B. Solid-state drive
 - C. Processor fan
 - D. RAM
- 37.** Your office uses an inkjet printer. Recently, it started having problems picking up paper. Which component is likely to cause this problem?
- A. Transport rollers
 - B. Pickup rollers
 - C. Corona wire
 - D. Transmission rollers

- 38.** Your office uses an impact printer and multipart carbonless forms. The office manager noticed that the bottom copies of the forms are legible but the top copy is too light to read. What needs to be replaced?
- A.** Toner cartridge
 - B.** Printhead
 - C.** Ink ribbon
 - D.** Ribbon advance motor
- 39.** Your network uses 802.11ac and a single WAP for all client computers. Recently, several users moved from one office space to another, increasing the number of users in the area from 20 to about 50. Now, both new and old users are reporting very slow network transfer speeds. What is most likely the cause of the problem?
- A.** 802.11ac can't support that many concurrent users.
 - B.** The new office space is too far from the WAP.
 - C.** There are too many users for one wireless access point.
 - D.** The new users all have 802.11n network cards.
- 40.** You purchased a mobile device that requires the use of a stylus to input information; it does not respond to the touch of a finger but sometimes works using your fingernail. However, using your fingernail isn't convenient. You purchased a stylus, but it doesn't work with the mobile device. What type of stylus does this device need?
- A.** Tempered
 - B.** Resistive
 - C.** Capacitive
 - D.** Object-oriented
- 41.** You have installed an 802.11ax WAP for a company. To cut costs, the company wanted only one central WAP in the building, which is about 400 feet long. Users at both ends of the building report intermittent connectivity drops and slow access. What is most likely the cause of the problem?
- A.** Low RF signal
 - B.** Oversaturated WAP
 - C.** SSID not found
 - D.** IP address conflicts
- 42.** A customer complains that although they installed a 10 Gb Ethernet card in their server and their cable supports 10 Gbps, the network connection is still running at 1 Gbps. What is most likely the problem?
- A.** Debris in the PCIe slot
 - B.** Faulty network cable
 - C.** Slower switch
 - D.** Slower PC

- 43.** You receive a call from the accounting department that their printer is printing something very strange, including unexpected characters and text that is missing. Which of the following are likely culprits? (Choose two.)
- A.** Loose or defective printer cable
 - B.** Overheating
 - C.** Wrong language keyboard
 - D.** Incorrect or corrupted printer driver
- 44.** You're having lunch with a friend. They are charging their phone, and you notice that their phone is swelling. What action should be taken first?
- A.** Nothing, it's fine.
 - B.** Disconnect the power, and then turn it off.
 - C.** Turn it off, and then remove the battery if possible.
 - D.** Replace the battery.
- 45.** You have a laptop that the user says won't charge since they dropped it on the floor while it was plugged in. It landed on the side where the charger connects. It was running fine until the battery ran out. What might be the most expedient solution?
- A.** Replace the motherboard.
 - B.** Replace the power connector.
 - C.** Solder the power jack back onto the motherboard.
 - D.** Solder the power cord to the motherboard.
- 46.** A user complains that their laptop charges only when they wiggle the connector and move it to a certain angle. What do you most likely need to do?
- A.** Solder the port back into place.
 - B.** Replace the port.
 - C.** Replace the charger.
 - D.** This can't be fixed.
- 47.** Lately your friend's phone hasn't been charging very well from a wall outlet. It charges very slowly, if at all. Once it's charged, it seems to work okay. But when they connect it to their laptop, the laptop doesn't recognize the phone. What will you try first to remedy the situation?
- A.** Check for debris in the charging port.
 - B.** Spray a port-cleaning solution into the phone.
 - C.** Replace the phone battery.
 - D.** Replace the charger block and cord.

- 48.** Your tablet is not charging properly. When you look inside the port, you can see corrosion on the connectors. What should you do?
- A.** Replace the tablet.
 - B.** Replace the port.
 - C.** Use lint-free swabs with a small amount of isopropyl alcohol to gently clean the connection.
 - D.** Use a toothbrush dampened with isopropyl alcohol to brush the connector clean.
- 49.** Your office's laser printer recently started producing images that aren't completely set. People are smudging the images as they pick up the completed print jobs. What is causing this problem?
- A.** Fusing assembly
 - B.** Exit rollers
 - C.** Drying assembly
 - D.** Charging corona
- 50.** Guests in your office lobby are complaining that their wireless connection is often dropped and seems to be very slow (i.e., has high latency). The company president wants the visitors to be happy, so they've asked you to take care of the situation. You analyze the wireless signal strength in the lobby and discover that it's very weak when compared to the rest of the building. What are the two best solutions? (Choose two.)
- A.** Install wired connections in the lobby for visitors.
 - B.** Install a WAP in the lobby.
 - C.** Buy a faster WAP.
 - D.** Install a wireless range extender.
- 51.** A technician is troubleshooting a computer that is unable to connect to a wired network connection. They verified that the cable is plugged in, but there are no lights lit on the network card. The computer could connect yesterday, and no other users have reported an issue. Which of the following are most likely to be causing this problem? (Choose two.)
- A.** Faulty network cable
 - B.** Faulty network card driver
 - C.** Incorrect TCP/IP configuration
 - D.** Cable unplugged at the other end
- 52.** You are troubleshooting a network connectivity issue in one area of a large building. The connections are wired. What should be the first action you take?
- A.** Ask the user if they can reach the Internet.
 - B.** Test the NIC.

- C. Test the cable.
 - D. Determine if more than one person is affected.
53. You have just installed a new HP LaserJet printer on your network. You've plugged it directly into a Cat 6a network cable. You try to install the printer on a client computer using the printer's IP address, but you are unable to connect. The printer is in the Ready state. What should you do next?
- A. Double-check the printer's IP configuration information.
 - B. Stop and restart the spooler service.
 - C. Take the printer offline, and then bring it back online.
 - D. Turn the printer off and back on to save the IP configuration information.
54. Your network has recently grown from 50 client computers to about 90. All workstations on the network are connected using Cat 6 or better cabling, and all network devices support at least 1 Gbps data transfers. Users have been reporting very slow network speeds since the expansion, and complaints are now coming more frequently. Which of the following actions is most likely to help resolve the issue?
- A. Add another hub to the network.
 - B. Upgrade all the cabling to Cat 8.
 - C. Upgrade the existing router to support 10 Gbps data transfers.
 - D. Add another switch to the network.
55. Your junior IT administrator has identified a port on your Cisco switch that changes between up and down repeatedly. What have they observed?
- A. Port flapping
 - B. Port toggling
 - C. Port flashing
 - D. Port flagging
56. Users have been complaining that a network resource has intermittent connectivity. You've identified the problem: the switch port is flapping. The connected device is not EEE-compliant, and users need it to be available. What should you do?
- A. Configure link-flap-prevention settings.
 - B. Replace the offending device.
 - C. Disable EEE on the switch.
 - D. Disable EEE on the device.
57. A user calls you about a printer not working. The user is standing next to the printer, and you are in the next building. How can the user be helpful to you while you're diagnosing the problem? Choose the best first action.
- A. Turn the printer off and on.
 - B. Read the printer error code.

- C. Remove the jammed paper.
 - D. Check the network link light.
58. A user calls to report that they can't access the Internet or a corporate server. However, they are still able to print to a printer nearby. They have not received any error messages. Other users in the area are also unable to access the Internet. Of the options given, which is most likely the problem?
- A. IP address conflict
 - B. Default gateway down
 - C. Incorrect subnet mask
 - D. Network card failure
59. A workstation is sending print jobs directly to a printer with a stapler as a finishing option. When they retrieve the print job, the document is not stapled. Which of the following could be the problem? (Choose three.)
- A. The stapler is empty.
 - B. The staples are in backward.
 - C. A different printer driver is needed.
 - D. The stapler is not enabled.
60. A message has appeared on the office copier/printer that says "Stapler Jam." Which of the following are true? (Choose three.)
- A. The jam must be cleared before anything else is printed.
 - B. Print jobs not involving the stapler may still occur.
 - C. The symptom can be caused by trying to staple too many pages.
 - D. The manufacturer's documentation should be consulted for procedures to follow.
61. You set your phone in a cubby on the dashboard of your car while you're driving. It's a cold winter day in upstate New York, so you have the car's heat on fully. When you get to your destination and grab your phone, you discover that it has shut down and won't turn on again. What do you need to do?
- A. Buy a new phone.
 - B. Heat the phone with a blow dryer.
 - C. Let the phone cool down before turning it on again.
 - D. Remove the battery and reinstall it.
62. The print tray in your multifunction device (MFD) is not being recognized. Which of these could be the problem? (Choose two.)
- A. The tray isn't fully inserted.
 - B. The printer isn't installed.

- C. There is a paper jam or other material in the way.
 - D. The printer is out of paper.
63. A user reports that the video on their desktop computer does not display properly. There are several places where the screen will not light up; those spots are always black dots. What is this a symptom of?
- A. Artifacts
 - B. Dead pixels
 - C. Backlight failure
 - D. Overheating
64. A user calls the help desk, stating that the icons on their computer screen are huge. They can see only about six of them and can't see the Start menu. What most likely caused this issue?
- A. Failing backlight
 - B. Incorrect video resolution
 - C. External interference, such as a fan or a motor
 - D. Incorrect video driver
65. You are troubleshooting a desktop computer and receive S.M.A.R.T. errors. To which component do these errors refer?
- A. SSD
 - B. RAM
 - C. CPU
 - D. Network card
66. You are troubleshooting a computer system that received a S.M.A.R.T. error. Which of the following will you do first?
- A. Check that the system has adequate cooling/ventilation.
 - B. Back up the system's data.
 - C. Run a drive diagnostic tool.
 - D. Run a RAM diagnostic tool.
67. You're troubleshooting a computer that isn't booting properly. When the computer is powered on, the power supply fan spins, but the computer will not POST. When you remove the cover, you notice a swollen capacitor, as shown in the center of the following figure. What should you do?



- A. Replace the power supply.
 - B. Replace the capacitor.
 - C. Replace the motherboard.
 - D. Discharge the capacitor.
68. You are troubleshooting a Lenovo laptop that has a track point in the center of the keyboard. If nobody is moving the external mouse or track point, the cursor will slowly drift up and to the right. You have tried a different external mouse and the problem still happens. What should you do to resolve the problem?
- A. Replace the laptop's keyboard.
 - B. Recenter the laptop's track point.
 - C. Recenter the laptop's touchpad.
 - D. Replace the laptop's motherboard.
69. The desktop computer you are troubleshooting will not retain the proper time and date. You set the time and date, power the system down, wait a few seconds, and then power it back on. Again, the settings are incorrect. Which component is likely causing the issue?
- A. CMOS battery
 - B. UEFI
 - C. Hard drive
 - D. RAM
70. Your friend's smartphone always has the wrong time. You tell them it's a simple fix. What should they do?
- A. Trade in the phone for a new one.
 - B. Go to Settings, select the System or General tab, look for Date and Time, and then choose Set Automatically or a similar setting, depending on the phone's OS.

- C. Replace the phone's battery.
 - D. Update the iOS to the latest version.
71. A technician is troubleshooting a RAID-5 array with four hard disks. One of the disks has failed. What can the technician do to recover the array?
- A. Replace the failed disk, and rebuild the array.
 - B. Replace the failed disk, and restore from backup.
 - C. Rebuild the failed disk, and restore from backup.
 - D. Remove the failed disk, and rebuild the array.
72. Your corporate finance team is getting ready for a presentation in the conference room in about an hour. They frantically call you because the image the projector is putting on the screen is fuzzy. Which of the following is the least likely cause?
- A. The projector's lens needs to be cleaned.
 - B. The projector focus needs to be adjusted.
 - C. The contrast setting is too high.
 - D. The PC's resolution is too high for the projector.
73. A user reports that regardless of what is showing on their LCD desktop display, they can always see an outline of another image that never changes. What is the solution to this problem?
- A. Replace the video card.
 - B. Degauss the display.
 - C. Replace the display.
 - D. Clean the screen.
74. A user claims that on their laptop, the mouse cursor will occasionally jump to a different screen area when they are typing. It is causing problems with their work because they end up typing in different fields than they need to. What can you suggest that will help this issue?
- A. Disable the track point.
 - B. Replace the keyboard.
 - C. Replace the motherboard.
 - D. Disable the touchpad.
75. A user is complaining that the mouse pointer drifts away on its own while they are working on their company laptop. They have changed the batteries, tried a new mouse pad, and cleaned the mouse's sensor. What should they try next to resolve the issue? (Choose two.)
- A. Remove and reinstall the mouse driver.
 - B. Get a new mouse.
 - C. Plug the mouse into a different USB port.
 - D. Disable the mouse in the control panel.

- 76.** A coworker comes to you for help with their iPhone. When they touch the screen, it acts as if they touched it somewhere else. They have already cleaned the touchscreen with a microfiber cloth. What will you do to help them?
- A.** Download a calibration app.
 - B.** Adjust the touch accommodations settings.
 - C.** Suggest they get the digitizer replaced.
 - D.** Suggest they get a new phone.
- 77.** Your RAID controller is beeping for three seconds and then off for one second continuously. What does this indicate? (Choose the best two options.)
- A.** In the process of installing a drive with the power off
 - B.** A normally functioning RAID array
 - C.** A problem with the RAID array
 - D.** Depends on the controller manufacturer
- 78.** Your Surface Pro tablet running Windows 11 is not responding properly to your touch gestures. What will you do?
- A.** Buy a new tablet.
 - B.** Use the built-in calibration software.
 - C.** Replace the digitizer.
 - D.** Replace the device.
- 79.** Your smartphone slipped into the ocean when you were taking pictures. You retrieved it after a minute or so, but it's wet. What do you do first?
- A.** Place it in a bag of rice.
 - B.** Use a hairdryer to dry it out.
 - C.** Nothing. It's fine.
 - D.** Immediately turn it off.
- 80.** A customer enters your shop with a smartphone that is acting strangely. Its sound is distorted, and there is static when they plug in their headphones. You look into the SIM card slot and see a red line. What will you tell the customer? (Choose two.)
- A.** This phone may have water damage.
 - B.** This phone has been exposed to high temperatures.
 - C.** There is no way to fix your phone.
 - D.** We can replace corroded components, but the fix may not last.
- 81.** A coworker is trying to print, but the paper isn't feeding into the printer. An error message displayed on the printer says, "Paper Mismatch." What do you tell them to do? (Choose three.)
- A.** Verify that the setting is correct in printer properties or tray properties, depending on the printer.
 - B.** Ensure that they've selected the right paper size in their software.

- C. Remove and replace the paper in the tray, and verify that the paper guides are properly placed.
 - D. Change the orientation in the software.
- 82.** You've recently doubled the number of employees in your call center. Users of your company's VoIP phones have been complaining that the calls sound like the person on the other end is stuttering, if they can understand them at all. What can you do to remedy this situation? (Choose two.)
- A. Add more RAM to each VoIP phone.
 - B. Set up a VLAN for the phones.
 - C. Configure QoS to prioritize phones.
 - D. Configure WoL.
- 83.** Laser printer users are complaining that their print jobs aren't printing. They're using an accounting package that won't let them reprint the reports they have printed. When you look at the print queue, you see their print jobs just sitting there. What will you do? (Choose two.)
- A. Ensure that the printer is turned on.
 - B. Ensure that there is paper in the printer.
 - C. Stop and restart the print server service.
 - D. Delete and reinstall the printer in the OS.
- 84.** A presenter using a projector is near the end of a lengthy presentation when an audible pop is heard, and the image goes dark. What will you do to fix the situation?
- A. Allow the projector to cool down for a while.
 - B. Unplug the projector, wait 30 seconds, and plug it back in.
 - C. Reset the lamp timer.
 - D. Replace the projector bulb.
- 85.** Your Wi-Fi network has very high latency. Which of the following will not improve this?
- A. Enable SSID broadcast.
 - B. Disable SSID broadcast.
 - C. Add switches to the network to divide traffic.
 - D. Scan and remove any network malware.
- 86.** Which of the following does not cause authentication failure on a network?
- A. Wrong username or password
 - B. Damaged router
 - C. Disabling the SSID broadcast
 - D. Outdated firmware/encryption protocols

- 87.** You have a NAS system and have observed alternating blinking red and white LEDs. What is happening?
- A.** The array is ready to receive data.
 - B.** The drives are booting up or shutting down.
 - C.** The RAID is synchronizing, or the software is updating.
 - D.** You're not sure, so you must check the vendor's documentation.
- 88.** Your home computer was working fine yesterday, but today you get an error stating "bootable device not found." Which of the following is most likely?
- A.** The hard drive has failed.
 - B.** The OS was deleted.
 - C.** The POST is faulty.
 - D.** A USB drive is in a USB port.
- 89.** Which two of the following are finishing processes that can cause problems with print jobs? (Choose two.)
- A.** Paper orientation
 - B.** Staple
 - C.** Hole punch
 - D.** Paper size
- 90.** Users on your network are complaining about the quality of their VoIP calls. They're experiencing calls where they only hear every other word. What is this a symptom of?
- A.** Jitter
 - B.** High bandwidth
 - C.** Packet loss
 - D.** Low latency
- 91.** A user is trying to print and hole-punch reports on the shared office printer/copier, but the documents print out without holes every time the print job is sent to the printer. Which of the following would be related to this problem? (Choose two.)
- A.** The hole-punch waste tray is full.
 - B.** The user didn't properly select hole punch.
 - C.** A document was left in the ADF.
 - D.** The hole-punch feature is not enabled.
- 92.** Which of the following is not a symptom of a projector bulb that is burning out?
- A.** Flickering projector image
 - B.** Dim image, even in a dark room with the projector brightness up
 - C.** Muddled (not crisp) colors being projected
 - D.** A fan running when you're done projecting

- 93.** You’re working on a server RAID array and observe that the drive is blinking first green, then amber, then off. What does this tell you?
- A.** The drive is preparing to be ejected.
 - B.** You’re not sure but should check the vendor documentation.
 - C.** The drive has failed.
 - D.** The drive is online and is working fine.
- 94.** You have a multitude of USB drives that you use for different storage purposes, but whenever you leave one in your PC, the computer tries to boot to the USB port instead of your Windows SSD and gives you an error message about “no boot device found.” What can you do to remedy this situation?
- A.** Enter BIOS/UEFI, and change the boot order so that USB is disabled or last.
 - B.** Put USB locks on all the USB ports.
 - C.** Install the OS on a USB.
 - D.** Install Linux.
- 95.** Your Wi-Fi network is experiencing some interference, which is causing poor performance and making it unstable. Which of the following might help? (Choose two.)
- A.** Enable SSID broadcast.
 - B.** Disable SSID broadcast.
 - C.** Lower the bandwidth.
 - D.** Choose a different channel.
- 96.** You’ve just built a new system with an SSD drive. It POSTs just fine, but it’s telling you that the hard drive is not found. What should you do first?
- A.** Replace the SSD with an HDD.
 - B.** Format the hard drive.
 - C.** Ensure that the hard drive’s data and power cables are plugged in.
 - D.** Install the OS.
- 97.** You are troubleshooting a Windows 10 computer that has crashed. It displays a blue screen with the error `UNEXPECTED_KERNEL_MODE_TRAP` on it. Which component most likely caused this problem?
- A.** RAM
 - B.** CPU
 - C.** SSD
 - D.** PSU

- 98.** Your computer has been intermittently rebooting when you play an online video game. You install a hardware monitoring utility and notice in the log that the CPU temperature spikes before the system shuts down. Which action should you take first to help resolve the issue?
- A.** Use the system BIOS to overclock the CPU.
 - B.** Replace the CPU and heat sink.
 - C.** Reseat the CPU heat sink.
 - D.** Replace the power supply.
- 99.** A user reports that their tablet computer will work on battery power for only about 20 minutes, even after the battery icon says it's full. They claim that it initially worked on battery power for several hours. What is the most likely cause of the problem?
- A.** The user is running too many apps.
 - B.** The user is constantly using the Wi-Fi connection.
 - C.** The battery needs to be charged longer.
 - D.** The battery is failing.
- 100.** A user complains that when they turn on their desktop computer, nothing appears on the screen. It sounds like the computer's fan is running, and the user reported hearing one beep when the computer powered on. What is the first thing you should check?
- A.** Is the display plugged into the video port?
 - B.** Did the computer complete the POST properly?
 - C.** Is there a power light illuminated on the display?
 - D.** Does another display work on this computer?
- 101.** The AC adapter for your laptop has a green LED indicator on it. When you plug the adapter into a wall outlet, the light does not illuminate. You've ensured that all power connections from the wall to the PC are physically connected. What could be the reasons for this? (Choose two.)
- A.** The laptop is off.
 - B.** The wall outlet is defective.
 - C.** The AC adapter is defective.
 - D.** The voltage selector for the AC adapter is set incorrectly.
- 102.** You're taking a walk around the exterior of your office building to survey the wireless network, when your Wi-Fi analyzer shows that your network is visible in the parking lot. You're concerned that an unauthorized person can connect to your wireless network. What should you do?
- A.** Enable SSID broadcast.
 - B.** Lower the WAP's power setting.
 - C.** Increase the WAP's power setting.
 - D.** Turn off the WAP's broadcast.

- 103.** You have a macOS desktop computer that does not produce an image on the screen when it boots. You hear a chime sound, and the normal indicator lights are on. The display is connected to the computer, and the power light is on. What should be your next troubleshooting step?
- A. Try the display on another computer or another display on this computer.
 - B. Replace the video card.
 - C. Switch the display to another video connector on the video card.
 - D. Replace the motherboard.
- 104.** The desktop computer you are troubleshooting will not boot. When you push the power button, no status light indicators come on, and you do not hear a fan. You verify that the outlet is working and try a power cord that you know works, but it doesn't help. Which component is most likely causing the problem?
- A. RAM
 - B. PSU
 - C. CPU
 - D. HDD
- 105.** While plugging in an older display with a VGA connector, a user bent some of the pins on the connector. You attempted to straighten them, but two of them broke off. If you use this display, what will most likely happen?
- A. It will work properly.
 - B. It will display incorrect colors.
 - C. It will display a distorted image.
 - D. It will produce dim or flickering images.
- 106.** You have a macOS computer that is beeping during startup. It beeps once every five seconds. What do you need to do?
- A. Reseat the RAM if the model allows it.
 - B. Replace the motherboard.
 - C. Replace the video card.
 - D. Nothing. It's updating firmware.
- 107.** You're troubleshooting a printing problem. The user selected to print in landscape mode in the software, but it comes out as a small box in the middle of a portrait-mode page. What can you do to attempt to fix this? (Choose two.)
- A. Tell the user to change their setting to portrait mode.
 - B. Verify that the printer is set to print in landscape mode.
 - C. Have the user select a different printer tray.
 - D. Take the paper out of the printer tray, and turn it 90 degrees.

- 108.** Your child has a new inkjet printer. They've been having fun printing all sorts of things, but today it's making a grinding noise and the printhead is not moving. What can you do quickly that might fix it? (Choose two.)
- A. Ensure that the cable moving the printhead moves freely.
 - B. Check for blockages and debris.
 - C. Replace the printer's ink ribbon.
 - D. Replace the printhead.
- 109.** Your company's advertising group is complaining that their printer is not printing the correct colors. Which of the following can you try to correct this problem? (Choose two.)
- A. Change the print orientation.
 - B. Dispose of generic print cartridges, and use those made by the manufacturer for this printer.
 - C. Reinstall the printer.
 - D. Change the printer settings to better quality, not faster speed.
- 110.** A laser printer you are servicing has been producing echo images. That is, regardless of whatever prints, you can always see a faint copy of a previous image that was printed. What can be causing this? (Choose two.)
- A. Dirty charging corona wire
 - B. Broken cleaning blade
 - C. Broken fusing assembly
 - D. Bad erasure lamps
- 111.** The desktop computer you are troubleshooting will not boot. When you push the power button, no status light indicators come on, and you do not hear a fan. You verify that the outlet is working and try a power cord that you know works, but it doesn't help. What two things will you do next? (Choose two.)
- A. Push the power button in for 10 seconds.
 - B. Check the I/O switch on the back of the PSU.
 - C. Check the 115/220 switch on the back of the PSU.
 - D. Reseat the motherboard's RAM.
- 112.** You just installed and configured a new WAP to provide better network connectivity in a remote part of the building. When you turn on your laptop to check the connectivity, there are only a couple of bars even though you're looking up at the WAP. What do you need to do?
- A. Increase the WAP's signal strength.
 - B. Broadcast its WAP's SSID.
 - C. Turn on the laptop's Wi-Fi.
 - D. Adjust the WAP's antennas.

- 113.** A user complains of a burning smell coming from their desktop computer. You instruct them to immediately shut down the system. What should be your next step?
- A. Replace the power supply.
 - B. Replace the motherboard.
 - C. Test the power supply with a multimeter.
 - D. Inspect the inside of the computer for visible signs of damage.
- 114.** You have a Xerox color laser printer that makes a grinding noise when printing. What is the first thing you'll try to fix the problem?
- A. Replace the toner cartridge.
 - B. Clean the printhead lenses.
 - C. Cycle the power.
 - D. Gently shake the toner cartridge.
- 115.** The company's advertising department has been printing documents for an upcoming seminar all day. They've called you because they noticed that the last few printouts have lighter images (echoes) of the print job displayed under the original one. What component will you clean or replace?
- A. The photosensitive drum
 - B. The corona wire
 - C. The fusing roller
 - D. The HVPS
- 116.** Users are printing to a laser printer, but nothing is coming out. When you look at the print queue, you see several jobs backed up. You try to restart them, but your mouse clicks aren't recognized. The printer is online, has paper, and says Ready. What should you do to resolve the problem?
- A. Turn the printer off and back on.
 - B. Stop and restart the print spooler.
 - C. Press the Reset button on the printer.
 - D. Use the printer's display to clear out the oldest job, take it offline, and put it back online.
- 117.** You are troubleshooting an inkjet printer. Users report that the printer is printing in the wrong colors. The problem just started happening recently. What could be causing it? (Choose two.)
- A. Incorrect paper
 - B. Leaking ink cartridges
 - C. Malfunctioning fusing assembly
 - D. Malfunctioning stepper motor

- 118.** Lately, print jobs have been pulling multiple sheets of paper from the tray instead of just one. You've verified that the paper is the correct weight and that the tray is properly adjusted, and you've fanned the paper's edges, but it still happens. What component will you likely need to replace in the printer?
- A. Fusing assembly
 - B. Paper tray
 - C. Pickup roller or separation pad
 - D. Printhead
- 119.** People are complaining that the output from the company's printer has little spots all over it, and it's been getting gradually worse. What will you do to correct this? (Choose two.)
- A. Replace the HVPS.
 - B. Ensure that the correct paper is being used.
 - C. Thoroughly clean the printer.
 - D. Blow debris out of the printer with canned air.
- 120.** A user is upset because their Android tablet does not ring whenever they receive a phone call. What is the first thing you should have them check?
- A. If the tablet is configured to receive voice calls
 - B. If the tablet is in Airplane mode
 - C. If the tablet is set to silent mode
 - D. If the tablet's speakers are working in another application
- 121.** A routine check of IOPS of your RAID array reveals that it has dropped significantly. What is the likely cause? (Choose two.)
- A. The HDDs were replaced by SSDs.
 - B. Usage patterns have changed.
 - C. The HDDs were replaced with M.2 drives.
 - D. A drive in the array has failed.
- 122.** A user complains that they can barely see the image on their smartphone. Everything seems to work fine, but they can't see it. What will you do first?
- A. Check the brightness settings.
 - B. Replace the display assembly.
 - C. Turn on location settings.
 - D. Replace the battery.
- 123.** The inkjet printer in your office is producing consistently faded prints. What should you do to resolve the problem?
- A. Replace the paper feed mechanism.
 - B. Turn up the color dithering.

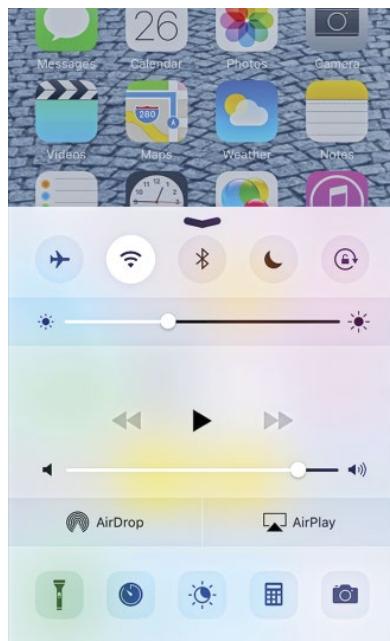
- C. Replace the ink cartridge.
 - D. Adjust the printhead to be closer to the paper.
- 124.** The day after an electrical thunderstorm, you are troubleshooting a computer. After you power it up, it flashes information briefly on the screen and then reboots. It continuously reboots itself after this. Which components are most likely to cause this problem? (Choose two.)
- A. Hard drive
 - B. Power supply
 - C. Motherboard
 - D. CPU
- 125.** Within the last five minutes, several users in one part of the building have called in to report that they have lost their network connection. The connection had been working earlier in the day. What is most likely the cause of the problem?
- A. Faulty network card drivers
 - B. Incorrect TCP/IP configuration
 - C. Bad network cable
 - D. Faulty switch
- 126.** A user reports that they cannot see their network shares or email, or even connect to the printer, but local applications are working fine. You ask what has changed since the last access, and the user mentions cleaning their desk. What is most likely the problem?
- A. The user might not have logged in.
 - B. The printer, email, and file server could be offline.
 - C. The network cable may not be connected.
 - D. The Group Policy was reconfigured.
- 127.** During a meeting, the manager mentions that the projector has been problematic since the start of the meeting. They tried running the projector from a few laptops with no success. Multiple popups were occurring, but it's unknown what the popup windows reported. What might be your next step?
- A. Open the log for information on failed jobs.
 - B. Check the light source for failure.
 - C. Verify that cables were attached.
 - D. Allow the projector to cool down, and try again.
- 128.** A user reports that the wireless Internet connection will randomly shut down in the afternoon. You check the Internet router by the window and find it still has power. What is the most likely cause of this problem?
- A. Network overloaded
 - B. Printer queue full

- C. Wireless router overheating
 - D. Workstation requires patching
- 129.** Your client is running a RAID-6 array with twelve 16 TB HDDs, for a total capacity of 192 TB. They are complaining that the array's average IOPS isn't enough to keep up with company demands. How might you reconfigure or change the array for your client to maintain capacity but increase performance? (Choose two.)
- A. Buy a single 192 TB HDD.
 - B. Reconfigure the array to be RAID-5.
 - C. Replace the HDDs with SSDs
 - D. Use six 32 TB HDDs instead of twelve 16 TB HDDs.
- 130.** A billing clerk just moved from their normal office out to a new office, which is separated from the loading dock by a cement block wall. The shipping clerk on the loading dock doesn't have a problem with wireless connectivity, but the billing clerk can't get reception in their new office. When they step out onto the loading dock, their laptop works just fine. Why are they losing connectivity in their office?
- A. They're too far from the WAP.
 - B. The cement walls block the signal.
 - C. The shipping clerk's PC interferes with the signal.
 - D. The billing clerk accidentally turned off their Wi-Fi.
- 131.** Your spouse just began working from home. They've decided that they like to work on the kitchen island, so they moved the router into the kitchen to get a better signal. Now the Wi-Fi connection gets dropped periodically no matter where they are in the home. What is going on?
- A. Your service provider is limiting the bandwidth.
 - B. The router is old and needs replacing.
 - C. The motors in the kitchen appliances are interfering with the Wi-Fi signal.
 - D. Your spouse needs a better laptop to work from home.
- 132.** You've moved to a new two-story townhouse and are trying to decide where to put your router. The townhouse is a rather open concept with the dining room near its center. Which of the following options would be best?
- A. On a stand in the corner of the dining room.
 - B. Next to the metal staircase, so there will be a good signal upstairs.
 - C. Hide it behind the sofa.
 - D. Set it on a sunny windowsill to reflect the signal back in.

133. Your friend dropped their iPad, and it landed on its corner, on a rock. Now the screen has three large cracks from the corner radiating outward. The icons are still visible, and the Home button works, but the screen only responds in some places to touch, and they cut their fingers on the broken screen. What will you tell them? (Choose two.)

- A. Recycle it and get a new one.
- B. If possible, back up the device.
- C. The digitizer and glass need replacing.
- D. The display assembly needs replacing.

134. A mobile phone user is unable to connect the phone to their wireless headset so they can make hands-free calls. Their iPhone screen is shown here. What is most likely the problem?



- A. Their wireless headset is turned off.
- B. Bluetooth is disabled.
- C. AirPlay is disabled.
- D. Airplane mode is enabled.

135. You're considering storage devices for a RAID array. Some drives are HDD, and some are SSD. You need to balance drive speeds and price. What will you use to compare the drive speeds?

- A. RPM
- B. IOPS

- C. Mbps
 - D. Gbps
- 136.** You're at your favorite coffee shop. You want to use its Wi-Fi, but your smartphone didn't automatically connect like it usually does. What do you suspect?
- A. The coffee shop's WAP is down.
 - B. Airplane mode is on.
 - C. The coffee shop's DNS server is down.
 - D. Your phone is damaged.
- 137.** You're in an office building and need to make a phone call, but when you look at your phone, you have half a bar. What should you do?
- A. Ask to join the company's Wi-Fi, and use it to make a call.
 - B. Move toward an outside wall.
 - C. Move closer to the elevator.
 - D. Go to a lower floor.
- 138.** You are troubleshooting a computer with a RAID-0 array using four disks. One of the disks fails. What can you do to recover the array?
- A. Rebuild the failed disk, and restore it from backup.
 - B. Replace the failed disk, and rebuild the array.
 - C. Replace the failed disk, and restore it from backup.
 - D. Remove the failed disk, and rebuild the array.
- 139.** A user is trying to display a presentation on a projector, but nothing appears on the external screen. It looks fine on their laptop screen. They try toggling their LCD cutoff switch, and it doesn't help. Another user had just presented on the projector, and it worked fine. Which component is most likely causing the problem?
- A. Video card
 - B. Display
 - C. Video port
 - D. Inverter
- 140.** The laser printer in your office is about eight years old. It seems to be printing slowly, and there are multiple jobs in the print queue. Recently, when you print, you occasionally get "Low Memory" error messages, and large print jobs sometimes won't print at all. What should you do to fix the problem?
- A. Stop and restart the print spooler.
 - B. Implement printing priorities for the most important users.
 - C. Upgrade the printer's memory.
 - D. Upgrade the printer's hard drive.

- 141.** You are troubleshooting a recently installed three-disk RAID array. The original technician left notes that they were concerned about creating multiple points of potential failure in the system. Which type of RAID array creates more points of potential failure than a single hard drive?
- A. RAID-10
 - B. RAID-1
 - C. RAID-0
 - D. RAID-5
- 142.** You've been working a while and decide to restart your Windows computer, but instead of booting into the OS, the screen flashes on and off several times and seems to restart. What is likely happening?
- A. The OS is performing updates.
 - B. The display is about to fail.
 - C. The hard drive is about to fail.
 - D. The display cable is loose.
- 143.** You are troubleshooting a laser printer that keeps producing vertical black lines running down the page. Which component is most likely causing this problem?
- A. Fusing assembly
 - B. Pickup rollers
 - C. Exit rollers
 - D. EP drum
- 144.** The display on your laptop seems to go off and on whenever you move it. What's happening?
- A. The video cable is loose.
 - B. The laptop is failing.
 - C. The battery is failing.
 - D. The motherboard is failing.
- 145.** Your employer has a heavily used conference room with a ceiling-mounted projector. The projector connects to users' laptops with an HDMI cable. Lately, users are complaining that no matter what computer is connected to the projector, the sound is muffled. What will you try first to fix it?
- A. Replace the lamp assembly.
 - B. Replace the HDMI cable.
 - C. Clean the speakers.
 - D. Clean the lens.

- 146.** A day-long training is taking place in your company’s conference room. The group took a break for lunch, and when they returned, the projector was off. The presenter has called you for help. What has most likely happened?
- A. The projector overheated.
 - B. The projector entered standby.
 - C. The power cable is loose.
 - D. The lamp has burned out.
- 147.** You have just upgraded the RAM in a desktop computer. After you power on the computer, no video appears on the screen, and the computer produces a series of three long beeps. What does this indicate?
- A. The system BIOS detected an error in the POST routine.
 - B. The system BIOS completed the POST routine normally.
 - C. The RAM is faulty.
 - D. The motherboard needs to be replaced.
- 148.** A user’s Android phone has been crashing, and they complain that their data usage has gone way up, although their phone habits haven’t changed. What will you suspect is the problem?
- A. Bad battery
 - B. Water damage
 - C. Malware
 - D. Loose data cable
- 149.** Your friend’s home theater projector is turning off unexpectedly. Which one of the following is not a possible cause?
- A. The power cable is loose.
 - B. The unit is overheating.
 - C. The filter needs cleaning.
 - D. The HDMI cable is loose.
- 150.** Over time, the hard drive performance of your computer has gotten slower. A quick check of Performance Monitor shows that your disk read/writes are taking more time as compared to the baseline. What should you do to resolve this issue?
- A. Format the hard drive, and restore the data.
 - B. Enable write caching on the drive.
 - C. Delete the partition, create a new one, and restore the data.
 - D. Run chkdsk.

- 151.** Your server's drive read/write times are a bottleneck in your system, and you're concerned about downtime in the event of a drive failure. Which of the following will improve performance and fault tolerance?
- A. Replace the HDD with an SSD.
 - B. Install RAID-0.
 - C. Install RAID-1.
 - D. Install RAID-6.
- 152.** A user complains of a loud whining noise coming from their computer. It occurs whenever the computer is on and is relatively constant. Which component is most likely to cause this problem?
- A. RAM
 - B. SSD
 - C. CPU
 - D. PSU
- 153.** You are troubleshooting a computer that will not boot properly. When you power it on, it produces a series of beeps. Which components are most likely to be causing this to happen? (Choose two.)
- A. BIOS
 - B. Hard drive
 - C. Network card
 - D. RAM
- 154.** You are working on a laptop that appears to be frozen. You press the Num Lock key several times, but the indicator light remains on. What should you do to try to resolve this issue?
- A. Push and hold the power button until the laptop turns off, and reboot.
 - B. Remove the battery and disconnect the laptop from an AC power source, and reboot.
 - C. Press and hold the Num Lock key until the light turns off.
 - D. Press Ctrl+Alt+Del to reboot the laptop.
- 155.** A user reports that their mobile phone is extremely hot and appears to be locked up. What should you instruct them to do?
- A. Plug the phone into a wall outlet or USB port to charge it.
 - B. Turn the phone off, and let it cool down.
 - C. Perform a factory reset of the phone.
 - D. Open the Power app, and set the phone to operate on the low-voltage setting.

- 156.** You have installed a PCIe RAID controller and want to create a RAID-5 array with three disks. You plug the disks in and boot up the computer. The RAID array is not detected. Where should you go to set up or troubleshoot the RAID array?
- A. Windows Device Manager
 - B. Windows Disk Management
 - C. The RAID controller's BIOS
 - D. System BIOS/UEFI
- 157.** The desktop computer in your office's lobby plays a welcome video for guests. Recently, the audio started intermittently failing. You replaced the speakers, and it still happens. What is the next step you should take in troubleshooting the issue?
- A. Replace the motherboard.
 - B. Reseat the speakers.
 - C. Replace the sound card.
 - D. Reseat the sound card.
- 158.** You have just used administrative privileges to install a printer on a user's workstation. When the user tries to print to the printer, they get an error message saying, "Access Denied." What is the cause of this problem?
- A. The printer is offline.
 - B. The printer is out of memory.
 - C. The print spooler needs to be restarted.
 - D. The user does not have the security permissions to print.
- 159.** The inkjet printer in your office jams often and produces many crinkled papers. What is the most likely cause of this? (Choose two.)
- A. Incorrect paper
 - B. Dirty printheads
 - C. Obstructed paper path
 - D. Paper that is too dry
- 160.** You are troubleshooting a laptop that has poor battery life. It will work for only about 30 minutes on a full charge. Which two things should you try first? (Choose two.)
- A. Replace the battery.
 - B. Perform battery calibration.
 - C. Drain the battery completely, and then charge it fully.
 - D. Open the Power Management app, and set the laptop to run on low-energy mode.

- 161.** You have sent several print jobs to a networked printer, yet nothing has printed. You do not have printer administrator access. What can you do to see if your Windows computer is communicating properly with the printer?
- A. Send the print job in RAW format.
 - B. Stop and restart the print spooler.
 - C. Print a test page.
 - D. Print a blank document from Notepad.
- 162.** A user reports that their two-year-old LCD display is unusually dim and flickering constantly. What is the easiest course of action to resolve this problem?
- A. Replace the video card.
 - B. Replace the display.
 - C. Remove external interference such as fans or motors.
 - D. Degauss the display.
- 163.** You are having problems printing to a networked printer from your Windows workstation. Several jobs were sent, but none printed. You just tried to print a test page, and nothing came out. What should you do?
- A. Check your connections, and stop and restart the print spooler service.
 - B. Turn the printer off and back on.
 - C. Use the printer's display to clear out the oldest job, take it offline, and put it back online.
 - D. Press the printer's Reset button.
- 164.** A user reports that none of the keys on their laptop keyboard seem to work. They have rebooted the computer, and the problem has not gone away. They need to finish an important paper before lunch. What should you do next?
- A. Replace the keyboard.
 - B. Check to ensure that the internal keyboard is still connected properly.
 - C. Connect an external keyboard using the USB port.
 - D. Clean under the keys of the keyboard with compressed air.
- 165.** At random times, your computer will completely lock up, requiring a hard reboot. Which two components are most likely to cause this type of problem? (Choose two.)
- A. CPU
 - B. RAM
 - C. PSU
 - D. GPU

- 166.** A user just replaced the toner cartridge in their laser printer. Now the printer only prints blank pages. What should you do to resolve the problem?
- A.** Stop and restart the print spooler.
 - B.** Reinstall the printer driver.
 - C.** Replace the toner cartridge with a new toner cartridge.
 - D.** Remove the toner cartridge, remove the sealing tape, and then reinstall the cartridge.
- 167.** A user reports that they are not able to install any apps on their mobile device. When you investigate, you notice that there is very little free space. What is the first solution to try?
- A.** Add more RAM.
 - B.** Remove old files or unused applications.
 - C.** Restore the device to factory settings.
 - D.** Replace the device.
- 168.** A user complains that sometimes their computer will not open files, applications crash, and it happens in different programs, not just one. Which component is most likely to cause this problem?
- A.** RAM
 - B.** CPU
 - C.** HDD/SSD
 - D.** Motherboard
- 169.** A user calls the help desk to complain that they're getting an error message stating, "SSID not found." Then you get a second call for the same reason. Both users were connected from the same locations the day before. What is most likely the problem?
- A.** Low RF signal
 - B.** Oversaturated WAP
 - C.** Disabled SSID broadcast
 - D.** Nonfunctioning WAP
- 170.** You have just installed a printer on a client computer. When you print to the printer, the output is completely garbled characters. What is the most likely cause of this problem?
- A.** The print spooler
 - B.** The printer's memory
 - C.** The printer driver
 - D.** The print queue

- 171.** A user’s laptop computer does not display anything on the screen, although the power light and other indicator lights are on. You plug in an external display, and after you toggle the LCD cutoff switch, an image appears on the external display. Which component is most likely causing the problem?
- A. Video driver
 - B. Backlight
 - C. Display
 - D. Video card
- 172.** You have an Android phone that’s running very slowly. The apps aren’t working as quickly as they used to, but you still have plenty of free memory. You have rebooted the phone several times, and it’s still slow. You tried running only one app at a time, and it’s still slow regardless of what app you’re running. You’ve run a malware-removal tool. What should you try next?
- A. Hold the Power button and the Home button simultaneously for 10 seconds, and the phone will reset.
 - B. Back up the phone, and then reset it to factory specifications.
 - C. Uninstall and reinstall all apps.
 - D. Get a new phone.
- 173.** You have installed an internal Redundant Array of Independent Disks (RAID) controller and configured a RAID-5 array on it with four physical drives. It has been operating normally. Today, when you boot up, you receive an error message saying, “Missing RAID array.” Which components are most likely causing this issue? (Choose two.)
- A. One of the four drives
 - B. The RAID controller
 - C. The system BIOS/UEFI
 - D. The onboard SATA controller

**COMPTIA A+
CORE 2 EXAM
220-1202**

**PART
II**



- Operating Systems
- Security
- Software Troubleshooting
- Operational Procedures
- Practice Exam 1 (220-1201)
- Practice Exam 2 (220-1202)

Chapter

6



Operating Systems

THE COMPTIA A+ 220-1202 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

- ✓ 1.1 Explain common operating system (OS) types and their purposes.
 - Workstation systems (OSs)
 - Windows
 - Linux
 - macOS
 - Chrome OS
 - Mobile OSs
 - iPadOS
 - iOS
 - Android
 - Various filesystem types
 - New Technology File System (NTFS)
 - Resilient File System (ReFS)
 - File Allocation Table 32 (FAT32)
 - Fourth extended filesystem (ext4)
 - Extended Filesystem (XFS)
 - Apple File System (APFS)
 - Extensible File Allocation Table (exFAT)
 - Vendor life-cycle limitations
 - End-of-life (EOL)
 - Update limitations
 - Compatibility concerns between operating systems



✓ **1.2 Given a scenario, perform OS installations and upgrades in a diverse environment.**

- **Boot Methods**

- **Universal Serial Bus (USB)**
- **Network**
- **Solid-state/flash drives**
- **Internet-based**
- **External/hot-swappable drive**
- **Internal hard drive (partition)**
- **Multiboot**

- **Types of installations**

- **Clean install**
- **Upgrade**
- **Image deployment**
- **Remote network installation**
- **Zero-touch deployment**
- **Recovery partition**
- **Repair installation**
- **Other considerations**
 - **Third-party drivers**

- **Partitioning**

- **GUID [globally unique identifier] Partition Table (GPT)**
- **Master boot record (MBR)**

- **Drive format**

- **Upgrade considerations**
- **Backup files and user preferences**
- **Application and driver support/backward compatibility**
- **Hardware compatibility**

- **Feature updates**

- **Product life cycle**



✓ **1.3 Compare and contrast basic features of Microsoft Windows editions.**

- **Windows 10 editions**
 - Home
 - Pro
 - Pro for Workstations
 - Enterprise
- **Windows 11 editions**
 - Home
 - Pro
 - Enterprise
- **N versions**
- **Feature differences**
 - Domain vs. workgroup
 - Desktop styles/user interface
 - Availability of Remote Desktop Protocol (RDP)
 - Random-access memory (RAM) support limitations
 - BitLocker
 - gpedit.msc
- **Upgrade paths**
 - In-place upgrade
 - Clean install
- **Hardware requirements**
 - Trusted Platform Module (TPM)
 - Unified Extensible Firmware Interface (UEFI)

✓ **1.4 Given a scenario, use Microsoft Windows operating system features and tools.**

- **Task Manager**
- **Services**
- **Startup**
- **Performance**



- **Processes**
- **Users**
- **Microsoft Management Console (MMC) snap-in**
 - **Event Viewer (eventvwr.msc)**
 - **Disk Management (diskmgmt.msc)**
 - **Task Scheduler (taskschd.msc)**
 - **Device Manager (devmgmt.msc)**
 - **Certificate Manager (certmgr.msc)**
 - **Local Users and Groups (lusrmgr.msc)**
 - **Performance Monitor (perfmon.msc)**
 - **Group Policy Editor (gpedit.msc)**
- **Additional tools**
 - **System Information (msinfo32.exe)**
 - **Resource Monitor (resmon.exe)**
 - **System Configuration (msconfig.exe)**
 - **Disk Cleanup (cleanmgr.exe)**
 - **Disk Defragment (dfsgui.exe)**
 - **Registry Editor (regedit.exe)**

✓ **1.5 Given a scenario, use the appropriate Microsoft command-line tools.**

- **Navigation**
 - **cd**
 - **dir**
- **Network**
 - **ipconfig**
 - **ping**
 - **netstat**
 - **nslookup**
 - **net use**
 - **tracert**
 - **pathping**



- **Disk management**
 - chkdsk
 - format
 - diskpart
- **File management**
 - md
 - rmdir
 - robocopy
- **Informational**
 - hostname
 - net user
 - winver
 - whoami
 - [command name] /?
- **OS management**
 - gpupdate
 - gprestart
 - sfc

✓ **1.6 Given a scenario, configure Microsoft Windows settings.**

- **Internet Options**
- **Devices and Printers**
- **Program and Features**
- **Network and Sharing Center**
- **System**
- **Windows Defender Firewall**
- **Mail**
- **Sound**
- **Device Manager**
- **Indexing Options**
- **Administrative Tools**
- **File Explorer Options**



- View hidden files
- Hide extensions
- General options
- View options
- Power Options
 - Hibernate
 - Power plans
 - Sleep/suspend
 - Standby
 - Choose what closing the lid does
 - Turn on fast startup
 - USB selective suspend
- Ease of Access
- Time and Language
- Update and Security
- Personalization
- Apps
- Privacy
- Devices
- Network and Internet
- Gaming
- Accounts

✓ **1.7 Given a scenario, configure Microsoft Windows networking features on a client/desktop.**

- Domain joined vs. workgroup
- Shared resources
- Printers
- File servers
- Mapped drives
- Local OS firewall settings
- Application restrictions and exceptions
- Configuration



- **Client network configuration**
 - **Internet Protocol (IP) addressing scheme**
 - **Domain Name System (DNS) settings**
 - **Subnet mask**
 - **Gateway**
 - **Static vs. dynamic**
- **Establish network connections**
 - **Virtual private network (VPN)**
 - **Wireless**
 - **Wired**
 - **Wireless wide area network (WWAN)/cellular network**
- **Proxy settings**
- **Public network vs. private network**
- **File Explorer navigation - network paths**
- **Metered connections and limitations**

✓ **1.8 Explain common features and tools of the macOS/desktop operating system.**

- **Installation and uninstallation of applications**
 - **File types**
 - **.dmg**
 - **.pkg**
 - **.app**
 - **App Store**
 - **Uninstallation process**
- **System folders**
 - **/Applications**
 - **/Users**
 - **/Library**
 - **/System**
 - **/Users/Library**



- **Apple ID and corporate restrictions**
- **Best practices**
 - Backups
 - Antivirus
 - Updates/patches
 - Rapid Security Response (RSR)
- **System Settings**
 - Displays
 - Networks
 - Printers
 - Scanners
 - Privacy
 - Accessibility
 - Time Machine
- **Features**
 - Multiple desktops
 - Mission Control
 - Keychain
 - Spotlight
 - iCloud
 - iMessage
 - FaceTime
 - Drive
 - Gestures
 - Finder
 - Dock
 - Continuity
- **Disk Utility**
- **FileVault**
- **Terminal**
- **Force Quit**



✓ **1.9 Identify common features and tools of the Linux client/desktop operating system.**

- **File management**

- **ls**
- **pwd**
- **mv**
- **cp**
- **rm**
- **chmod**
- **chown**
- **grep**
- **find**

- **Filesystem management**

- **fsck**
- **mount**

- **Administrative**

- **su**
- **sudo**

- **Package management**

- **apt**
- **dnf**

- **Network**

- **ip**
- **ping**
- **curl**
- **dig**
- **traceroute**

- **Informational**

- **man**
- **cat**
- **top**
- **ps**



- du
- df
- **Text editors**
 - nano
- **Common configuration files**
 - /etc/passwd
 - /etc/shadow
 - /etc/hosts
 - /etc/fstab
 - /etc/resolv.conf
- **OS components**
 - systemd
 - kernel
 - bootloader
- **Root account**

✓ **1.10 Given a scenario, install applications according to requirements.**

- **System requirements for applications**
 - 32-bit vs. 64-bit dependent application requirements
 - Dedicated vs integrated graphics card
 - Video random-access memory (VRAM) requirements
 - RAM requirements
 - Central processing unit (CPU) requirements
 - External hardware tokens
 - Storage requirements
 - Application to OS compatibility
- **Distribution methods**
 - Physical media vs. mountable ISO file
 - Downloadable package
 - Image deployment



- **Impact considerations for new applications**

- Device
- Network
- Operation
- Business

- ✓ **1.11 Given a scenario, install and configure cloud-based productivity tools.**

- Email systems
- Storage
- Sync/folder settings
- Collaboration tools
- Spreadsheets
- Videoconferencing
- Presentation tools
- Word processing tools
- Instant messaging
- Identity synchronization
- Licensing assignment

1. You want to transfer files from your computer to a remote server. To do this, you want to connect to a shared directory on the server and copy the files. Which command-line utility will allow you to do this?
 - A. netstat
 - B. net use
 - C. netshare
 - D. netdom
2. A technician is troubleshooting a computer that occasionally will not read data from the hard drive. What should they try first?
 - A. Run Defragment and Optimize Drives.
 - B. Run chkdsk /f at a command prompt.
 - C. Format the hard drive and reinstall the OS.
 - D. Replace the hard drive.
3. You have replaced a failed hard drive and need to prepare the new drive for data storage. Which of the following utilities will you use first?
 - A. format
 - B. chkdsk
 - C. diskpart
 - D. gpupdate
4. Which of the following file system types available in Windows Pro for Workstations will detect when data on a mirrored drive has been corrupted and will use a healthy copy of the data on other drives to attempt to correct corrupted data and protect data?
 - A. NTFS
 - B. ReFS
 - C. ext4
 - D. FAT32
5. You want to use BitLocker to encrypt the company president's laptop drive, but when you go into the Control Panel to find it, it isn't there. What Windows 10 edition does this computer have?
 - A. Home
 - B. Pro
 - C. Pro for Workstations
 - D. Enterprise

6. Which of the following Windows editions support ReFS? (Choose two.)
 - A. Home
 - B. Pro
 - C. Pro for Workstations
 - D. Enterprise
7. You just purchased a new computer that has four CPUs. What edition of Windows will you need, at a minimum, to take advantage of the computer's processing capability?
 - A. Home
 - B. Pro
 - C. Pro for Workstations
 - D. Enterprise
8. An employee wants to bring their Windows device to use at work. At work, they will need to log in to a domain. Which reason listed will prohibit the employee from using their device on the domain?
 - A. Their device has only one processor.
 - B. Their device OS is Windows Home.
 - C. Their device has only 8 GB of RAM.
 - D. Their device must be Windows Enterprise edition.
9. One of your technicians needs to use the Task Manager utility. What are two ways they can open Task Manager? (Choose two.)
 - A. Press Ctrl+Alt+Delete and then click Task Manager
 - B. Press Ctrl+Shift+T
 - C. Press Ctrl+Alt+T
 - D. Press Ctrl+Shift+Esc
10. You need to configure Internet connections on a Windows workstation. Which tabs of the Internet Options utility in the Control Panel would you use to set the Home page and enable the pop-up blocker?
 - A. Connections, Security
 - B. General, Security
 - C. General, Privacy
 - D. Connections, Privacy

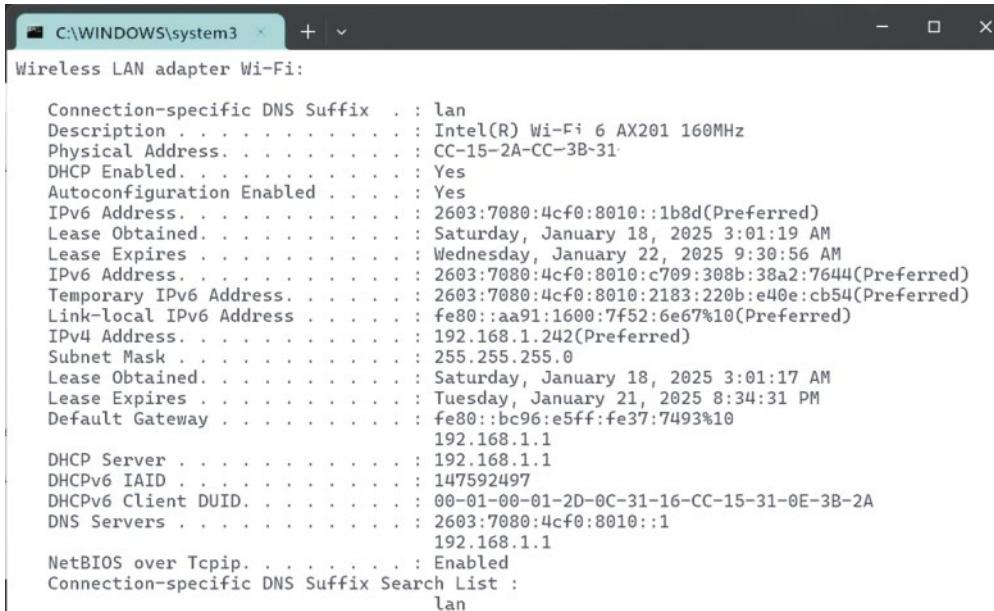
11. A network connection doesn't seem to be working as it should. You've verified that the cables are good from end to end. Where can you quickly look in the OS to see if there is a problem with the onboard NIC driver?
 - A. Device Manager
 - B. Programs and Features
 - C. File Explorer Options
 - D. Ease of Access
12. A salesperson in your company travels regularly to foreign countries through different time zones. They have asked you if there is a way to set their Windows 11 PC so that it will always show the time and date for their location. How can this be done?
 - A. In Windows Settings, choose Time & language, then choose Date And Time, and select Set Time Automatically.
 - B. In the Control Panel, choose Date and Time, and then select Set Time Zone Automatically.
 - C. In Windows Settings, choose Date And Time, and then select Synchronize Your Clock.
 - D. In Windows Settings, choose Time & language, then choose Date And Time, and select Set Time Zone Automatically and Set Time Automatically.
13. One of your Windows 10 users has limited eyesight and has asked you to enable voice activation for as many applications as possible. Where can this be done?
 - A. In the Control Panel, Default Programs
 - B. In Windows Settings, under Privacy, Notifications
 - C. In Windows Settings, under Privacy, Voice Activation
 - D. In the Control Panel, Indexing Options
14. You are working with a customer that has a small workgroup (peer-to-peer) network. The employee computers have a program that requires using the x drive. Several computer users need to be able to access this drive, which is actually a shared folder located on the manager's PC. What can you do to make this drive available for other computers to access as Drive x:\? (Choose two.)
 - A. On each client computer, open File Explorer, right-click on This PC (or the name of the PC), and then click Map Network Drive. Next to Drive:, choose x:, and then navigate to the shared resource.
 - B. On the manager's PC, navigate to the shared folder, and then right-click on it and choose Map Network Drive.
 - C. On the manager's PC, ensure that each user who will connect to the manager's PC has a user account.
 - D. On the client computer, create a folder called Drive x, and then, on the manager's PC, map drive X: to that folder.

- 15.** You are setting up a network for a very small company. It has a total of 10 computers running a mix of Windows 11 Home and Windows 11 Pro computers, and it has a network-attached printer. What will you use to allow the company to share files and its printer?
- A.** Domain
 - B.** Workgroup
 - C.** Homegroup
 - D.** Crossover cables
- 16.** A user's Windows workstation seems to be using an excessive amount of memory. Which management tool could you use to identify the application that is causing the problem?
- A.** Performance Monitor
 - B.** Computer Management
 - C.** Windows Memory Diagnostics
 - D.** Processes tab of Task Manager
- 17.** The CEO will be attending several meetings whose discussions must remain confidential. They want to ensure that the microphone on their Windows 11 PC is not available while they are using certain apps. Where can these settings be configured?
- A.** In Windows Settings, choose Privacy & Security and then Microphone.
 - B.** Device Manager
 - C.** Computer Management
 - D.** In Windows Settings, choose Personalization.
- 18.** You are manually configuring IPv4 addresses on a computer. The IP address is 200.100.1.10, and the network number is 200.100.0.0. What is the appropriate subnet mask for this computer?
- A.** 200.100.0.0
 - B.** 255.255.0.0
 - C.** 0.0.255.255
 - D.** 192.168.0.0
- 19.** You are configuring a Windows client computer on a network that has a DHCP server and a DNS server attached. From where will the computer get a dynamic IP address and subnet mask?
- A.** You will manually configure them in Windows Settings by choosing Personalization.
 - B.** You will manually configure them in Windows Settings by choosing Network & Internet.
 - C.** It will automatically get them from the DHCP server.
 - D.** It will automatically get them from the DNS server.

20. You have been told to configure a static IP of 110.110.1.5 for a server. This server will need to be able to access the Internet. Which of the following is not a required setting to configure?

- A. Default gateway
- B. IP address
- C. Proxy server
- D. Subnet mask

21. Considering the graphic, what is most likely the IP address of a router?



```
C:\WINDOWS\system32 + - □ ×
Wireless LAN adapter Wi-Fi:

Connection-specific DNS Suffix . : lan
Description . . . . . : Intel(R) Wi-Fi 6 AX201 160MHz
Physical Address. . . . . : CC-15-2A-CC-3B-31
DHCP Enabled. . . . . : Yes
Autoconfiguration Enabled . . . . . : Yes
IPv6 Address. . . . . : 2603:7080:4cf0:8010::1b8d(Preferred)
Lease Obtained. . . . . : Saturday, January 18, 2025 3:01:19 AM
Lease Expires . . . . . : Wednesday, January 22, 2025 9:30:56 AM
IPv6 Address. . . . . : 2603:7080:4cf0:8010:c709:308b:38a2:7644(Preferred)
Temporary IPv6 Address. . . . . : 2603:7080:4cf0:8010:2183:220b:e40e:cb54(Preferred)
Link-local IPv6 Address . . . . . : fe80::aa91:1600:7f52:6e67%10(Preferred)
IPv4 Address. . . . . : 192.168.1.242(Preferred)
Subnet Mask . . . . . : 255.255.255.0
Lease Obtained. . . . . : Saturday, January 18, 2025 3:01:17 AM
Lease Expires . . . . . : Tuesday, January 21, 2025 8:34:31 PM
Default Gateway . . . . . : fe80::bc96:e5ff:fe37:7493%10
                                         192.168.1.1
DHCP Server . . . . . : 192.168.1.1
DHCPv6 IAID . . . . . : 147592497
DHCPv6 Client DUID. . . . . : 00-01-00-01-2D-0C-31-16-CC-15-31-0E-3B-2A
DNS Servers . . . . . : 2603:7080:4cf0:8010::1
                                         192.168.1.1
NetBIOS over Tcpip. . . . . : Enabled
Connection-specific DNS Suffix Search List :
                                         lan
```

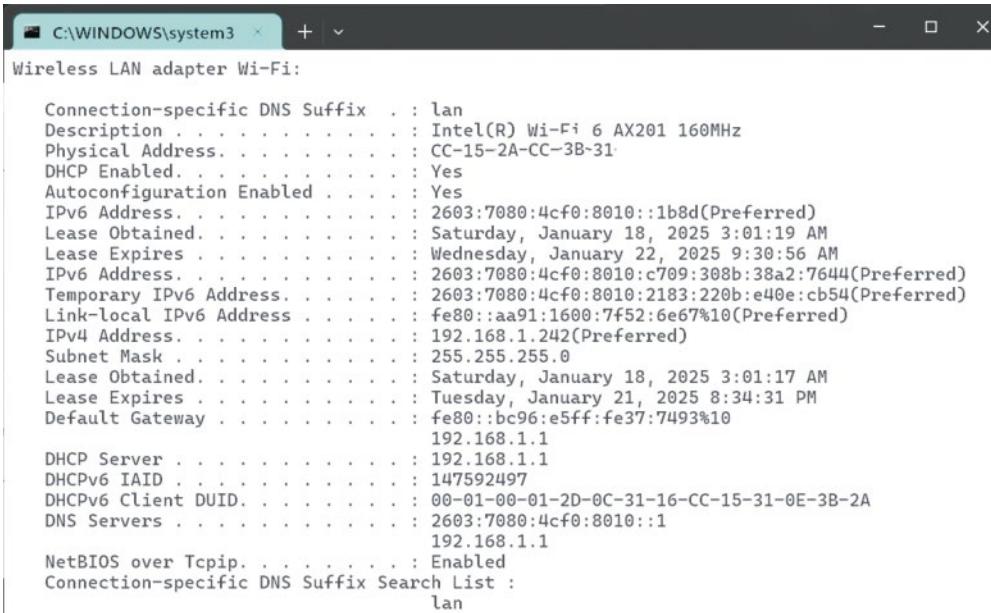
- A. 192.168.1.242
- B. 192.168.1.1
- C. CC-15-2A-CC-3B-31
- D. 255.255.255.0

22. What security feature, common to iOS and iPad OS 16.4.1 or greater and macOS 13.3.1 or greater, automatically provides security updates that are installed on startup before the OS is even active?

- A. Sandbox
- B. File Quarantine
- C. RSR
- D. Antivirus

- 23.** What is the purpose of a subnet mask?
- A.** Identifies the network portion of an IPv4 address
 - B.** Identifies the network portion of an IPv6 address
 - C.** Masks (hides) part of the IP address from a hacker
 - D.** Masks (hides) the host number from a hacker
- 24.** You've been asked to help with a network for a company that has 50 computers. The company has been using workgroups, but they are getting too difficult to manage. There are an assortment of Windows 11 editions on the computers, including Home, Pro, and Enterprise. What will you do to set up the new network? (Choose two.)
- A.** Upgrade all the Windows Home PCs to Windows Pro.
 - B.** Install a server with Active Directory.
 - C.** Downgrade all the Windows 11 Enterprise workstations to Windows 11 Pro.
 - D.** Upgrade all the workstations to Windows 11 Enterprise.
- 25.** You work for a multinational corporation. All the company laptops are configured to use United States English; however, a worker who speaks Bajan (Barbados English) would prefer to see apps and websites in their native language. Is this possible?
- A.** No, this is not possible.
 - B.** Yes. Add English (Barbados) in the Control Panel, Programs and Features utility.
 - C.** Yes. Add English (Barbados) in Windows Settings, Time & language, Language section.
 - D.** Yes. but it will require reinstalling the OS in Bajan.
- 26.** A Windows workstation has an application that appears to be locked up, but the keyboard is responsive in other applications. What system tool can you use to terminate the nonresponsive application?
- A.** Event Viewer
 - B.** Task Manager
 - C.** Computer Management
 - D.** msconfig.exe
- 27.** Which of the following Control Panel utilities enables configuration of a proxy server?
- A.** Internet Options
 - B.** File Explorer Options
 - C.** Device Manager
 - D.** Security and Maintenance

- 28.** Considering the following graphic, what do you know about the network configuration of this computer? (Choose two.)



```
C:\WINDOWS\system32 + 
Wireless LAN adapter Wi-Fi:

Connection-specific DNS Suffix . : lan
Description . . . . . : Intel(R) Wi-Fi 6 AX201 160MHz
Physical Address. . . . . : CC-15-2A-CC-3B-31
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                                         192.168.1.1
DHCP Server . . . . . : 192.168.1.1
DHCPv6 IAID . . . . . : 147592497
DHCPv6 Client DUID. . . . . : 00-01-00-01-2D-0C-31-16-CC-15-31-0E-3B-2A
DNS Servers . . . . . : 2603:7080:4cf0:8010::1
                                         192.168.1.1
NetBIOS over Tcpip. . . . . : Enabled
Connection-specific DNS Suffix Search List :
                                         lan
```

- A. The PC is configured to obtain an address dynamically.
 - B. This computer is getting its address from a DHCP server.
 - C. The IPv4 address is a routable address.
 - D. The internal network number is 192.168.1.0.
- 29.** Given the IP address of fe80::308c:fee2:2abc:8337, what do you know about this address? (Choose two.)
- A. It is an IPv4 address.
 - B. It is an IPv6 address.
 - C. The subnet mask is 0.
 - D. It is not routable.
- 30.** You see an IP address with /48 after it. What does the /48 tell you? (Choose two.)
- A. There are 48 PCs on this network.
 - B. The prefix length is 48 bits.
 - C. This network uses the IPv6 addressing scheme.
 - D. This network uses the IPv4 addressing scheme.

- 31.** Which of the following IPv6 address types are routable?
- A.** Global unicast
 - B.** Link-local
 - C.** Loopback
 - D.** Unique local
- 32.** You are on a Windows computer that is joined to a workgroup. You're going home and ready to shut your computer down but want to be certain that no one is using the shared files on the computer first. Where would you go to check?
- A.** Task Manager, Users tab
 - B.** Users and Groups
 - C.** Performance Monitor
 - D.** Control Panel, Networking
- 33.** You have a workstation with a 64-bit processor and no operating system. When you install an operating system on the workstation, which of the following is true?
- A.** You can only install a 64-bit operating system.
 - B.** You can only install a 32-bit operating system.
 - C.** You can install either a 64-bit or 32-bit operating system.
 - D.** You can install a 64-bit operating system or a 32-bit operating system running in compatibility mode.
- 34.** A customer has an older PC on which they would like to install Windows 11 Pro. What is the minimum processor speed they must have to install Windows 11?
- A.** 1 GHz, 32-bit
 - B.** 1 GHz, 64-bit
 - C.** 2 GHz
 - D.** 4 GHz
- 35.** Which of the following is not a Windows edition?
- A.** Home
 - B.** Enterprise
 - C.** Pro Artist
 - D.** Pro Workstation

- 36.** Which of the following Windows editions doesn't include media-related technologies?
- A.** Home
 - B.** Pro
 - C.** Enterprise
 - D.** Pro N
- 37.** You're troubleshooting a PC and want to see which ports TCP is connected on and the IP addresses of those connections. What command-line utility can you use to see statistics on network interfaces?
- A.** ping
 - B.** nbtstat
 - C.** nslookup
 - D.** netstat
- 38.** A new technician asked you how to use a Windows command. In the spirit of sharing knowledge with others, you show them how to get help on many commands instead of just one. Which one of the following does not work with any commands?
- A.** `help [command name]`
 - B.** `[command name] help`
 - C.** `[command name] /?`
 - D.** `/? [command name]`
- 39.** Which Windows utility allows you to view error messages generated by system events, applications, or login failures?
- A.** System Information
 - B.** Windows Defender
 - C.** Event Viewer
 - D.** Disk Management

40. You want to know how much RAM is in this system. Which of the following commands should you type in the search bar and launch to quickly bring up the window shown in the graphic?

The screenshot shows the Windows System Information window. The left pane has a tree view with nodes: System Summary, Hardware Resources, Components, and Software Environment. The right pane displays a table of system properties with columns 'Item' and 'Value'. Key memory-related entries include:

Item	Value
System SKU	ASUS-NotebookSKU
Processor	Intel(R) Core(TM) i7-6500U CPU @ 2.50GHz, 2592 Mhz, 2 C.
BIOS Version/Date	American Megatrends Inc. Q524UQ.301, 4/18/2019
SMBIOS Version	3.0
Embedded Controller V...	255.255
BIOS Mode	UEFI
BaseBoard Manufacturer	ASUSTeK COMPUTER INC.
BaseBoard Product	Q524UQ
BaseBoard Version	1.0
Platform Role	Mobile
Secure Boot State	On
PCR7 Configuration	Elevation Required to View
Windows Directory	C:\WINDOWS
System Directory	C:\WINDOWS\system32
Boot Device	\Device\HarddiskVolume1
Locale	United States
Hardware Abstraction L...	Version = "10.0.19041.1151"
User Name	HOT-CHOCOLATE\Audrey
Time Zone	Eastern Standard Time
Installed Physical Mem...	12.0 GB
Total Physical Memory	11.9 GB
Available Physical Mem...	1.79 GB
Total Virtual Memory	23.4 GB
Available Virtual Memory	3.36 GB
Page File Space	11.5 GB
Page File	C:\pagefile.sys
Kernel DMA Protection	Off
Virtualization-based se...	Not enabled
Device Encryption Supp...	Elevation Required to View

At the bottom, there is a 'Find what:' input field, a 'Find' button, a 'Close Find' button, and two checkboxes: 'Search selected category only' and 'Search category names only'.

- A. msinfo32.exe
B. resmon.exe
C. msconfig.exe
D. devmgmt.msc
41. In Windows 11, preconfigured power plans can be found in Settings, System, Power and Battery, and Power Mode. Which of the following isn't a default power mode?
- A. Best Power Efficiency
B. Balanced
C. Fast
D. Best Performance

- 42.** Your manager has a laptop running Windows. They want to configure the laptop so that when it is on battery power, the display shuts off after five minutes of inactivity. When the laptop is plugged in, the display needs to stay active for up to 45 minutes of inactivity. Which Control Panel utility is used to configure these settings?
- A. Power Options
 - B. Computer Management
 - C. Performance Monitor
 - D. System Configuration
- 43.** You need to work in the Command Prompt on a Windows PC. When you open the utility, you are at C:\window\system32. You need to work on the second partition, which is listed as D:. How do you navigate to the D: drive? Assume that you press **Enter** after the command.
- A. root D:
 - B. D:
 - C. cd D:
 - D. cd D:\
- 44.** Which Windows Editions support up to four CPU sockets? (Choose two.)
- A. Home
 - B. Pro
 - C. Pro for Workstations
 - D. Enterprise
- 45.** You have a workstation with a 32-bit processor and no operating system installed. When you install an operating system on the workstation, which of the following is true?
- A. You can only install a 32-bit operating system.
 - B. You can install a 64-bit operating system, but it will run in compatibility mode.
 - C. You can install either a 32-bit or 64-bit operating system, and either will run fine.
 - D. You can install a 64-bit operating system, but it will only run half as fast.
- 46.** You are reinstalling the Windows 10 Home 64-bit operating system on a friend's computer. What is the minimum storage space that must be available for the OS installation?
- A. 1 GHz
 - B. 2 GHz
 - C. 20 GB
 - D. 64 GB

- 47.** You are in the Windows Command Prompt, using Run as Administrator. There is a directory named `d:\files` that you want to delete. It currently has six subdirectories and dozens of files in it. Which command should you use to delete `d:\files`?
- A. `del d:\files /s`
 - B. `del d:\files /q`
 - C. `rmdir d:\files /s`
 - D. `rmdir d:\files /q`
- 48.** You've installed several identical new PCs and want to capture a baseline of their performance for future troubleshooting. What tool would be best suited for that purpose?
- A. Event Viewer
 - B. Performance Monitor
 - C. System Information
 - D. System Configuration
- 49.** A user has called the Help Desk saying that the Internet is down on their Windows computer. After asking a few questions, you want to examine their network configuration to determine the cause of their computer's connectivity problem. You've talked them through accessing the Windows Command Prompt. What command will you have them type so they can read the computer configuration to you?
- A. `ipconfig /all`
 - B. `ipconfig /renew`
 - C. `ip`
 - D. `tracert`
- 50.** A Windows 11 computer user that you support is having difficulty reading the words on the screen, because they have a visual impairment making distinguishing colors difficult for them. What can you change in Windows Settings to make their screen more readable?
- A. In Windows Settings, go to Personalization and then Fonts.
 - B. In Windows Settings, go to Personalization and then Background, and choose High Contrast Settings.
 - C. In Windows Settings, select System, then Display, and then Nightlight.
 - D. In Windows Settings, select Accessibility, and click on Contrast Themes to select a theme that will work better for them.
- 51.** You need to work at a command prompt on a Windows PC. When you open the utility, you are at `C:\window\system32`. You need to be at the root of the C drive for what you'll be doing. How do you get to `C:\`? Assume you would press **Enter** after the command.
- A. `cd c:`
 - B. `cd\`
 - C. `C:\`
 - D. `cd root`

- 52.** A laptop user has traveled to visit a client and forgot their power adapter. They are heading to lunch with the client and want to conserve their battery power but enable the fastest possible startup when they get back, with the applications already open. Which power mode will conserve battery life but enable the fastest startup?
- A. Shut down
 - B. Sleep/suspend
 - C. Hibernate
 - D. Resting
- 53.** Which of the following operating systems is open-source, allowing its users to customize it as they wish to suit their individual needs?
- A. Windows
 - B. Linux
 - C. macOS
 - D. Chrome OS
- 54.** What does Keychain provide for the user in macOS?
- A. Password management
 - B. Local file sharing
 - C. Certificate management
 - D. Screen protection
- 55.** You're installing Windows 11 on a workstation. Which of the following do not meet the minimum system requirements? (Choose two.)
- A. 20 GB storage
 - B. 2 GB RAM
 - C. UEFI
 - D. TPM 2.0
- 56.** Which Windows edition supports up to 2 TB of RAM?
- A. Home
 - B. Pro
 - C. Pro for Workstations
 - D. Enterprise

- 57.** You work at home with a computer that has Windows Home edition installed. You’re trying to run `gpedit.msc` to establish group policies on the computer that will limit what your children can do on it. For some reason, `gpedit.msc` won’t launch. What should you do?
- A.** Reboot the computer, and then run `gpedit.msc`.
 - B.** Upgrade to Windows Pro edition.
 - C.** Install Windows Active Directory.
 - D.** Launch it from the Administrative tools.
- 58.** You are on a Windows computer at the command prompt, on the C drive. You need to create a directory named `files` on the D: drive. What is the proper command and syntax to do this?
- A.** `cd d:\files`
 - B.** `cd files d:\`
 - C.** `md d:\files`
 - D.** `md files d:\`
- 59.** You will be installing several new resource-intensive applications on a Windows workstation, and the user has concerns over system performance. You want to monitor memory and CPU performance and set up the workstation so that it logs performance over time. Which utility should you use to set this up?
- A.** Resource Monitor
 - B.** Performance Monitor
 - C.** Task Viewer
 - D.** Event Viewer
- 60.** You don’t like the pictures that are on your desktop that automatically change from time to time. Where will you go in Windows Settings to change this setting?
- A.** Accounts
 - B.** Apps
 - C.** Personalization
 - D.** System
- 61.** What operating system developed by Google is used on tablets or laptops used mainly for online and Android applications?
- A.** Ubuntu
 - B.** iOS
 - C.** Windows 11 Pro
 - D.** Chrome OS

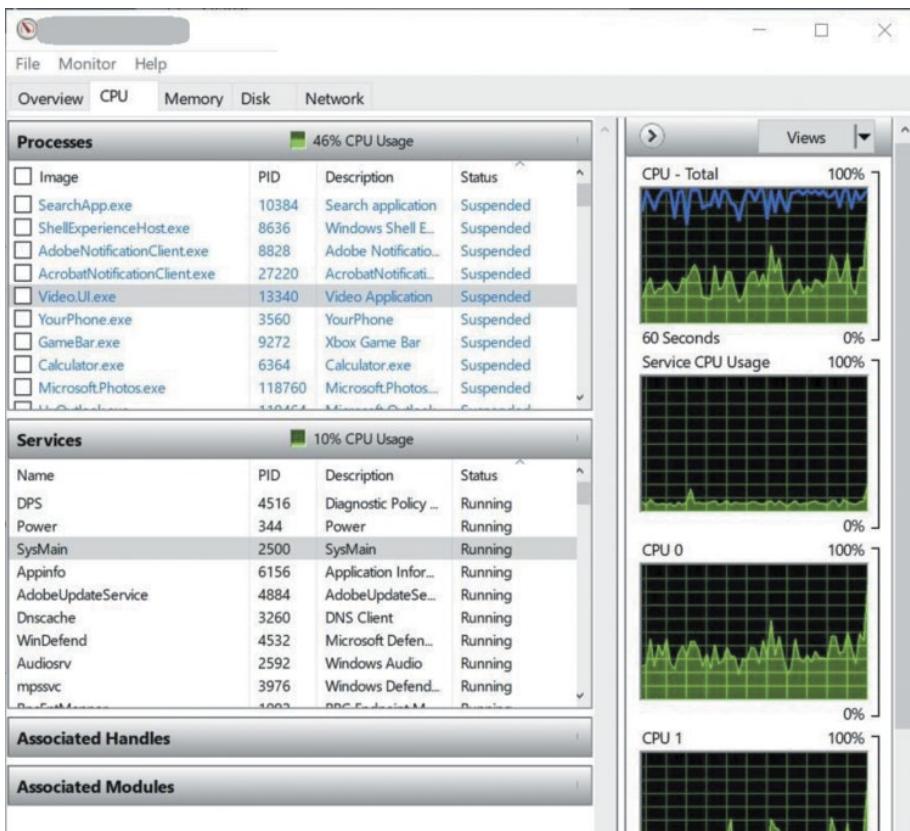
- 62.** On your laptop running macOS, what is the name of the utility used to browse through files and folders?
- A.** Spotlight
 - B.** Remote Disc
 - C.** iCloud
 - D.** Finder
- 63.** You're troubleshooting a network connectivity issue and want to see if the local computer can reach a particular server on the Web. What command do you use?
- A.** ping
 - B.** tracert
 - C.** ipconfig
 - D.** pathping
- 64.** Which command in a Linux environment is used to display the full path to the current directory?
- A.** ls
 - B.** pwd
 - C.** cp
 - D.** yum
- 65.** One of the users you support has a MacBook. They're finding that their desktop is too cluttered. What can they use to have quick access to what they want and help them organize their desktop?
- A.** Finder
 - B.** Time Machine
 - C.** Notes
 - D.** Multiple desktops

66. What is the name of the bar on the bottom of the screenshot shown in the graphic, where shortcuts to commonly used programs and utilities are kept in macOS?



- A. Taskbar
 - B. Dock
 - C. File Explorer
 - D. Finder
67. What Windows feature best describes Event Viewer (`eventvwr.msc`), Disk Management (`diskmgmt.msc`), and Certificate Manager (`certmgr.msc`)?
- A. Services
 - B. Processes
 - C. Policies
 - D. Snap-ins
68. Your laptop battery is getting older and won't hold a charge as long as it once did, so you want to ensure that when you walk away from it for a period of time and it isn't plugged in, it will not use any power but save everything and let you pick up where you left off working. What power state will work for this scenario?
- A. Always On
 - B. Sleep
 - C. Hibernate
 - D. Hyper-V

69. You are at a command prompt on a Windows PC, at C:\>, and you need to get to C:\Windows\system32. Which commands listed will get you there? Assume you press Enter after the line. (Choose two.)
- A. c:\windows cd system32
 - B. cd C:\windows\system32
 - C. cd windows\system32
 - D. cd system32 windows
70. Your system is running sluggishly, and you want to know why. Which application, as shown in the graphic, shows CPU usage by core and allows you to end problematic processes and stop running services?



- A. eventvwr.msc
- B. lusrmgr.msc
- C. perfmon.msc
- D. resmon.exe

- 71.** You have Windows 10 32-bit on a desktop computer that has a 32-bit processor. It seems to be working fine, but when you install more RAM, bringing the total up to 12 GB, the operating system doesn't recognize anything above 4 GB. What is the problem?
- A. You need to tell the BIOS that the extra RAM is there.
 - B. A 32-bit OS can support a maximum of 4 GB of RAM.
 - C. You need to go to Device Manager to add the RAM.
 - D. You need to replace the motherboard.
- 72.** You're at a friend's house when a manager at your company calls to say they are having a problem with their Windows Pro PC while working at home. You listen and tell them you can easily fix it using Remote Desktop to take over their computer for a minute or two. Which of the following would not be an option to use Remote Desktop from where you are?
- A. Use your friend's Windows Home PC.
 - B. Use your friend's Windows Pro PC.
 - C. Use Microsoft Remote Desktop on your iOS device.
 - D. Use Microsoft Remote Desktop on your Android device.
- 73.** You are at a Windows workstation and have the Command Prompt open. Which of the following commands is used to refresh Group Policy settings and force their changes to take effect?
- A. gredit
 - B. gpresult
 - C. grefresh
 - D. gpupdate
- 74.** You've been having trouble with network communications to one of your company's offices. You want to determine the source of latency on the connection. What command will you use in the Windows Command Prompt to see where the latency is?
- A. grep
 - B. pathping
 - C. tracert
 - D. mv
- 75.** Your spouse is trying to work at home but has started to complain about the constant notifications appearing on the computer and interrupting their work. What category can you access in Windows Settings to turn them off?
- A. System
 - B. Gaming
 - C. Update & Security
 - D. Apps

- 76.** Your grandparent just bought a computer with macOS Ventura on it. They can't find the Security & Privacy settings. What will you tell them? (Choose two.)
- A.** They can no longer change preferences.
 - B.** Preferences is renamed System Settings in Ventura and newer versions.
 - C.** Security & Privacy has been renamed Privacy & Security in Ventura and newer editions.
 - D.** Preferences has moved to the Dock.
- 77.** A macOS user is complaining that their MacBook has been acting strangely lately, and it's very slow to start. What utility will you use to repair any potential disk errors?
- A.** FileVault
 - B.** Terminal
 - C.** Disk Utility
 - D.** Force Quit
- 78.** You've created a batch file that needs to run every day before the employees arrive. What can you use to ensure that this batch file is run every weekday at 6 A.M.?
- A.** Task Scheduler
 - B.** Event Viewer
 - C.** Device Manager
 - D.** Local Users and Groups
- 79.** A smartphone user recently found their phone on the End-of-Support list when looking up the product life-cycle. They asked you what this means. Why will you recommend they purchase a new phone?
- A.** They can't download any more apps.
 - B.** Their phone will stop working by the date on the list.
 - C.** Their phone may not receive any more feature or security updates.
 - D.** Their phone will no longer connect to cellular service.
- 80.** You are on a Windows computer working at a command prompt, and you need to see a list of files in the directory in which you are working. What command will you type?
- A.** dir
 - B.** ls
 - C.** pwd
 - D.** grep

- 81.** A user with a Windows workstation recently received a second hard drive. Another administrator created a partition on the hard drive, and it's ready for use. The user will store the raw video files they create on that drive and insist that it be called the R: drive. Which of the following statements is true?
- A.** You can use Disk Management to change the drive letter to R:.
 - B.** You can use Disk Management to change the drive letter to R:, but only if it's a dynamic disk.
 - C.** You can use Disk Management to change the drive letter to R:, but only if it's in an extended partition.
 - D.** You will need to use Disk Management to delete the partition first and then re-create it as R:.
- 82.** A salesperson at your company travels with their macOS laptop every week. You want to encrypt the data on their startup disk to ensure data security. What macOS utility will you use?
- A.** Finder
 - B.** Time Machine
 - C.** FileVault
 - D.** BitLocker
- 83.** A user wants to perform a backup on their MacBook. Which software utility should be used to make backups?
- A.** Image Recovery
 - B.** Time Machine
 - C.** iBackup
 - D.** Accessibility
- 84.** One of your network users has a MacBook Pro. Where should this user go to see whether there are any OS updates available?
- A.** Software Updates in Settings
 - B.** In the App Store
 - C.** Click Updates on the dock
 - D.** Open Finder and click Updates on the menu bar

85. What command will bring up the screen shown in the following graphic?



- A. winver
- B. version
- C. osver
- D. build

86. Which of the following commands was used to display the screen snippet shown in the graphic?

The screenshot shows a Command Prompt window with the title 'Select Administrator: Command Prompt'. The window displays RSOP data for the user 'Audrey' on the computer 'HOT-CHOCOLATE'. The data includes OS configuration (Standalone Workstation, Version 10.0.19042), site and roaming profiles (N/A), local profile (C:\Users\Audrey), and network connection (No). It also shows user settings like group policy application time (11/28/2021 at 12:21:18 PM), domain information (Domain Name: HOT-CHOCOLATE, Domain Type: <Local Computer>), and applied GPOs (None). It notes that some GPOs were filtered out due to local policy filtering. Finally, it lists the security groups the user belongs to, including High Mandatory Level, Everyone, Administrators, Users, Interactive Logon, Authenticated Users, This Organization, and the user's email address (aoshea@live.com).

```
RSOP data for HOT-CHOCOLATE\Audrey on HOT-CHOCOLATE : Logging Mode

OS Configuration: Standalone Workstation
OS Version: 10.0.19042
Site Name: N/A
Roaming Profile: N/A
Local Profile: C:\Users\Audrey
Connected over a slow link?: No

USER SETTINGS

Last time Group Policy was applied: 11/28/2021 at 12:21:18 PM
Group Policy was applied from: N/A
Group Policy slow link threshold: 500 kbps
Domain Name: HOT-CHOCOLATE
Domain Type: <Local Computer>

Applied Group Policy Objects
-----
N/A

The following GPOs were not applied because they were filtered out
-----
Local Group Policy
Filtering: Not Applied (Empty)

The user is a part of the following security groups
-----
High Mandatory Level
Everyone
Local account and member of Administrators group
BUILTIN\Administrators
BUILTIN\Users
NT AUTHORITY\INTERACTIVE
CONSOLE LOGON
NT AUTHORITY\Authenticated Users
This Organization
aoshea@live.com
```

- A. gpedit
- B. gpreresult
- C. gprefresh
- D. gpupdate

- 87.** Which Linux command is used to copy files, groups of files, or whole directories from one place to another?
- A.** mv
 - B.** cp
 - C.** find
 - D.** cat
- 88.** Despite your great objections, someone you know is still running a Windows OS that predates Windows 10 and has reached its EOL. The software they regularly use on it still works, and they have an antivirus installed. Why should they update to a newer OS? (Choose two.)
- A.** They will not receive security updates.
 - B.** They will not receive feature updates.
 - C.** Their apps will stop working.
 - D.** Their OS will stop working at end-of-life.
- 89.** A smartphone user has come to you for help. They would like a laptop so they can use a bigger screen, but they don't know what to choose. They're accustomed to doing their work online with Google Docs and their smartphone and saving it to the cloud. They would like to be able to use some of the same apps that they have available on their Android phone. Cost is a factor. What type of laptop would you recommend for this user?
- A.** Windows Home
 - B.** Linux
 - C.** macOS
 - D.** Chromebook (Chrome OS)
- 90.** A user called the Help Desk because they were denied access to a secure server and received a message that they have an invalid certificate. Their computer was recently updated. Where can you go in Windows to manage their certificates?
- A.** Device Manager
 - B.** Local Users and Groups
 - C.** Certificate Manager
 - D.** Group Policy Editor
- 91.** Which desktop operating system is a proprietary product of Apple?
- A.** Apache
 - B.** Red Hat Linux
 - C.** macOS
 - D.** FreeBSD

- 92.** A user on your network complains that they are unable to type a human-friendly name like Sybex.com into their browser to reach a website, but typing in an IP address in the browser works. What client network configuration setting do you suspect is the problem?
- A.** Authentication Server
 - B.** DNS server
 - C.** DHCP server
 - D.** Proxy server
- 93.** You need to start a new shell on a Linux workstation, with `root` permissions. Which command should you use to do this?
- A.** `su`
 - B.** `sudo`
 - C.** `apt-get`
 - D.** `ps`
- 94.** A user wants to change the resolution on their MacBook. Which System Preferences pane would they use to do that?
- A.** Printers & Scanners
 - B.** Desktop & Screen Saver
 - C.** Accessibility
 - D.** Displays
- 95.** How do you get access to collaboration tools like spreadsheets, video conferencing, and presentation tools? (Choose three.)
- A.** When you log in to your account on Google or Microsoft 365
 - B.** When you install the software and purchase a license
 - C.** They come preinstalled on many devices.
 - D.** You must purchase each separately and then install it on your device.
- 96.** You are in the Command Prompt in Windows. You believe that some of the Windows system files are corrupt. Which command should you use to scan and repair problematic system files?
- A.** `sfc /scanfile`
 - B.** `sfc /scannow`
 - C.** `sfc /verifyfile`
 - D.** `sfc /verifyonly`

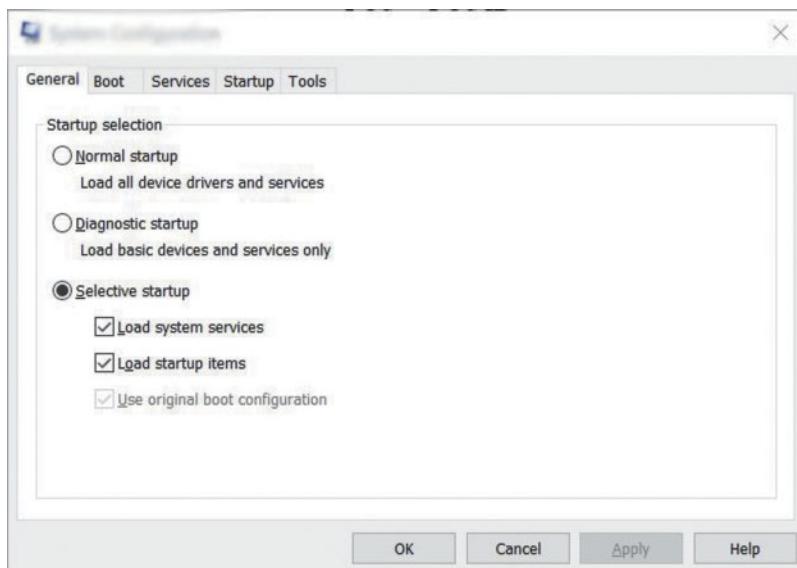
- 97.** You are at a command prompt in Windows. Which command enables you to copy files and directories, copy NTFS permissions, and mirror a directory tree?
- A. copy
 - B. xcopy
 - C. robocopy
 - D. copyall
- 98.** The HDD performance on your Windows workstation has deteriorated over time. To attempt to improve performance, you want to ensure that files on the drive are written in contiguous blocks. Which Windows tool should you use to make this happen?
- A. diskmgmt.msc
 - B. dfsgui.exe
 - C. perfmon.msc
 - D. devmgmt.msc
- 99.** Your client is taking over a business and wants to upgrade the computer systems, which are currently all legacy Windows machines. They will be using Microsoft 365 along with accounting and manufacturing software that is part of the business. They are concerned about compatibility of other files with their customers, vendors, and historical company data. What operating system would you recommend for their workstations?
- A. Chrome OS
 - B. Linux
 - C. macOS
 - D. Windows
- 100.** In macOS, where can the menus Displays, Printers, and Privacy be found, and settings changed?
- A. System Preferences
 - B. Accessibility
 - C. Settings
 - D. App Store
- 101.** Your friend has a Windows 10 PC and has never created a backup. You provide them with an external drive to use. What category will you choose in Windows Settings to turn on automatic backups for your friend every hour?
- A. System
 - B. Apps
 - C. Update & Security
 - D. Network & Internet

- 102.** Your company has a DHCP server to dynamically assign IP addresses to any nodes that connect to it. Which of the following would you want to assign a static IP address to? (Choose two.)
- A. Workstation
 - B. File server
 - C. Printer/MFD
 - D. Local printer
- 103.** You're installing an application that requires 4 GB of RAM on a Windows 11 Home workstation. The workstation has 4 GB of RAM. Will you need to make any configuration changes to the system to install this application?
- A. No, because the system already has 4 GB of RAM.
 - B. No, because the OS and the application won't be running at the same time.
 - C. Yes. You'll need at least 4 additional GB of RAM.
 - D. Yes. You'll need at least 2 additional GB of RAM.
- 104.** Which of the filesystem types offered is the best to use when running a Linux database server?
- A. FAT32
 - B. NTFS
 - C. XSF
 - D. ext4
- 105.** You are going to install Windows on a workstation from an image located across the network on a server. What does the workstation need to support to enable it to install Windows this way?
- A. Netboot
 - B. Unattended installation
 - C. PXE boot
 - D. USB boot
- 106.** You're in a secure environment where the workstations are not allowed to have USB ports or DVD drives. You've just received 10 new bare-metal workstations, with PXE support, that need to have Windows installed. How will you install the Windows OS on these 10 PCs?
- A. Optical Media
 - B. External drive
 - C. Internet-based
 - D. Network

- 107.** You need to run just one command as root. What will you use?
- A. su
 - B. sudo
 - C. apt
 - D. ps
- 108.** You're working in a school district in a computer lab full of Windows workstations, setting up an application that uses the computer's name to identify it on the application. What command can you use at a workstation to determine its name? (Choose two.)
- A. nslookup
 - B. clientname
 - C. hostname
 - D. ping localhost
- 109.** You're at a Windows workstation, troubleshooting a connectivity problem with a computer in another office on your campus-area network. You need to determine where packets between the two are being dropped. Which command will tell you the last router the packet traversed?
- A. ipconfig /all
 - B. ping
 - C. ip
 - D. tracert
- 110.** You're setting up a computer for a user with limited vision, who would like to have the contents of the screen read to them. What Control Panel utility will you use to accomplish this?
- A. Devices and Printers
 - B. Programs and Features
 - C. Ease of Access Center
 - D. Sound
- 111.** The Linux workstation you are using seems slow. You want to see what processes are running on the computer. Which command should you use?
- A. su
 - B. sudo
 - C. apt
 - D. ps

- 112.** Which of the following is not an advantage that the ext4 filesystem has over the ext3 filesystem?
- A. Supports larger volumes and files
 - B. Compatible with macOS and Windows
 - C. Unlimited number of subdirectories
 - D. Faster filesystem checks
- 113.** A user installed a new headset, but the audio is still playing through the speakers. Where can you go to change that configuration? (Choose two.)
- A. Control Panel, Security and Maintenance
 - B. The System window of Windows Settings, and then choose Sound
 - C. Control Panel, Sound
 - D. Windows Settings, Apps
- 114.** A user wants to know if it's possible to change what happens when they close the lid on their Windows 11 laptop. Currently, closing the lid does nothing, but they would like the laptop to hibernate when the lid is closed. Where can this setting be changed?
- A. Control Panel, Power Options utility
 - B. Control Panel, Devices and Printers utility
 - C. Windows Settings, System group, Power & Battery
 - D. Windows Settings, Devices group, Power options
- 115.** A friend wants to upgrade from Windows 8 to Windows 11. What will you tell them? (Choose two.)
- A. There isn't a direct upgrade.
 - B. Sure! It's free and easy to upgrade.
 - C. They must install 8.1 first and then 11.
 - D. Their hardware probably won't work, but they can check system requirements.
- 116.** You need to uninstall an app that is on your Linux computer. What command will you use?
- A. su
 - B. sudo
 - C. apt-remove
 - D. ps
- 117.** You want to upgrade all the computers in your SOHO from Window 11 Home to Windows 11 Pro so your computers can join a domain. You don't want to lose user information and settings in the process. Which type of installation will you perform?
- A. Clean installation
 - B. In-place upgrade
 - C. Program-only upgrade
 - D. Multiboot

- 118.** You're having trouble with a new digitizing pad that the operating system doesn't seem to be recognizing. Which tool would you use to troubleshoot the problem?
- A. Event Viewer
 - B. Performance Monitor
 - C. Device Manager
 - D. Disk Management
- 119.** You suspect that one of your running services is causing problems with the operating system. What is the tool, shown in the graphic, that lets you choose a diagnostic startup on the next restart?



- A. Event Viewer
 - B. Performance Monitor
 - C. System Information
 - D. System Configuration
- 120.** You need to check the integrity of key Windows system files on the C: drive, which are hidden from view by default. Which Control Panel utility can you use to view hidden files?
- A. Programs and Features
 - B. File Explorer Options
 - C. Indexing Options
 - D. System

- 121.** What is the name of the macOS command-line user interface?
- A.** Terminal
 - B.** Finder
 - C.** Command Prompt
 - D.** File Explorer
- 122.** You’re setting up an online storage system for backing up your data, but the remote storage company said that you need to open your software firewall to allow the online storage solution to communicate with your computer. Where in the Windows Control Panel can you do this?
- A.** Programs and Features
 - B.** Internet Options
 - C.** Windows Defender Firewall
 - D.** Network and Sharing Center
- 123.** You’re troubleshooting a file problem and need to see the file extensions, but they are not visible. Which Control Panel utility can you use to show hidden file extensions?
- A.** Programs and Features
 - B.** File Explorer Options
 - C.** Indexing Options
 - D.** File Explorer
- 124.** You need to make some changes to group membership for an employee who was just promoted. Which of the following will you type in the Run dialog box?
- A.** eventvwr.msc
 - B.** lusrmgr.msc
 - C.** perfmon.msc
 - D.** groups.exe
- 125.** You are working on a Linux file server. Which command would you use to see the amount of free disk space on a volume?
- A.** grep
 - B.** df
 - C.** ps
 - D.** dig

- 126.** You are working on a Windows 11 workstation and want to change the Account Lockout policy. You are working at a command prompt. Which of the following commands can you enter to open a graphical utility that enables you to change all local policy settings?
- A. gpedit
 - B. gprestart
 - C. grefresh
 - D. gpupdate
- 127.** You're setting up security for a company that is expanding rapidly. Part of your plan is to create groups to manage permissions to folders and then add users to those groups to grant them the permissions they need. What utility will enable you to add users to groups?
- A. Device Manager
 - B. Local Users and Groups
 - C. Certificate Manager
 - D. Group Policy Editor
- 128.** One of your users has a MacBook Air, and an application appears to have crashed. What can they use to compel the app to close?
- A. Task Manager
 - B. Force Quit
 - C. Terminal
 - D. Time Machine
- 129.** You would like to monitor CPU, memory, and Wi-Fi usage in real time on a Windows computer. Which of the following options will provide you with that information? (Choose two.)
- A. The Task Manager Performance tab
 - B. In Administrative Tools, choose System Information.
 - C. Event Viewer
 - D. Resource Monitor
- 130.** You are on a Linux computer working in Terminal and need to see a list of files in the directory that you are working in. What command will you type?
- A. dir
 - B. ls
 - C. pwd
 - D. grep

131. What Linux utility is like the Windows Command Prompt?

- A. Time Machine
- B. Mission Control
- C. Terminal
- D. Shell

132. A system has been doing some quirky things, and you think it might have something to do with a temporary file. A best practice to avoid malware is to remove files and programs that aren't being used. Which tool, shown in the graphic, will you use to delete temporary and unused files from a computer system?



- A. resmon.exe
- B. diskmgmt.msc
- C. regedit.exe
- D. cleanmgr.exe

- 133.** You’re using the Event Viewer tool to see a list of failed login attempts. What command will you launch to access it?
- A. eventvwr.msc
 - B. lusrmgr.msc
 - C. perfmon.msc
 - D. groups.exe
- 134.** You have recently deployed a custom application to several Windows workstations on your network. The application appears to have a bug, and the developer suggests you edit the Registry to fix it. Which administrative tool would you use to do this?
- A. msinfo32.exe
 - B. compmgmt.msc
 - C. regedit.exe
 - D. notepad.exe
- 135.** A couple of applications that run at startup are causing problems with a computer. Where can you change settings, so those programs won’t automatically start when the computer does?
- A. Task Manager, Services tab
 - B. Task Manager, Startup apps
 - C. Services Console
 - D. Task Scheduler
- 136.** You are working on a computer with macOS, with about a dozen applications open. Which feature allows you to easily see all of them and switch to your desired application?
- A. Spotlight
 - B. Keychain
 - C. Mission Control
 - D. Finder
- 137.** You have a Windows 11 Pro computer with multiple printers installed. Which Control Panel utility allows you to manage multiple print servers and printers from a single interface?
- A. Devices and Printers
 - B. Programs and Features
 - C. Network and Sharing Center
 - D. Device Manager

- 138.** Which power state will close applications and files, log off users like a full shutdown would, save the kernel state and system session to a hibernation file before shutdown, and then, when the computer restarts, quickly restore that file, saving some time involved in a normal boot?
- A. Hibernate
 - B. Sleep
 - C. Selective Suspend
 - D. Fast Startup
- 139.** You’re troubleshooting a Windows computer that is unable to resolve domain names to IP addresses. What command-line utility can help identify what DNS server the computer relies on?
- A. nslookup
 - B. netstat
 - C. ping
 - D. tracert
- 140.** A user recently left the company, and you need to change ownership of their files on the Linux server to a new user. Which command should you use to do this?
- A. chown
 - B. chmod
 - C. cat
 - D. cp
- 141.** You need to configure a VPN for an employee working remotely on a Windows Pro computer. What category group in Windows Settings provides options for establishing dial-up or VPN connections?
- A. Network and Sharing Center
 - B. Network & Internet
 - C. System
 - D. Accounts
- 142.** You’re installing Windows 11 on a computer that uses BIOS, not UEFI, and has only one storage drive. You’ll be booting from this drive. Which of the following are true? (Choose two.)
- A. The partition scheme must be MBR.
 - B. The partition scheme must be GPT.
 - C. The partition must be less than 2 TB.
 - D. You won’t be able to boot from this drive.

- 143.** A print queue has stalled, so you’re going to stop and restart the Print Spooler service. Where can you do this?
- A. Device Manager
 - B. Task Manager, Services
 - C. Disk Management, Services
 - D. Task Scheduler
- 144.** A user types their username and password into a workstation, which is a member of a domain instead of a workgroup. What examines their information and determines whether they are allowed access to network resources?
- A. Local operating system
 - B. File server
 - C. AAA server
 - D. DHCP server
- 145.** Your spouse takes gaming seriously and has complained that restart notifications sometimes pop up on the screen at crucial moments, disrupting their game. What settings group can you use to stop restart notifications from appearing and stop unnecessary programs from running in the background?
- A. System
 - B. Gaming
 - C. Windows Update
 - D. Apps
- 146.** What type of operating system is found on an Apple iPhone?
- A. iPhone OS
 - B. iOS
 - C. Android
 - D. Windows for iPhone
- 147.** You want to find and download a new application to use for network monitoring on your MacBook. Where can you do this in macOS?
- A. Finder
 - B. App Store
 - C. Mission Control
 - D. FileVault

- 148.** You work as the IT manager of a telephone call center. Your company just purchased 100 computers in anticipation of a large wave of hiring, and you need to configure them all with the OS, applications, and settings that your company uses. What type of installation will you do?
- A. Upgrade
 - B. Recovery partition
 - C. Repair installation
 - D. Image deployment
- 149.** A MacBook user has a program that they no longer use. What are their options for removing it from their computer? (Choose two.)
- A. Use Finder and then Applications to locate the app, and then right-click and choose Delete.
 - B. Use Finder and then Applications to locate the app's folder, and then drag the app to Trash, or on your keyboard press Command+Delete.
 - C. Use Launchpad, hold the Option key until the apps wiggle, then click the X next to the app to delete it, and then click Applications to find the app and drag the app from the Applications folder to Trash.
 - D. Click on Apple and then Uninstall, and then choose the app.
- 150.** You're on a Linux system and need to change a user's access to a file. Which command will you use to do this?
- A. chown
 - B. chmod
 - C. cat
 - D. cp
- 151.** You just got a new MacBook for a child, but they said the text on the screen is too hard to read. What system preference would you use to help them?
- A. Accessibility options
 - B. Displays
 - C. Privacy
 - D. Time Machine
- 152.** An application on a user's Windows Pro workstation has become corrupted. Where can you go in the Control Panel to attempt to repair, or reinstall, the application?
- A. Devices and Printers
 - B. Programs and Features
 - C. Network and Sharing Center
 - D. Device Manager

- 153.** A Wi-Fi user at your company said that their MacBook isn't connecting to the network. What option will you choose from Preferences in the Apple menu to turn Wi-Fi on and select Automatically Join This Network?
- A. Ethernet
 - B. Wi-Fi
 - C. Network
 - D. Accessibility
- 154.** You are at a Linux workstation and need to search for text within several files. Which command should you use?
- A. sudo
 - B. grep
 - C. cp
 - D. ls
- 155.** You need to install Windows on a new machine. Which of the following is not an installation option?
- A. USB
 - B. Network
 - C. External drive
 - D. CD
- 156.** Which of the following is not a best practice for hardening your macOS against attack?
- A. Use Time Machine to back up your Mac.
 - B. Use BitLocker to encrypt your drive.
 - C. Install updates and patches as soon as they are available.
 - D. Turn on the firewall in the System Settings, Network, and then click to enable the Firewall.
- 157.** Which of the following file types is a drive image that can be mounted in macOS and treated like a drive?
- A. .pkg
 - B. .bat
 - C. .dmg
 - D. .app
- 158.** Your company's graphics department just purchased a new printer, and now you need to install it. What System Preference pane can you use to install new printers in macOS?
- A. Printers
 - B. Printers & Scanners
 - C. Devices
 - D. Sharing

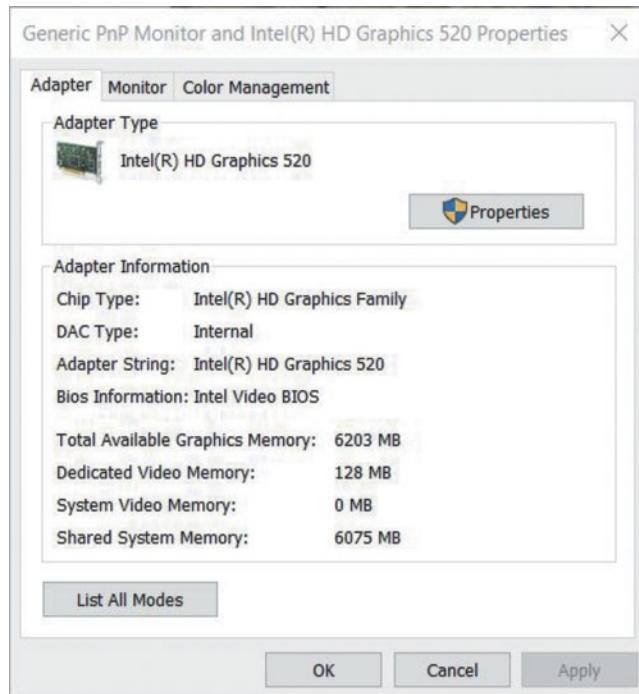
- 159.** You’re setting up a new PC with Windows 11 and using a GPT partition scheme for the boot partition. Which of the following are true? (Choose two.)
- A. Your system must have UEFI.
 - B. You can only have four partitions.
 - C. Your partition size is realistically unlimited.
 - D. You won’t be able to boot from this drive.
- 160.** Your friend just bought a new iPad. What type of operating system will it have?
- A. iPhone OS
 - B. iOS
 - C. iPadOS
 - D. Android
- 161.** You would like to see the contents of a file named `bogus.txt`. What command do you use to view the file’s contents?
- A. `chown`
 - B. `chmod`
 - C. `cat`
 - D. `cp`
- 162.** You’ve noticed that a USB device consistently won’t work after a time of inactivity. When you move it to another USB port, it works, but after a time that port stops working too. What can you do to resolve this problem? (Choose two.)
- A. Enable USB selective suspend.
 - B. Disable USB selective suspend.
 - C. Replace the device.
 - D. Replace the motherboard.
- 163.** Your company just purchased five new MacBook computers for employee use. You will be providing tech support for them. What filesystem will they have?
- A. ReFS
 - B. APFS
 - C. ext4
 - D. NTFS
- 164.** Your friend decided to buy a used Microsoft Duo 2 folding phone. What operating system will likely be on their new phone?
- A. iPadOS
 - B. iOS
 - C. Android
 - D. Windows

- 165.** On a Mac using macOS 10.6 or later, what is the best way to protect the system against viruses and other malware, given the following choices? (Choose two.)
- A. Install an antivirus from a vendor you trust.
 - B. Ensure that the system's data files and security updates are set to run automatically.
 - C. Only install software from the App Store or reliable sources.
 - D. Use Finder to find and delete viruses and malware.
- 166.** A user calls your hotline saying that they can't get directions and Siri can't give them the weather. What System Preferences pane do they need to use to remedy the situation?
- A. Privacy
 - B. Mission Control
 - C. Accessibility
 - D. Networks
- 167.** A salesperson will be working remotely, and you need to set up a virtual private network (VPN) for them. What Control Panel utility will you use to do this?
- A. Devices and Printers
 - B. Programs and Features
 - C. Network and Sharing Center
 - D. User Accounts
- 168.** A user brought you their laptop that wouldn't boot into the OS. After trying some troubleshooting techniques, you inform them that you will need to reinstall their operating system. After ensuring that they have a backup of their files, you restart the computer and press F10, and the OS installation begins. What type of installation are you doing?
- A. Upgrade
 - B. Recovery partition
 - C. Repair installation
 - D. Image deployment
- 169.** A second person is going to be using the Windows computer at your desk when you're not there. What would you choose in Windows Settings to create their user account?
- A. Accounts
 - B. User Accounts
 - C. Personalization
 - D. System

- 170.** You’re working in the Linux Terminal and need to locate a file. Which command lets you locate and perform actions on a file?
- A. find
 - B. ps
 - C. man
 - D. nano
- 171.** A user wants to install an application that requires a 2 GHz processor on a Windows 11 installation. What is the minimum speed processor that their computer must have?
- A. 1 GHz
 - B. 2 GHz
 - C. 3 GHz
 - D. 4 GHz
- 172.** Which of the filesystems listed is compatible with more operating systems than the others?
- A. FAT32
 - B. exFAT
 - C. NTFS
 - D. ext4
- 173.** Which of the following operating systems can be found on a smartphone? (Choose two.)
- A. iOS
 - B. macOS
 - C. Android
 - D. Windows 11
- 174.** Before you upgrade your Windows 10 OS to Windows 11, you want to create a backup of your Windows 10 system configuration so you can restore it if something goes wrong. What should you create?
- A. Restore point
 - B. System restore
 - C. Windows backup
 - D. Shadow copy

- 175.** A friend has a game that they love to play on their macOS desktop computer, and they want to place it on the Windows laptop with which they travel. What will you tell them?
- A.** Sure, it's no problem to install it.
 - B.** They can only install it if both are 64-bit systems.
 - C.** They can install macOS software on a Windows machine, but not Windows software on a Mac.
 - D.** They will need to find a Windows-compatible version of the software to install it on their Windows laptop.
- 176.** You're looking at the specifications for a new computer and notice that it says, "Graphics type: Intel Arc, Integrated." What is true about this graphics card? (Choose two.)
- A.** The GPU is on an expansion card.
 - B.** The GPU is located on the processor.
 - C.** It uses part of the system's RAM.
 - D.** It has its own VRAM.
- 177.** You want to uninstall an app on a Windows computer. Where will you go in Windows Settings to uninstall it?
- A.** System
 - B.** Apps
 - C.** Update & Security
 - D.** Gaming
- 178.** You just built your first computer from components. What type of operating system install will you perform?
- A.** Upgrade installation
 - B.** Recovery partition
 - C.** Clean installation
 - D.** Image deployment
- 179.** You need to be able to boot into two different operating systems on the same hardware, and it doesn't support using a VM. What other option can you use?
- A.** Clean installation
 - B.** In-place upgrade
 - C.** Network installation
 - D.** Multiboot

- 180.** You’re buying a new graphics-intensive program that says it must have a GPU with 256 MB of dedicated VRAM. Your existing graphics adapter’s properties are shown in the graphic. What is your best option?



- A.** Purchase a new graphics card that meets the requirements.
B. Replace the CPU with one that has an integrated GPU.
C. Add VRAM to your graphics card.
D. Add RAM to your system.
- 181.** You’re working in the Linux Terminal and aren’t sure how to use the ps command. Which of the following will show you detailed information about the command?
- A.** find ps
B. ps man
C. man ps
D. nano ps

- 182.** You're moving your Windows 10 computer to Windows 11. What type of installation are you doing?
- A. Upgrade installation
 - B. Recovery partition
 - C. Clean installation
 - D. Image deployment
- 183.** You're considering upgrading your Windows 10 PC to Windows 11. Which of the following does not need to be done before upgrading?
- A. Backups of user files and preferences
 - B. Operating system refresh
 - C. Check application and driver compatibility
 - D. Check hardware compatibility
- 184.** You're purchasing software that says it uses 32-bit processing. Your computer has a 64-bit processor. Can you use this software on your computer?
- A. Yes, a 32-bit software program can run on a 64-bit processor.
 - B. No, a 32-bit software program must have a 32-bit processor.
 - C. Yes, if you replace the processor with a 32-bit one.
 - D. Yes, it will just need more RAM.
- 185.** Which of the following commands, when entered into a Linux Terminal, will open a text editor?
- A. find
 - B. ps
 - C. man
 - D. nano
- 186.** You would like to know the IP address of a website. What Linux tool will you use?
- A. chown
 - B. dig
 - C. top
 - D. ip
- 187.** Which of the following is not true regarding managed Apple IDs?
- A. They are created by a company for its employees.
 - B. They can't make purchases.
 - C. An IT administrator can remove or update your account.
 - D. You can reset your own password.

- 188.** Which of the following are methods of booting an OS? (Choose two.)
- A.** Solid-state/flash drives
 - B.** Internal drives
 - C.** In-place upgrade
 - D.** Formatting
- 189.** Which of the following filesystems is optimized for flash drives?
- A.** FAT32
 - B.** NTFS
 - C.** ext4
 - D.** exFAT
- 190.** You are working on a Linux workstation. A file named `docs` needs to be renamed to `newdocs`. What is the right command to execute this?
- A.** `ren docs newdocs`
 - B.** `mv docs newdocs`
 - C.** `cp docs newdocs`
 - D.** `rm docs newdocs`
- 191.** Which method of booting a computer requires having a PXE and a bootable image on the Internet?
- A.** Solid-state/flash drives
 - B.** Internal drives
 - C.** Internet-based
 - D.** Network-based
- 192.** You have the Control Panel open and want to quickly check how much RAM is installed in the system and what processor it has. Which Control Panel utility will you use to view this information?
- A.** System utility
 - B.** Device Manager
 - C.** Devices and Printers
 - D.** Programs and Features
- 193.** You downloaded a new application that you want to install on your Windows PC and noticed that it has only one file, and that file has an `.iso` extension. Which of the following is true regarding this file?
- A.** Double-click it and let it run to install the application.
 - B.** Right-click the file and choose Mount. Windows will then see and treat the file as a disk in an optical drive.
 - C.** You will need a third-party utility to open this file.
 - D.** Right-click and choose Extract to install the software.

- 194.** You're considering installing new software for monitoring network traffic. You know that it will generate additional network traffic of its own. Which of the following should be considered before purchasing the software? (Choose three.)
- A. Impact on the network
 - B. Impact on operations
 - C. Impact on the software company
 - D. Impact on the business
- 195.** An application that you're installing requires 20 GB of space plus storage for data files of 400 GB. What is the absolute minimum size your hard drive must be if you're running Windows 10 64-bit, which requires 20 GB of storage?
- A. 20 GB
 - B. 400 GB
 - C. 420 GB
 - D. 440 GB
- 196.** You're working at a Linux command prompt (i.e., you're in the Linux Terminal) and need to delete a file called `oldstuff.txt`. Which of the following commands will work?
- A. `rm oldstuff.txt`
 - B. `del oldstuff.txt`
 - C. `er oldstuff.txt`
 - D. `rd oldstuff.txt`
- 197.** Which of the following is a file that can be extracted, or opened, with an installer app to install an application?
- A. `.pkg`
 - B. `.bat`
 - C. `.dmg`
 - D. `.app`
- 198.** Which of the following is not an advantage of a downloadable software distribution over using physical media to distribute software?
- A. It's always current.
 - B. It costs the distributor less.
 - C. It works on a system without a DVD drive.
 - D. It works on all bare-metal systems.

- 199.** You’re working on a Windows computer that is having some trouble booting. After trying System File Checker (SFC) and other troubleshooting techniques, you decide that you need to reinstall the operating system files. What type of installation will you be doing?
- A. Upgrade
 - B. Repair
 - C. Clean
 - D. Remote
- 200.** You need to quickly view the network configuration on a Linux computer. What command do you use?
- A. ipconfig
 - B. ipconfig /all
 - C. ip
 - D. cfg
- 201.** You purchased a Windows laptop and notice that it immediately resumes when you open the lid. What allows it to do that?
- A. Hibernate
 - B. Idle mode
 - C. Standby
 - D. Auto Off
- 202.** You’re at a command prompt in Windows and need to quickly add a user named student. What command will you use?
- A. net user student * /add
 - B. net use /add student *
 - C. net user student *
 - D. user /add student
- 203.** What shortcut keys open the Quick Link menu, on which you can quickly access many of the technician tools used in Windows operating systems?
- A. Press Windows Logo Key+D key.
 - B. Press Windows Logo Key+L key.
 - C. Press Windows Logo Key+I key.
 - D. Press Windows Logo Key+X key.

204. A friend just installed Windows on their bare-metal machine. They called you because everything works except their network. What do they most likely need to do?

- A. Reinstall the operating system.
- B. Install third-party drivers.
- C. Remove and reinstall the network card.
- D. Replace the faulty network card.

205. What Linux command is used to display the partial dynamic table shown in the graphic?

top - 16:10:38 up 3:06, 1 user, load average: 0.12, 0.06, 0.02										
tasks: 202 total, 1 running, 201 sleeping, 0 stopped, 0 zombie										
%CPU(s): 0.3 us, 0.2 sy, 0.0 ni, 99.5 id, 0.0 wa, 0.0 hi, 0.0 si, 0.0 s										
MiB Mem: 3831.9 total, 1797.2 free, 783.4 used, 1251.3 buff/cache										
MiB Swap: 2048.0 total, 2048.0 free, 0.0 used, 2696.4 avail Mem										
PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+
3545	audrey	20	0	20492	3364	3364	R	0.7	0.1	0:02.49
914	audrey	20	0	761080	47404	23116	S	0.3	1.2	0:26.34
1	root	20	0	167732	11748	8505	S	0.0	0.3	0:02.77
2	root	20	0	0	0	0	S	0.0	0.0	0:00:00
3	root	0	-20	0	0	0	I	0.0	0.0	0:00:00

- A. chown
- B. dig
- C. top
- D. ip

206. A Mac user has accidentally deleted an app and wants to reinstall it. They believe that the file to install the software again is still on their computer. What file extensions will you be looking for? (Choose two.)

- A. .pkg
- B. .bat
- C. .dmg
- D. .app

207. What feature, known more for mobile devices than desktops, is available for the desktop macOS by using a trackpad or Magic Mouse?

- A. SDK
- B. Power options
- C. Gestures
- D. Emergency notifications

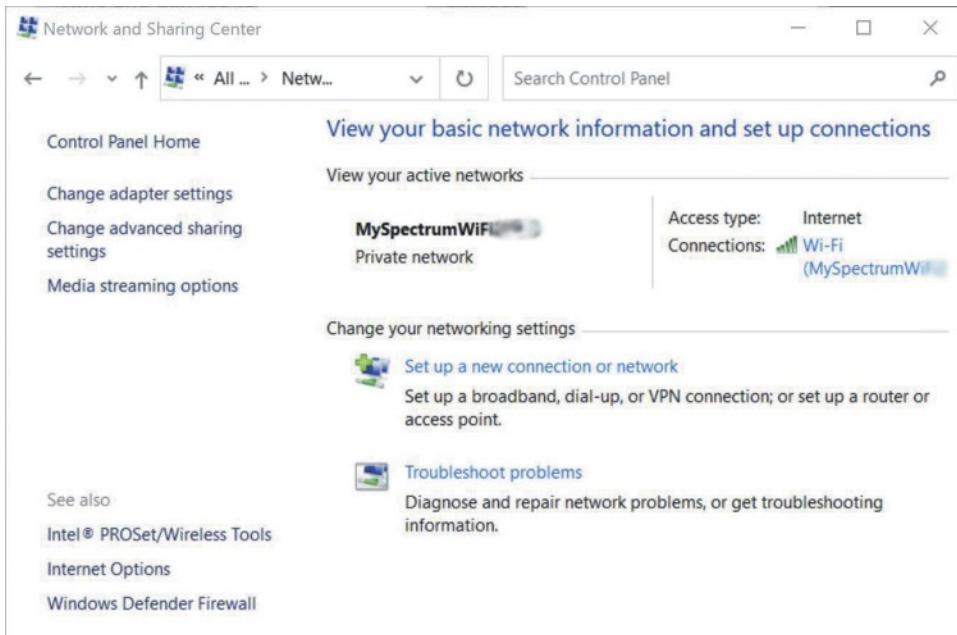
- 208.** You have a workgroup with all Windows Home PCs. One of the computers is sharing a folder with two users who don't have an account on this PC. What Control Panel utility do you use to add the users and their passwords to this computer?
- A. Administrative Tools
 - B. User Accounts
 - C. Local Users and Groups
 - D. Mail
- 209.** Your company has employees working in a remote location. A new employee has been hired to work there. You send them a desktop computer that doesn't have an OS on it. When it arrives, the employee plugs it in and turns it on. It then uses PXE to install the company's desktop image from the corporate server. Finally, an administrator logs in remotely using RDP and configures the computer. What has just happened?
- A. Unattended installation
 - B. Zero-touch installation
 - C. Internet-based installation
 - D. Remote network installation
- 210.** On your PC, it seems that searching through files has gotten slower and slower. What utility will organize data so searches run faster?
- A. Control Panel, choose the Indexing Options utility
 - B. Windows Settings, choose the System group
 - C. Windows Settings, choose the Apps group
 - D. Control Panel, choose the Default Programs utility
- 211.** You are on a Domain Controller and need to share a folder of data files for some users and not others. Where do you configure access to the folder? (Choose two.)
- A. On the Domain Controller
 - B. In Windows Active Directory
 - C. Configure sharing on individual workstations.
 - D. Run a batch file to copy the files to each user computer that needs access.
- 212.** Your company has employees working in a remote location, and a new employee has been hired to work there. The company's PC supplier sends a computer to the new hire and the computer's serial number and other information to you. The supplier has preconfigured the computer to install software and connect to your network when the computer is turned on. You then use MDM to finish the configuration automatically. What has just happened?
- A. Unattended installation
 - B. Zero-touch installation
 - C. Internet-based installation
 - D. Remote network installation

- 213.** You’re installing Windows 11 Enterprise in a bare-metal system. What is the maximum amount of RAM you can put into this system?
- A. 128 GB
 - B. 2 TB
 - C. 6 TB
 - D. 256 TB
- 214.** You are creating a network for a small office with Windows Pro computers. They do not want centralized security, but they want it to be easy to share printers and files, including libraries. What type of network setup should you recommend?
- A. Workgroup
 - B. Homegroup
 - C. Personal Area Network
 - D. Domain
- 215.** Your accounting department uses an application requiring them to insert a fob into a USB port on the computer before they can use the application, to ensure that they have a valid license to use it. What are they using?
- A. A remote certificate
 - B. An external software token
 - C. An external hardware token
 - D. A biometric device
- 216.** Which of the following is not a best practice for updating/patching a Linux distribution?
- A. Keep installed software updates current.
 - B. Verify that installed packages have a valid signature.
 - C. Update packages quarterly.
 - D. Download packages only from trusted sources.
- 217.** Your company’s sales department wants to install a new customer management system, but they first need your approval. Which of the following impacts do you and the company need to consider when deciding whether to install this software? (Choose three.)
- A. Device
 - B. Network
 - C. Installation time
 - D. Business

- 218.** You’re configuring a new user’s computer so that their Microsoft Outlook mail will automatically be downloaded onto their Windows computer. What pieces of information will you need to set up their profile? (Choose two.)
- A. The protocol the server uses
 - B. The user’s email address
 - C. The user’s password
 - D. The server port number
- 219.** You have a MacBook Pro and want to share files with a small group of Mac users. Because your team edits the files frequently, you want to make sure everyone has access to the same version of the files online. What storage solution should you use?
- A. iCloud
 - B. Finder
 - C. Remote Disc
 - D. Spotlight
- 220.** Which of the following is not a best practice for backing up Linux (or any) desktop systems?
- A. Follow the 3-2-1 rule.
 - B. Carefully document backups.
 - C. Make only monthly backups.
 - D. Periodically verify that backups are not corrupt and can be restored.
- 221.** You’re working at a Windows command prompt and need to prepare a hard drive to receive data using the NTFS filesystem. The hard drive should be designated as drive x. Which command would you use at a Command Prompt to do this?
- A. format x: /fs:ntfs
 - B. initialize x: /fs:ntfs
 - C. format x: /ntfs
 - D. initialize x: /ntfs
- 222.** You’re running a computer with macOS. Which of the following will protect your data against accidental deletion?
- A. Mirrored drives
 - B. An online utility
 - C. Time Machine
 - D. Nothing

- 223.** You are a junior IT administrator, and the senior IT administrator has just set up a proxy server, so you need to add settings for it to every workstation. What information do you need to properly set up the proxy server in the Network & Internet group of Windows Settings? (Choose two.)
- A. The proxy server's IP address
 - B. The router's IP address
 - C. The DHCP server's IP address
 - D. The port number to use for the proxy server
- 224.** You are working on a MacBook Pro and need to search it for a document you wrote a few months ago. Which feature should you use to search the computer's hard drive?
- A. Keychain
 - B. Spotlight
 - C. Finder
 - D. Siri
- 225.** Which of the following is not a best practice for avoiding viruses/malware in a Linux system?
- A. Create a different user and disable the root user.
 - B. Install an antivirus/anti-malware program and update it regularly.
 - C. Only use eight-character alphanumeric passwords.
 - D. Use sudo instead of su.
- 226.** You are installing a new network for a small office. They are concerned about security and want a single place where access to files, printers, and other shared resources is established. You're installing Windows computers, so what type of network setup will you choose?
- A. Workgroup
 - B. Homegroup
 - C. Personal Area Network
 - D. Domain

- 227.** You are viewing the screen shown in the following graphic. Which of the following is not true about the network connection from this screen?



- A. It is likely a network you or your company controls.
 - B. File and Printer Sharing is likely enabled.
 - C. It is a public network.
 - D. Network Discovery is likely enabled.
- 228.** A user has shared a folder with you. Working in File Explorer, how can you configure access to this shared network location each time you log in without reentering the path? (Choose two.)
- A. Left-click on This PC and choose the network share.
 - B. Select This PC on the left and then click the Map Network Drive icon in the File Explorer ribbon and follow the onscreen prompts, ensuring that you choose Reconnect At Sign-in.
 - C. Use File Explorer to drill down to the shared network resource. Right-click on the shared resource and then choose Map Network Drive and follow the onscreen prompts, ensuring that you choose Reconnect At Sign-in.
 - D. Click on Quick Access and choose the network share.

- 229.** You're on your private wired network at home and notice that your mouse pointer is moving across the screen, but you aren't moving it. Also, your computer seems to be running slowly, so you suspect someone with malicious intent has hacked into it. You want to immediately block access through the local machine's firewall. Where can you quickly do this?
- A. Search for Firewall. Choose Firewall & Network Protection, click Private, and then click the box next to Block All Incoming Connections, including those in the list of allowed apps.
 - B. Start typing Windows in the search box, choose Windows Defender Firewall, and then click Private Networks and Disable.
 - C. Search for air, click on Turn Airplane Mode On Or Off, and then turn Airplane Mode on.
 - D. Search for Windows Defender Firewall and choose it, and then turn the firewall off.
- 230.** You have a Windows Pro computer set up in a workgroup, and you need to perform some routine management tasks on it. Before you do, you need to see what shares already exist on the local computer. How can you do this?
- A. In Windows Settings, choose Network & internet.
 - B. In Windows Settings, choose Ease Of Access.
 - C. In Computer Management, choose Shared Folders, and then double-click Shares.
 - D. In the Network and Sharing Center utility of the Control Panel, click on Change Advanced Sharing.
- 231.** Your laptop is equipped with a WWAN card, and you've arranged for service with a cellular provider. Where in Windows 11 can you connect to the network? (Choose two.)
- A. Click on the wireless network icon on the taskbar, and then click Network And Internet Settings, Cellular.
 - B. In the Network & Internet group of Windows Settings, click on Mobile Hotspot.
 - C. In the Network & Internet group of Windows Settings, click on Wi-Fi.
 - D. Open the Control Panel, click on Network And Sharing Center, and then click Set Up A New Connection Or Network.
- 232.** You want to block an application from communicating through your Windows Defender Firewall. What will you set up for this application?
- A. An exception
 - B. A restriction
 - C. A mapped drive
 - D. A network share

- 233.** You need to connect to the Internet, but you regularly work in remote areas, and your only option is to use a cellular network. What type of network are you establishing when you connect to the Internet?
- A. PAN
 - B. CAN
 - C. WWAN
 - D. LAN
- 234.** You’re working on your laptop at a friend’s house. You click on your browser to research something, but a window pops up saying No Internet. How do you resolve this? (Choose two.)
- A. Right-click the browser shortcut and choose New Window.
 - B. Open Settings, choose Network & Internet, click on Wi-Fi, and then click on Show Available Networks. Choose your friend’s network, and ask for the password.
 - C. Click the taskbar icon that looks like a globe, and then choose your friend’s network and ask for the password.
 - D. Type `firewall` in the search box and choose Firewall & Network Protection, and then click on Private Network.
- 235.** You need to create an exception to allow Open Office to communicate through the local Windows computer’s firewall. How do you configure this? (Choose two.)
- A. In the Search box, type Firewall & network protection, and then choose it and click Allow An App Through Firewall.
 - B. In Windows Settings, choose the Apps group.
 - C. In the Control Panel, choose Windows Defender Firewall, and then select Allow An App Or Feature Through Windows Defender Firewall.
 - D. In the Control Panel, open the Programs and Features utility.
- 236.** A user has a laptop that they think has WWAN capabilities. Where can you quickly check?
- A. Disk Management
 - B. Device Manager
 - C. Apps & Features
 - D. Programs and Features
- 237.** A user wants to use a WWAN connection to the Internet because they travel, and Ethernet and Wi-Fi networks aren’t always available for connection. What will this user need? (Choose two.)
- A. A wireless NIC
 - B. A WWAN card or device
 - C. A cellular service provider
 - D. An RJ-45 connector

- 238.** A user at your company just signed up for WWAN service through their cellular provider. Their data is capped at 10 GB per month. It's very costly if they go over, so they've asked you if there is a way for them to avoid going over their data limit. What will you do for them?
- A. Set up their cellular WWAN as a metered service.
 - B. Use Performance Monitor to track their WWAN use.
 - C. Switch them to a VPN so it won't cost anything.
 - D. Use a proxy server so their data downloads won't count.
- 239.** A junior network administrator wants to know what the fastest way is to access File Explorer, because they use it often. What do you tell them?
- A. Press Windows Logo Key+F key.
 - B. Press Windows Logo Key+M key.
 - C. Press Windows Logo Key+E key.
 - D. Press Windows Logo Key+X key, and then choose File Explorer from the menu.
- 240.** You need to establish a wired connection between a newly installed Windows Pro computer and an Ethernet home network. The router is located next to the desk and provides DHCP services. What will you need to connect a desktop computer to this network? (Choose two.)
- A. Patch cable
 - B. Wireless NIC
 - C. NIC with RJ-45 port
 - D. IP address and subnet mask
- 241.** You need to know the path to a network resource. How can you locate it? (Choose two.)
- A. In File Explorer, look at the path in the title bar.
 - B. In File Explorer, right-click the resource, choose Properties, and then click the Sharing tab and look under Network Path.
 - C. Type mynetworkdrives in a browser.
 - D. In Computer Management, choose Shared Folders and then Shares.
- 242.** When installing a new application, which of the following is not an advantage of using a mountable file over physical media?
- A. Ease of installation
 - B. Lower cost to distribute
 - C. Easier to change
 - D. Easier to locate

- 243.** You've installed a new hard drive in a Windows PC and need to partition the drive and format the volumes. What tools can you use to format it? (Choose two.)
- A. diskmgmt.msc
 - B. diskpart
 - C. perfmon.msc
 - D. services.msc
- 244.** You're troubleshooting problems with an application on a Mac computer. You've uninstalled the application, but it won't reinstall because it says the application is already installed. You're going to manually delete the application file so you can then reinstall it. What file extension will you look for?
- A. .pkg
 - B. .bat
 - C. .dmg
 - D. .app
- 245.** Your company has Windows on its workstations and wants to use file encryption and advanced permissions at the file level. What filesystem will the company be using?
- A. ReFS
 - B. FAT32
 - C. ext4
 - D. NTFS
- 246.** Which of the following filesystem types are you most likely to find on a Linux workstation?
- A. FAT32
 - B. NTFS
 - C. XSF
 - D. ext4
- 247.** Which of the following filesystem types is required on Windows 11?
- A. FAT32
 - B. NTFS
 - C. XSF
 - D. ext4

- 248.** You want to automate a repetitive process. You press the Windows Logo Key+R Key simultaneously. What do you type in the Run dialog box?
- A. automate
 - B. tasksched.msc
 - C. diskmgmt.msc
 - D. dfregui.exe
- 249.** You want to know who is currently logged in to a workstation. What command works in both the Linux terminal and Windows Command Prompt and Terminal and will show information about the current user?
- A. whoami
 - B. users
 - C. idme
 - D. net use
- 250.** You find that you are often using System Configuration, Disk Cleanup, and Event Viewer. What Windows 10 Control Panel utility gives you quick access to these and more tools?
- A. Computer Management
 - B. Resource Monitor
 - C. Administrative Tools
 - D. Task Scheduler
- 251.** You just upgraded a computer from Windows 10 to Windows 11 and can't find Administrative Tools. What Windows 11 utility is most similar to Windows 10 Administrative Tools?
- A. Computer Management
 - B. Resource Monitor
 - C. Windows Tools
 - D. Task Scheduler
- 252.** You've been called to troubleshoot a customer's computer. You first observe that the desktop has the taskbar icons slid to the left of the taskbar instead of in the center, and when you click on the Windows button at bottom-left, a start screen with tiles appears. What version of Windows does this user have?
- A. Windows 8
 - B. Windows 9
 - C. Windows 10
 - D. Windows 11

- 253.** Which of the following is not an available tab in the File Explorer Options applet found in the Control Panel?
- A. General tab
 - B. View tab
 - C. Search tab
 - D. Options tab
- 254.** In macOS, which of the following folders holds universal fonts, settings, and other information used by everyone who uses the system?
- A. /Library
 - B. /Users~/Library
 - C. /System
 - D. /Applications
- 255.** In macOS, which of the following folders holds information about everyone who uses the computer?
- A. /Library
 - B. /Users
 - C. /System
 - D. /User
- 256.** What two iCloud applications enable audio, video, and text messages to be shared between Mac systems? (Choose two.)
- A. iPhone
 - B. iMessage
 - C. FaceTime
 - D. Teams
- 257.** Your mom has an Apple Watch that enables her to answer and make phone calls, check her email, and read and respond to messages, even if her iPhone is not near her. What's the name of the feature of Apple devices that enables these devices to synchronize?
- A. Continuity
 - B. Individuality
 - C. Integration
 - D. iCloud

- 258.** Which of the following are involved in filesystem management in a Linux system? (Choose two.)
- A.** du
 - B.** fsck
 - C.** mount
 - D.** kernel
- 259.** Which of these Linux networking commands enables a user to communicate with a client computer through the Linux Terminal?
- A.** ping
 - B.** traceroute
 - C.** curl
 - D.** dig
- 260.** Which of these is a Linux command that is used to install, update, and remove packages?
- A.** man
 - B.** cat
 - C.** curl
 - D.** dnf
- 261.** Which of these is a Linux OS component that runs the initialization programs in many Linux distributions and manages services and systems?
- A.** systemd
 - B.** kernel
 - C.** bootloader
 - D.** traceroute
- 262.** Windows has administrator accounts that can control everything in a Windows computer. What is the username with similar power in a Linux system?
- A.** admin
 - B.** boss
 - C.** root
 - D.** systemd
- 263.** Which of these Linux OS folders holds a hashed version of username passwords?
- A.** /etc/passwd
 - B.** /etc/shadow
 - C.** /etc/hosts
 - D.** /etc/resolve.conf

- 264.** Which of these Linux OS folders is used to resolve hostnames on a local network to IP addresses?
- A. /ect/passwd
 - B. /ect/fstab
 - C. /ect/hosts
 - D. /ect/resolve.conf
- 265.** Which of these Linux OS folders automatically mounts and unmounts external devices?
- A. /ect/passwd
 - B. /ect/fstab
 - C. /ect/hosts
 - D. /ect/resolve.conf
- 266.** What two pieces of information are usually all that are required to configure a user's cloud-based email system? (Choose two.)
- A. Email address
 - B. DNS server
 - C. Password
 - D. Mail server IP address
- 267.** Which of these is not a cloud storage system/service?
- A. Google Drive
 - B. OneDrive
 - C. Dropbox
 - D. Linux drive
- 268.** A family member has a new iPhone and wants to know how to synchronize their photos so they can be viewed with their iPad. What do you tell them? (Choose two.)
- A. It can't be done.
 - B. On the phone, go to Settings, their name, and then iCloud, tap iCloud Drive, and click the button next to Sync This iPhone. Do the same on the iPad.
 - C. On the phone, go to Settings, their name, and then iCloud, tap iCloud Drive, and click the button next to Sync This iPhone. On the iPad, navigate to icloud.com, and then sign in with their Apple account.
 - D. On the phone, go to Settings and then their name, click Synchronize, and then enter their username and password. Click Synchronize Now to Google Drive. Access their Google Drive from the iPad.

- 269.** You're a network admin and need to give employees access to Microsoft 365 apps for business. You've already purchased licenses, so you go to <https://admin.cloud.microsoft>. Which of the following isn't required?
- A. Downloading Office 365
 - B. Adding the user's email address
 - C. Assigning a license to the user
 - D. Sending the user their credentials

Chapter

7



Security

THE COMPTIA A+ 220-1202 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

- ✓ **2.1 Summarize various security measures and their purposes.**

- Physical Security
 - Bollards
 - Access control vestibule
 - Badge Reader
 - Video surveillance
 - Alarm systems
 - Motion sensors
 - Door locks
 - Equipment locks
 - Security guards
 - Fences
- Physical access security
 - Key fobs
 - Smart cards
 - Mobile digital key
 - Keys
 - Biometrics
 - Retina scanner
 - Fingerprint scanner
 - Palm print scanner
 - Facial recognition technology (FRT)
 - Voice recognition technology



- Lighting
- Magnetometers
- Logical Security
 - Principle of least privilege
 - Zero Trust model
 - Access control lists (ACLs)
 - Multifactor authentication (MFA)
 - Email
 - Hardware token
 - Authenticator application
 - Short Message Service (SMS)
 - Voice call
 - Time-based one-time password (TOTP)
 - One-time password/passcode (OTP)
 - Security Assertions Markup Language (SAML)
- Single sign-on (SSO)
- Just-in-time access
 - Privileged access management (PAM)
 - Mobile device management (MDM)
 - Data loss prevention (DLP)
 - Identity access management (IAM)
 - Directory services

✓ **2.2 Given a scenario, configure and apply basic Microsoft Windows OS security settings.**

- Defender Antivirus
 - Activate/deactivate
 - Update definitions
- Firewall
 - Activate/deactivate
 - Port security
 - Application security



- Users and groups
 - Local vs. Microsoft account
 - Standard account
 - Administrator
 - Guest user
 - Power user
- Log-in OS options
 - Username and password
 - Personal identification number (PIN)
 - Fingerprint
 - Facial recognition
 - SSO
 - Passwordless/Windows Hello
- NTFS vs. share permissions
 - File and folder attributes
 - Inheritance
- Run as administrator vs. standard user
- User Account Control (UAC)
- BitLocker
- BitLocker-To-Go
- Encrypting File System (EFS)
- Active Directory
 - Joining domain
 - Assigning log-in script
 - Moving objects within organizational units
 - Assigning home folders
 - Applying Group Policy
 - Selecting security groups
 - Configuring folder redirection



✓ **2.3 Compare and contrast wireless security protocols and authentication methods.**

- Protocols and encryption
 - Wi-Fi Protected Access 2 (WPA2)
 - WPA3
 - Temporal Key Integrity Protocol (TKIP)
 - Advanced Encryption Standard (AES)
- Authentication
 - Remote Authentication Dial-in User Service (RADIUS)
 - Terminal Access Controller Access-control System (TACACS+)
 - Kerberos
 - Multifactor

✓ **2.4 Summarize types of malware and tools/methods for detection, removal, and prevention.**

- Malware
 - Trojan
 - Rootkit
 - Virus
 - Spyware
 - Ransomware
 - Keylogger
 - Boot sector virus
 - Cryptominer
 - Stalkerware
 - Fileless
- Adware
 - Potentially unwanted program (PUP)
- Tools and methods
 - Recovery console/environment/modes
 - Endpoint detection and response (EDR)
 - Managed detection and response (MDR)



- Extended detection and response (XDR)
- Antivirus
- Anti-malware
- Email security gateway
- Software firewalls
- User education regarding common threats
 - Antiphishing training
- OS reinstallation

✓ **2.5 Compare and contrast common social engineering attacks, threats, and vulnerabilities.**

- Social engineering
 - Phishing
 - Vishing
 - Smishing
 - QR code phishing
 - Spear phishing
 - Whaling
 - Shoulder surfing
 - Tailgating
 - Impersonation
 - Dumpster diving
- Threats
 - Denial of service (DoS)
 - Distributed denial of service (DDoS)
 - Evil twin
 - Zero-day attack
 - Spoofing
 - On-path attack
 - Brute-force attack
 - Dictionary attack
 - Insider threat



- Structured Query Language (SQL) injection
- Cross-site scripting (XSS)
- Business email compromise (BEC)
- Supply chain/pipeline attack
- Vulnerabilities
 - Non-compliant systems
 - Unpatched systems
 - Unprotected systems (missing antivirus/missing firewall)
 - EOL
 - Bring your own device (BYOD)

✓ **2.6 Given a scenario, implement procedures for basic small office/home office (SOHO) malware removal.**

- 1. Investigate and verify malware symptoms.
- 2. Quarantine infected system.
- 3. Disable System Restore in Windows Home.
- 4. Remediate infected systems.
- 5. Update anti-malware software.
- 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
- 7. Reimage/reinstall.
- 8. Schedule scans and run updates.
- 9. Enable System Restore and create a restore point in Windows Home.
- 10. Educate the end user.

✓ **2.7 Given a scenario, apply workstation security options and hardening techniques.**

- Data-at-rest encryption
- Password considerations
 - Length
 - Character types
 - Uniqueness
 - Complexity
 - Expiration



- Basic input/output system (BIOS)/Unified Extensible Firmware Interface (UEFI) passwords
- End-user best practices
 - User screensaver locks
 - Log off when not in use
 - Secure/protect critical hardware (e.g., laptops)
 - Secure personally identifiable information (PII) and passwords
 - Use password managers
- Account management
 - Restrict user permissions
 - Restrict login times
 - Disable guest account
 - Use failed attempts lockout
 - Use timeout/screen lock
 - Apply account expiration dates
- Change default administrator's user account/password
- Disable AutoRun
- Disable unused services

✓ **2.8 Given a scenario, apply common methods for securing mobile devices.**

- Hardening techniques
 - Device encryption
 - Screen locks
 - Facial recognition
 - PIN codes
 - Fingerprint
 - Pattern
 - Swipe
 - Configuration profiles



- Patch Management
 - OS updates
 - Application updates
- Endpoint security software
 - Antivirus
 - Anti-malware
 - Content filtering
- Locator applications
- Remote wipes
- Remote backup applications
- Failed log-in attempts restrictions
- Policies and procedures
 - MDM
 - BYOD vs. corporate-owned devices
- Profile security requirements

✓ **2.9 Compare and contrast common data destruction and disposal methods.**

- Physical destruction of hard drives
 - Drilling
 - Shredding
 - Degaussing
 - Incinerating
- Recycling or repurposing best practices
 - Erasing/wiping
 - Low-level formatting
 - Standard formatting
- Outsourcing concepts
 - Third-party vendor
 - Certification of destruction/recycling
- Regulatory and environmental requirements



✓ **2.10 Given a scenario, apply security settings on SOHO wireless and wired networks.**

- Router settings
 - Change default passwords
 - IP filtering
 - Firmware updates
 - Content filtering
 - Physical placement/secure locations
 - Universal Plug and Play (UPnP)
 - Screened subnet
 - Configure secure management access
- Wireless specific
 - Changing the service set identifier (SSID)
 - Disabling SSID broadcast
 - Encryption settings
 - Configuring guest access
- Firewall settings
 - Disabling unused ports
 - Port forwarding/mapping

✓ **2.11 Given a scenario, configure relevant security settings in a browser.**

- Browser download/installation
 - Trusted sources
 - Hashing
 - Untrusted sources
- Browser patching
- Extensions and plug-ins
 - Trusted sources
 - Untrusted sources
- Password managers
- Secure connections/sites - valid certificates



- **Settings**
 - Pop-up blocker
 - Clearing browsing data
 - Clearing cache
 - Private-browsing mode
 - Sign-in/browser data synchronization
 - Ad blockers
 - Proxy
 - Secure DNS
- **Browser feature management**
 - Enable/disable
 - Plug-ins
 - Extensions
 - Features

1. A client has a Windows 11 Home computer with a virus on it. They have quarantined the system from the rest of their network. To follow malware removal best practices, what should be done next?
 - A. Investigate and verify malware symptoms.
 - B. Disable System Restore in Windows Home.
 - C. Enable System Restore and create a restore point in Windows.
 - D. Update anti-malware software.
2. Someone has configured an external server with an IP address that should belong to one of your sister company's servers. With this new computer, they are attempting to establish a connection to your internal network. What type of attack is this?
 - A. Spoofing
 - B. On-path attack
 - C. Zombie/botnet
 - D. Non-compliant system
3. Which of the following options best describes the type of security device that often incorporates RFID technology to grant personnel access to secure areas or resources?
 - A. Smart card
 - B. Security token
 - C. Access control vestibule
 - D. Key fob
4. You are configuring a wireless network for a small office. What should you enable for the best encryption possible for network transmissions?
 - A. WPS
 - B. WEP
 - C. WPA
 - D. WPA3
5. You are working in a company with a domain. An employee received a new position in the company and will be relocating from the Miami, Florida, office to the Paris, France, office. What will be the result when you move them from the Miami OU to the Paris OU?
 - A. Their rights will stay the same, but permissions will change.
 - B. Their group policies and security settings will remain the same as at the Miami OU.
 - C. They will inherit group policies and security settings from the Paris OU.
 - D. You will need to create a new OU for moved employees.

6. Which types of security threats involve the attacker attempting to directly contact a potential victim? (Choose two.)
 - A. Spoofing
 - B. Phishing
 - C. Social engineering
 - D. Brute-force attacking
7. An employee uses their security badge to enter the building through a secured door. Another person tries to enter the building behind them before the door closes, without swiping a badge. What type of behavior is the second person demonstrating?
 - A. Shoulder surfing
 - B. On-path attack
 - C. Brute-force
 - D. Tailgating
8. You have a Windows domain network and want to ensure that users are forced to meet password complexity requirements. What is the best way to implement this on the network?
 - A. Use a firewall.
 - B. Use a VPN.
 - C. Use a GPO.
 - D. Use DLP processes.
9. You are planning security protocols for your company's new server room. What is the simplest way to keep potential attackers physically away from your servers?
 - A. Lock the door.
 - B. Use cable locks.
 - C. Install an access control vestibule.
 - D. Implement biometrics.
10. A user on your network reported that their screen went blank and a message popped up. It's telling them that their files are no longer accessible, and if they want them back, they need to enter a credit card number and pay a \$2,000 fee. Which type of malware has infected this system?
 - A. Rootkit
 - B. Ransomware
 - C. Trojan
 - D. Spyware

- 11.** You are setting up a new wireless SOHO router. Which of the following should you change immediately when initially configuring the network? (Choose two.)

 - A.** The router's default administrator username and password
 - B.** The default SSID
 - C.** The radio power level
 - D.** The guest account password
- 12.** You are configuring a router for a small office network. The network users should be able to access regular and secure websites and send and receive email. Those are the only connections allowed to the Internet. Which security feature should you configure to prevent additional traffic from coming through the router?

 - A.** MAC filtering
 - B.** Content filtering
 - C.** Port forwarding/mapping
 - D.** Port security/disabling unused ports
- 13.** On a Windows workstation, there are two NTFS volumes. The Managers group has Modify access to the D:\mgmt directory. You move the folder to the D:\keyfiles folder, to which the Managers group has Read access. What level of permissions will the Managers group have to the new D:\keyfiles\mgmt directory?

 - A.** Full Control
 - B.** Modify
 - C.** Read & Execute
 - D.** Read
- 14.** For users to log on to your network from a remote location, they are required to supply a username and password as well as a code from an RSA token. What type of security is being used?

 - A.** Firewall
 - B.** Multifactor authentication
 - C.** Access control list
 - D.** Principle of least privilege
- 15.** You want to recycle some hard drives that your company no longer uses, but you need to ensure that other people will not be able to access the data. Which methods of removing the data are acceptable for your purposes? (Choose two.)

 - A.** Formatting the drive.
 - B.** Using an overwrite utility.
 - C.** Using a drive erasing\wiping utility.
 - D.** Using electromagnetic fields.

- 16.** Your department is taking steps to create a system that will monitor computers, smartphones, servers, and any other company devices that interact with the outside world for potential malware attacks. When an attack is discovered, the system will automatically launch countermeasures to protect company data and endpoints, and monitor, report on, and mitigate the spread of potential problems.

What type of system are you deploying?

- A.** MDR
- B.** EDR
- C.** DDoS
- D.** PUP

- 17.** You have installed Windows 11 Pro on a workstation. For better security, which user account should you ensure is disabled?

- A.** Administrator
- B.** DefaultAccount
- C.** Power User
- D.** Guest

- 18.** Which type of network attack involves an intermediary hardware device intercepting data and altering it, or transmitting it to an unauthorized user?

- A.** On-path attack
- B.** Non-compliant system
- C.** Zombie/botnet
- D.** Spoofing

- 19.** You are implementing new password policies for your network, and you want to follow guidelines for password best practices. Which of the following will best help improve the security of your network? (Choose two.)

- A.** Force passwords to expire every 180 days.
- B.** Require passwords to be a minimum of eight characters.
- C.** Encourage users to use passphrases.
- D.** Restrict passwords to be no more than 10 characters long.

- 20.** What does NTFS use to track users and groups and their level of access to resources?

- A.** ACLs
- B.** Tokens
- C.** Badges
- D.** Control rosters

- 21.** You have created a user account for a contract employee on a Windows 11 PC. The contractor will be with the company for one month. Which user group should this user's account be placed in?
- A.** Power Users
 - B.** Administrators
 - C.** Standard Users
 - D.** Guest
- 22.** On your network, there are multiple systems that users need to access, such as domain resources, a cloud site for storage, and order processing software. You want to configure the network such that users do not need to remember separate usernames or passwords for each site; their login credentials will be good for different systems. Which technology should you use?
- A.** EFS
 - B.** MDM
 - C.** SSO
 - D.** UAC
- 23.** A user discovers a strange text file at the root of their user directory. It contains everything they have typed over the past few days, including their credentials. What is the likely cause of the text file?
- A.** System auditing enabled
 - B.** Keylogger installed
 - C.** Email application in debug mode
 - D.** Backup file
- 24.** What security solution would protect a user from unwanted network traffic probing their workstation?
- A.** Software firewall
 - B.** Anti-phishing training
 - C.** Anti-malware
 - D.** Antivirus
- 25.** The user wants to use MFA on their PC but does not want to carry a key fob and is strongly against biometrics. What method can you suggest?
- A.** Second password
 - B.** Hardware token
 - C.** Software token
 - D.** Fingerprint reader

- 26.** What wireless protocol used in WPA compensated for the weak encryption of WEP?
- A.** VLAN
 - B.** TKIP
 - C.** VPN
 - D.** AES
- 27.** Which of the following Active Directory concepts can help enforce security settings? (Choose two.)
- A.** EFS
 - B.** Group policy/updates
 - C.** Disabling unused ports
 - D.** Assigning login scripts
- 28.** What 128-bit block encryption that uses an encryption key of 128, 192, or 256 bits is used in WPA2 and is more secure than TKIP?
- A.** AES
 - B.** VPN
 - C.** RADIUS
 - D.** Kerberos
- 29.** What protocol was originally designed to authenticate remote users to a dial-in access server?
- A.** TKIP
 - B.** TACACS+
 - C.** VPN
 - D.** RADIUS
- 30.** A user is complaining that they can no longer sign in to their account because of too many bad login attempts. What basic directory services security function is at work here?
- A.** Failed login attempts restrictions
 - B.** Antivirus/anti-malware
 - C.** A bollard
 - D.** A rootkit
- 31.** What concept in Active Directory creates a directory subdivision within which may be placed users, groups, computers, and other objects to which the same group policies will be applied?
- A.** User
 - B.** Domain
 - C.** Organizational unit
 - D.** Home folder

- 32.** A technician is troubleshooting a Windows 10 computer that is acting strangely, and they suspect that it is infected with a virus. They have followed the best practices for malware removal and remediated the computer. What should they do next?
- A.** Schedule scans and run updates.
 - B.** Educate the end user.
 - C.** Enable System Restore and create a restore point.
 - D.** Disable System Restore in Windows.
- 33.** Your data center recently experienced the theft of a server from its rack. Which security mechanisms would protect servers from future theft? (Choose two.)
- A.** Equipment lock
 - B.** Security token
 - C.** Door lock
 - D.** External hardware token
- 34.** What other security devices are often employed in an access control vestibule? (Choose two.)
- A.** Bollard
 - B.** Motion sensors
 - C.** Security guards
 - D.** Video surveillance
- 35.** Normally, your company places users' profiles and folders on the local machine. Now, the organization would like users to be able to log in from other computers. What concept in Active Directory allows a user's profile folders to be placed in storage somewhere else on the network?
- A.** Home folder
 - B.** Folder redirection
 - C.** Organizational unit
 - D.** VPN
- 36.** What wireless encryption protocol uses both TKIP for backward compatibility and AES, and replaced WPA?
- A.** WEP
 - B.** WPA2
 - C.** WPA3
 - D.** RADIUS

- 37.** When should OS and application patches be applied to a system to avoid an unpatched system vulnerability?
- A.** Every 6 months
 - B.** Every 3 months
 - C.** Once a month
 - D.** As soon as they are available
- 38.** What do security groups manage in a Windows Active Directory environment? (Choose two.)
- A.** Permissions to access file servers
 - B.** Applying group policies
 - C.** Access to resources
 - D.** Updating OS on client computers
- 39.** You need to join a new Windows 11 workstation to your company's domain. What utility will you access to do this?
- A.** Administrative Tools
 - B.** System
 - C.** Computer Management
 - D.** System Information
- 40.** Which of the following are examples of physical security methods? (Choose two.)
- A.** Access control vestibule
 - B.** Multifactor authentication
 - C.** Keys
 - D.** Firewalls
- 41.** A user on your network reported that they received a phone call from someone in the IT department saying the user needed to reset their password. The caller offered to do it for them if the user could provide the IT worker with their current password. What is this most likely an example of?
- A.** The IT department helping the user to reset their password
 - B.** A spoofing attack
 - C.** A social engineering attack
 - D.** A brute-force attack
- 42.** Your corporate IT department has decided that, to enhance security, they will draft an MDM policy to require both a password and a fingerprint scan to unlock a mobile device for use. Which of the following is this not an example of?
- A.** An authenticator application
 - B.** Biometric authentication
 - C.** Device hardening
 - D.** Multifactor authentication

- 43.** Several employees at your company have been tailgating to gain access to secure areas. Which of the following security methods is the best choice for stopping this practice?
- A.** Door lock
 - B.** Entry control roster
 - C.** Access control vestibule
 - D.** ID badges
- 44.** A user has joined your company as a network administrator. Assume their user account name is AOShea. What is the recommended way to give AOShea the administrative privileges they need?
- A.** Add the AOShea user account to the Administrators group.
 - B.** Create an account called AdminAOShea. Add that account to the Administrators group. Have the new administrator use the AOShea account unless they need administrative rights, in which case they should use the AdminAOShea account.
 - C.** Copy the Administrator account and rename it AOShea.
 - D.** Add the AOShea user account to the Power Users group.
- 45.** You are designing a security policy for laptops on your network. Which of the following is a common method of biometric authentication used with laptops and other mobile devices?
- A.** Fingerprint scan
 - B.** Retina scan
 - C.** Swipe lock
 - D.** DNA lock
- 46.** An administrator is transferring confidential files from one Windows Pro workstation to another using a flash drive. Policy dictates that the files on the flash drive must be encrypted. Which technology should be used?
- A.** BitLocker
 - B.** BitLocker-To-Go
 - C.** EFS
 - D.** AES
- 47.** Which type of security system uses physical characteristics to allow or deny access to locations or resources?
- A.** ID badges
 - B.** Bollards
 - C.** Biometrics
 - D.** Tokens

- 48.** Your company's president has been contacted and threatened by someone who seems to know everything they've been doing on their computer system. What type of malware has their system been attacked by?
- A. Keylogger
 - B. Stalkerware
 - C. SQL injection
 - D. Trojan
- 49.** A security consultant for your company recommended that you begin shredding or burning classified documents before disposing of them. What security risk is the consultant trying to protect the company from?
- A. Shoulder surfing
 - B. Dumpster diving
 - C. Social engineering
 - D. Brute-force attack
- 50.** Several workstations on your network have operating systems and antivirus software that are outdated. The workstations don't have the most recent security policies applied. They do not have the standard operating environment configured. What type of vulnerability does this represent?
- A. Non-compliant systems
 - B. Zombie/botnet
 - C. Brute-force attack
 - D. Zero-day attack
- 51.** On the Internet, you get a news flash that the developer of one of your core applications found a security flaw. They will issue a patch for it in two days. Before you can install the patch, it's clear that the flaw has been exploited and someone has illegally accessed your network. What type of attack is this?
- A. Zombie/botnet
 - B. Non-compliant system
 - C. Zero-day attack
 - D. Brute-force attack
- 52.** UserA is a member of the Dev group and the HR group. They are trying to access a local resource on an NTFS volume. The HR group has Allow Full Control permission for the payroll folder, and the Dev group has Deny Read permission for the same folder. What is UserA's effective access to the payroll folder?
- A. Full Control
 - B. Read
 - C. Write
 - D. Deny

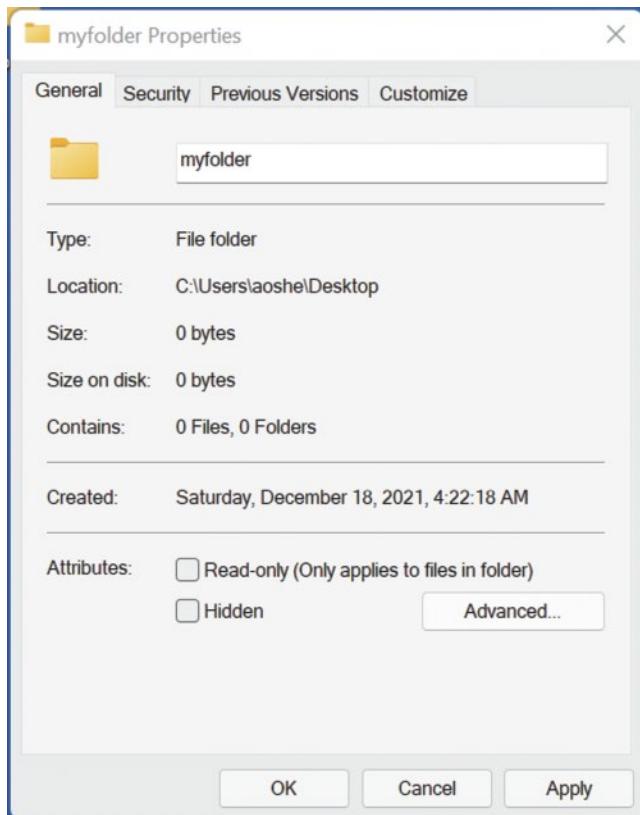
- 53.** Which default Windows group was designed to have more power than normal users but not as much power as administrators, and is now kept for backward compatibility only?
- A.** Superuser
 - B.** Standard Users
 - C.** Power Users
 - D.** Advanced Users
- 54.** You have installed a Window workstation on your LAN. Which of the following are recommended best practices for maximizing security regarding the Administrator account? (Choose two.)
- A.** Disable the Administrator account.
 - B.** Rename the Administrator account.
 - C.** Remove the Administrator account from the Administrators group.
 - D.** Create a different user with Administrator access, and only use it when necessary.
- 55.** Your friend asks you if it's necessary to clear browser history. What will you tell them the advantages of clearing history on exit are? (Choose two.)
- A.** To maintain their privacy
 - B.** To synchronize with other devices
 - C.** Their browser will exhibit better performance.
 - D.** To clear invalid certificates
- 56.** Which of the following are advantages of using NTFS permissions over using Share permissions? (Choose two.)
- A.** NTFS permissions will override Share permissions if there is a conflict.
 - B.** NTFS permissions affect users at the local computer, but Share permissions do not.
 - C.** NTFS permissions are more restrictive in their access levels than Share permissions.
 - D.** NTFS permissions can be set at the file level, but Share permissions cannot.
- 57.** Someone has placed an unauthorized wireless router on your network and configured it with the same SSID as your network. Users can access the network through that router, even though it's not supposed to be there. What type of security threat could this lead to?
- A.** Zombie/botnet
 - B.** Spoofing
 - C.** Non-compliant system
 - D.** On-path attack

- 58.** You’re working in Active Directory, and you need to change an employee’s security group. How do you associate an employee (user) with a selected security group? (Choose two.)
- A.** Open Active Directory Users and Computers, right-click the user account, click on the Member Of tab, and then click on Add and search for the group.
 - B.** Move them to a new OU.
 - C.** Delete the employee in Active Directory Users and Computers, and choose the right security group when you set them up again.
 - D.** Open Active Directory Users and Computers, right-click the group, click the Members tab, and then click Add and search for the employee.
- 59.** You’re working at a high-security server farm and must ensure that vehicles stay a certain distance away from the building. What physical security methods can be used for this purpose? (Choose two.)
- A.** Bollards
 - B.** Motion sensors
 - C.** Fences
 - D.** Lighting
- 60.** Between you and your family members, there are several mobile devices including phones, laptops, and smartwatches. Someone generally forgets where they put their phone, or it may be stolen, and it would be nice to easily find it. In addition, you want to see where other family members are when they are around town. Which type of app will allow you to do this?
- A.** Trusted source application
 - B.** Remote control application
 - C.** Locator application
 - D.** Firewall application
- 61.** Which security mechanism specifies permissions for users and groups as well as the type of activities the users or groups can perform?
- A.** ACL
 - B.** EFS
 - C.** VPN
 - D.** PIN
- 62.** You need to know which files have been modified in a folder. Which of the following is not a way to see when files have been modified?
- A.** Right-click each file and choose Properties and Advanced to see whether the archive bit is set.
 - B.** Open the folder in File Explorer and click on Date Modified to sort the files by the date they were last modified.
 - C.** Type archive at a command prompt.
 - D.** Type attrib at a command prompt.

- 63.** You want to create a new policy to encrypt all company drives using BitLocker. Which operating system will need to be upgraded?
- A.** Windows 10 Pro
 - B.** Windows 11 Home
 - C.** Windows 11 Pro
 - D.** Windows 10 for Workstations
- 64.** Software was installed on a laptop without the user's knowledge. The software has been tracking the user's activities and has transmitted the user's credit card information to an attacker. What type of threat is this?
- A.** Zombie/botnet
 - B.** Spoofing
 - C.** Spyware
 - D.** Ransomware
- 65.** A new user has joined your company as a network administrator. Which of the following statements is most correct regarding their network access?
- A.** They should have just one user account, with administrator-level permissions.
 - B.** They should have just one user account, with standard user-level permissions.
 - C.** They should have two user accounts, one with standard user-level permissions and one with administrator-level permissions.
 - D.** They should have three user accounts: one with user-level permissions, one with administrator-level permissions, and one with remote access administrator permissions.
- 66.** Which types of security threats are direct attacks on user passwords? (Choose two.)
- A.** Brute-force attack
 - B.** Zombie/botnet
 - C.** Dictionary attack
 - D.** Spoofing
- 67.** You read corporate email on your smartphone and do not want others to access the phone if you leave it somewhere. What is the first layer of security that you should implement to keep others from using your phone?
- A.** Multifactor authentication
 - B.** Full device encryption
 - C.** Screen lock
 - D.** Remote wipe software

- 68.** You use your smartphone for email and extensive Internet browsing. You want to add an additional level of security to always verify your identity online when accessing various accounts. Which type of app do you need?
- A.** Authenticator app
 - B.** Trusted source app
 - C.** Bariatric authenticator app
 - D.** Account encryption app
- 69.** You have instructed users on your network to not use common words for their passwords. What type of attack are you trying to prevent?
- A.** Brute-force
 - B.** Dictionary
 - C.** Social engineering
 - D.** Shoulder surfing
- 70.** Which type of malware is designed to look like a different program and, when installed, creates a backdoor for an attacker to access the target system?
- A.** Trojan
 - B.** Spyware
 - C.** Virus
 - D.** Whaling
- 71.** You have been asked to dispose of several old magnetic hard drives. What are you doing if you use a large magnet to clear the data off a hard drive?
- A.** Overwriting
 - B.** Zero-writing
 - C.** Degaussing
 - D.** Incineration

72. If you check the Read-only or Hidden box on the graphic, what feature of the folder is being changed?

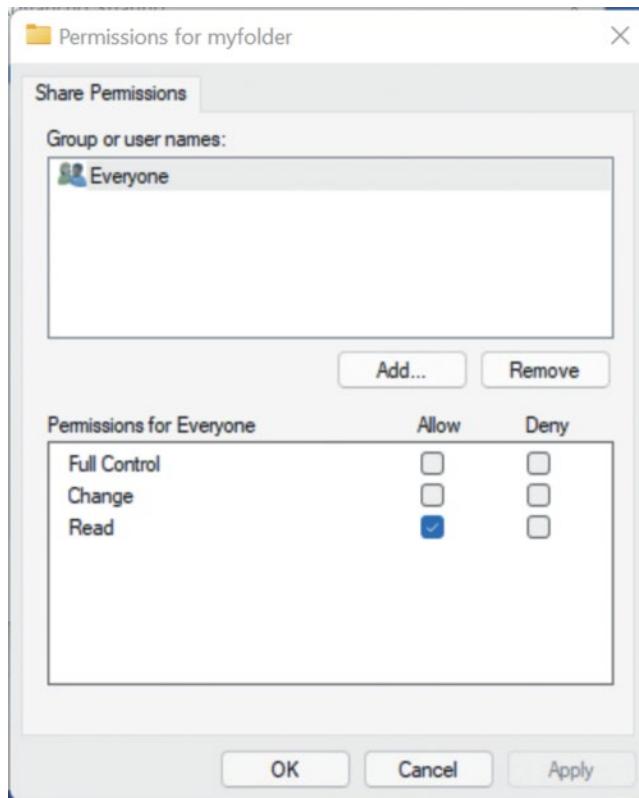


- A. Archive bit
B. NTFS permissions
C. Attributes
D. Share permissions
73. You're setting up a Windows 11 Pro machine and want to encrypt the entire hard drive, including startup files. Which technology best meets your needs?
- A. Windows OSs do not allow full-drive encryption.
B. BitLocker
C. BitLocker-To-Go
D. EFS

- 74.** Which type of security threat gains administrative-level access for an attacker to perform another attack, and then hides its presence from system management tools?
- A.** Virus
 - B.** Whaling
 - C.** Rootkit
 - D.** Ransomware
- 75.** A computer user wants to encrypt a few files on an NTFS volume on their Windows Pro workstation. They do not have administrative rights to the computer. Which of the following statements is correct?
- A.** They can only use device encryption.
 - B.** They can use BitLocker.
 - C.** They can use BitLocker-To-Go.
 - D.** They can use EFS.
- 76.** Which type of digital security protects your network from malicious software programs by both preventing them from entering the system and removing them if they are found?
- A.** Firewall
 - B.** Anti-malware
 - C.** EFS
 - D.** UAC
- 77.** Your company has hired a consultant to intentionally send emails asking for login information from your employees. What is your company engaging in?
- A.** Phishing
 - B.** Whaling
 - C.** Zero-day attack
 - D.** Anti-phishing training
- 78.** On a Windows workstation, there is one volume formatted with NTFS. The Developers group has Modify access to the C:\dev directory. You copy the folder to the C:\operations folder, to which the Developers group has Read access. What level of permissions will the Developers group have to the new C:\operations\dev directory?
- A.** Read & Execute
 - B.** Read
 - C.** Full Control
 - D.** Modify

- 79.** You are configuring NTFS and Share permissions on a Windows 11 workstation. Which of the following statements is true regarding permissions?
- A.** Both NTFS and Share permissions can be applied only at the folder level.
 - B.** NTFS permissions can be applied at the file or folder level, and Share permissions can be applied only at the folder level.
 - C.** NTFS permissions can be applied only at the folder level, but Share permissions can be applied to files and folders.
 - D.** Both NTFS and Share permissions support inheritance.
- 80.** You are troubleshooting a Windows Home system that was infected with malware. You've worked through all of the best-practice procedures for malware removal up to and including scheduling scans and running updates. What do you need to do next?
- A.** Enable System Restore and create a restore point in Windows Home.
 - B.** Disable System Restore in Windows Home.
 - C.** Remediate infected systems.
 - D.** Educate the end user.
- 81.** You recently noticed a change on your computer. Now, when you open your web browser, no matter what you search for, you get a dozen unsolicited pop-up windows offering to sell you items you didn't ask for. What type of problem does your computer have?
- A.** Adware
 - B.** Ransomware
 - C.** Zombie/botnet
 - D.** Trojan
- 82.** A computer user wants to encrypt the data on their Windows Home device. They have administrative rights to the computer. Which of the following statements is correct?
- A.** They may be able to use Windows device encryption.
 - B.** They can use BitLocker.
 - C.** They can use BitLocker-To-Go.
 - D.** They can use EFS.

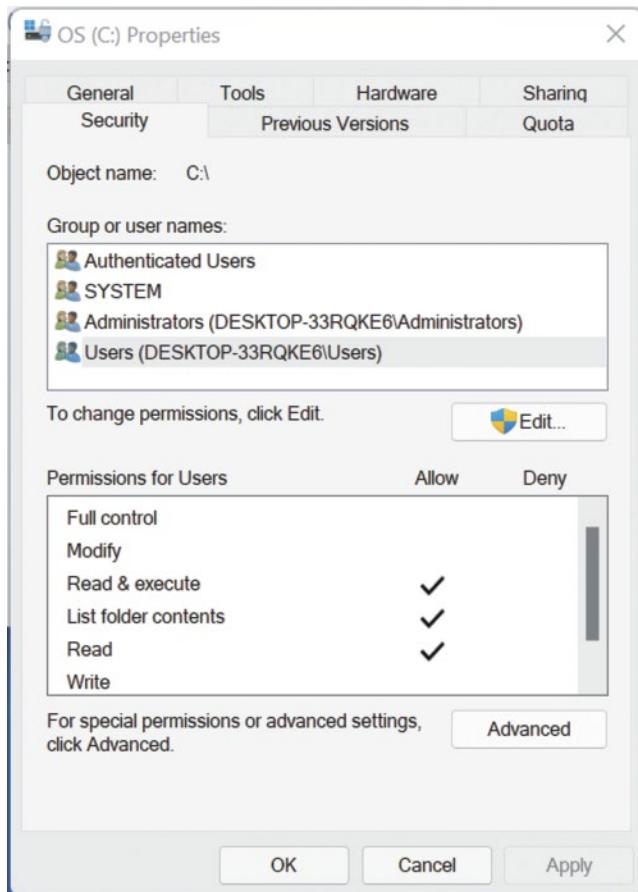
83. Which of the following are true about the permissions shown in the graphic? (Choose two.)



- A. They are in effect only when accessed via a network.
 - B. They are NTFS permissions.
 - C. This type can be used on files and folders.
 - D. Everyone can read files in this folder.
84. Which of the following statements are true regarding file and folder attributes on a Windows 11 workstation? (Choose two.)
- A. File attributes are available only on NTFS volumes.
 - B. Only members of the Administrators group can change file/folder attributes.
 - C. Attributes can be accessed by right-clicking the file/folder and choosing Properties, General tab.
 - D. Compression is an advanced file/folder attribute.

- 85.** Which type of digital security uses virus signatures, behavior analysis, and memory scanning to protect your network or computer?
- A.** Antivirus
 - B.** Firewall
 - C.** Access control list
 - D.** NTFS permissions
- 86.** You are at work and receive a phone call. The caller ID indicates it's coming from your manager's desk. You can see your manager's desk, and no one is sitting there. Which of the following is likely happening?
- A.** Zombie/botnet attack
 - B.** Impersonation attack
 - C.** Zero-day attack
 - D.** Phishing attack
- 87.** A user is working on a Windows workstation. Their user account is a member of the Managers group, and they are trying to access a folder named `reports`, located on a different computer. The NTFS permissions for the `reports` shared folder on that computer for the Managers group are Read and Write. The folders share permissions for the Managers group is Read permission. What are the user's effective permissions on the `reports` folder?
- A.** Full Control
 - B.** Read and Write
 - C.** Read
 - D.** No Access
- 88.** Which NTFS permission overrides all the others?
- A.** Full Control
 - B.** Deny
 - C.** List Folder Contents
 - D.** Read
- 89.** A system administrator is concerned about Windows users inadvertently installing malware from USB drives that contain malicious code. What can they do to help prevent this from happening?
- A.** Set restrictive user permissions.
 - B.** Enable BIOS/UEFI passwords.
 - C.** Disable AutoRun/AutoPlay.
 - D.** Enable data encryption.

90. Someone has placed an unauthorized wireless router on your network and configured it with the same SSID as your network. Users can access the network through that router, even though it's not supposed to be there. What is this router configuration known as?
- A. Zombie/botnet
 - B. Evil twin
 - C. Non-compliant system
 - D. DDoS
91. Which of the following are true about the information shown in the graphic? (Choose two.)



- A. The graphic shows Share permissions.
- B. The graphic shows NTFS permissions.
- C. These permissions will be inherited by any folder created on the C drive.
- D. These permissions are effective only when someone accesses them over a network.

- 92.** Your office has recently experienced several laptop thefts. Which security mechanism, as pictured in the graphic, is designed to protect mobile devices from theft?



- A.** Security token
 - B.** Equipment lock
 - C.** Key fob
 - D.** Magnetometer
- 93.** Which of the following is an open-source authentication encryption protocol that is widely used and uses a third party to verify user credentials?
- A.** AES
 - B.** TACACS+
 - C.** Kerberos
 - D.** RADIUS

- 94.** Your company allows employees to use their own devices, and as the IT director, you are naturally concerned about the security of corporate information on those devices. Which technology should you require in this situation?
- A.** EFS
 - B.** MDM
 - C.** SSO
 - D.** UAC
- 95.** Which of the following is not a logical security method of delivering a one-time code for multifactor authentication?
- A.** Voice call
 - B.** Email
 - C.** Bollards
 - D.** SMS
- 96.** Which of the following are examples of an external hardware token? (Choose two.)
- A.** Key fob
 - B.** Retina scanner
 - C.** Smart card
 - D.** Motion sensor
- 97.** Which of the following devices, often found in smartphones and other mobile devices, is used to pinpoint a person's location on Earth and therefore can be used for multifactor authentication?
- A.** Magnetometer
 - B.** Retina scanner
 - C.** Key fob
 - D.** External hardware token
- 98.** Which of the following is not a physical security measure for protecting computer systems and access to them?
- A.** Lighting
 - B.** Equipment locks
 - C.** Motion sensors
 - D.** Authenticator application
- 99.** Which of the following is not a biometric identification device?
- A.** Fingerprint reader
 - B.** Retina scanner
 - C.** External hardware token
 - D.** Palm print scanner

- 100.** A user is worried about others shoulder surfing. What should they use to help avoid this problem?
- A. Access control vestibule
 - B. Video surveillance
 - C. Display privacy filter
 - D. Smart card
- 101.** Which type of malware will often cause critical files to disappear, while sometimes displaying a taunting message, and requires user intervention (usually inadvertent) to spread from computer to computer?
- A. Botnet
 - B. Virus
 - C. Trojan
 - D. Rootkit
- 102.** A computer user in the accounting department received a phone call from someone who claimed to be from the company's bank. They had a partial account number and needed the user to verify the full account number, username, and password before they could discuss the reason for their call with the user. The user said they would call back, and the caller on the other end hung up abruptly. The user contacted you in the IT department because it seemed like such a strange call. What kind of attempted attack will you tell them just happened?
- A. Phishing
 - B. Vishing
 - C. Whaling
 - D. Evil twin
- 103.** Your company allows employees to use their personal devices for company work because it saves the company money on hardware. What is this called?
- A. BYOD
 - B. MDM
 - C. SSO
 - D. UAC
- 104.** Why is an EOL OS a security threat?
- A. There will be no more security updates.
 - B. There will be no more feature updates.
 - C. There will be no more company support.
 - D. The software will stop working on the EOL date.

- 105.** What type of malware is dangerous because it is loaded during system startup, before the antivirus software is able to load?
- A. Spyware
 - B. Ransomware
 - C. Boot sector virus
 - D. Keylogger
- 106.** Which of the following is not a type of malware that needs to be eradicated from a computer system?
- A. Keylogger
 - B. Virus
 - C. Recovery console/WinRE
 - D. Spyware
- 107.** Which type of malware doesn't launch from a file, but rather is launched in memory, often utilizing tools like PowerShell, making it difficult to find and eradicate?
- A. Trojan
 - B. Fileless
 - C. Boot sector
 - D. Stalkerware
- 108.** You're reviewing the Event Viewer logs and notice repeated failed attempts to access the corporate bank account information. The attempts are originating from someone with a company login, and you are able to catch the person, an employee hired only a month ago, in the act. What type of attack is this?
- A. Insider threat
 - B. Evil twin
 - C. Whaling
 - D. Social engineering
- 109.** Your web server just crashed because there was a flood of responses to a packet that looked like it was from your server, but your server didn't send it. What just happened?
- A. Whaling attack
 - B. Denial-of-service attack
 - C. Distributed denial-of-service attack
 - D. Evil twin attack

- 110.** A computer user on your network is trying to access a folder named Projects on a local NTFS volume. Their user account is in the Developers group. The Developers group has Read & Execute permissions to the folder, and the user's user account has Full Control. What is the user's effective access to the Projects folder?
- A. Full Control
 - B. Read & Execute
 - C. Read
 - D. No access
- 111.** You've discovered that a system on your network has had its firewall turned off and antivirus disabled. What type of vulnerability does this present?
- A. Zero-day attack
 - B. SQL injection
 - C. Unprotected system
 - D. Cross-site scripting
- 112.** What directory services security measure moves a user's data to a server and off the local drive, so that if a laptop is lost or stolen and someone gains access to it, they won't have access to information in the user's data files?
- A. Home folder
 - B. Security group
 - C. Organizational unit
 - D. Login script
- 113.** You notice that your computer seems to be working more than the normal updating it does when you're not actively using it. It also seems to be running more slowly than normal when you are using it. What type of malware uses your computing power instead of stealing your data?
- A. Spyware
 - B. Ransomware
 - C. Keyloggers
 - D. Cryptominers
- 114.** Which of the following is not important in preventing malware from damaging your computer system?
- A. User education regarding common threats
 - B. Installing a keylogger
 - C. Keeping anti-malware signatures up to date
 - D. Keeping operating system, browser, and application patches up to date

- 115.** A user on your network wants to install an interesting browser extension they found on a download site that neither you nor they have used before. They received a warning before going to the site but clicked an option to continue. What type of website is this?
- A. Spoofed
 - B. Trusted source
 - C. Untrusted source
 - D. Certified
- 116.** As the IT person in a small firm using Windows OSs, you would like a window to pop up whenever apps try to make changes to a system, and when the user makes changes to the system, so that an administrator password will be required to be entered. What utility will you use to configure that setting?
- A. UAC
 - B. Windows Defender Firewall
 - C. Facial recognition
 - D. Personalization
- 117.** A friend is considering purchasing an antivirus program. You let them know that there is one included with the Windows operating system. What settings should they look for in Windows settings?
- A. Windows Defender Firewall
 - B. Virus & Threat Protection
 - C. Windows Update
 - D. Device Security
- 118.** Your company's website has been a victim of a botnet attack, causing your server to crash. What type of attack did the botnet attack cause?
- A. Brute-force
 - B. Zero-day
 - C. Distributed denial-of-service
 - D. Non-compliant system
- 119.** What type of attack is like an SQL injection, except that it uses a website and HTML or JavaScript instead of a database, where malicious code is injected into the website (which is normally trusted by the user) and then used to gather data from the website user's computer because their systems don't see the normally trusted website as a threat?
- A. Zero-day attack
 - B. SQL injection
 - C. Unprotected system
 - D. Cross-site scripting

- 120.** Your company has various locations, each with its own management needs, but wants a cohesive way to manage all the users, computers, and other resources on the network. What directory services feature will you enroll those users, computers, and resources into that will provide a way to manage each location in one place?
- A. Active Directory
 - B. Organizational units
 - C. Security groups
 - D. Home folders
- 121.** The company's vice president just called you into the IT department because they received an email from you requesting their username and password. They didn't respond because they thought you should know them already. What kind of attack was just attempted?
- A. Phishing
 - B. Vishing
 - C. Whaling
 - D. Evil twin
- 122.** What is the name of the software used to control access to resources in a Windows domain?
- A. Home folder
 - B. Security group
 - C. Organizational unit
 - D. Active Directory
- 123.** You've been reading about a recent malware that is causing problems for other companies and want to verify that your Windows built-in antivirus definitions are up to date. Where is this done?
- A. Virus and Threat Protection in the Settings app
 - B. Virus and Threat Protection in the Control Panel
 - C. Windows Defender Firewall in the Settings app
 - D. Windows Defender Firewall in the Control Panel
- 124.** You are a junior IT administrator, and your supervisor has asked you to ensure that all workstations have the built-in Windows firewall activated. Where can you go to do that? (Choose two.)
- A. Firewall & Network Protection in the Settings app
 - B. Firewall & Network Protection in the Control Panel
 - C. Windows Defender Firewall in the Settings app
 - D. Windows Defender Firewall in the Control Panel

- 125.** Your company has started using new software in the cloud, but your users are finding that they can't use the software. Their computers are running Windows 11. What can you do to ensure that the software can be used remotely by the employees? (Choose two.)
- A. Click on Allow An App Through Firewall in the Firewall & Network Protection settings of the Settings app.
 - B. Click on Allow An App Through Firewall in the Virus & Threat Protection settings of the Settings app.
 - C. Click on Allow An App Through Firewall in Windows Defender Firewall, which can be found in the Control Panel.
 - D. Add a new rule in Administrative Tools in the Control Panel.
- 126.** Employees at your company work on very confidential projects. All employees have been instructed to lock their screens whenever they walk away from their computer, even if it's only for a minute. What key sequence will immediately lock their desktop and require a password to reenter?
- A. Windows Logo Key+X key
 - B. Windows Logo Key+L key
 - C. Windows Logo Key+Right arrow
 - D. Windows Logo Key+D key
- 127.** Your employees have all been trained in end-user best practices, including locking their laptop when they walk away from it. What can be done to ensure that each employee's laptop and its data will remain with the company and not fall into someone else's hands? (Choose two.)
- A. Use a cable equipment lock to secure the laptop to the desk.
 - B. Use MDM software to wipe the laptop remotely if stolen.
 - C. Place the laptop in a desk drawer when the employee walks away.
 - D. Ask a stranger to watch the laptop when they use the restroom at a coffee shop.
- 128.** You're setting up authentication for new users of Windows 10 and Windows 11 desktop machines. Which of the following Windows logon methods require specific hardware? (Choose two.)
- A. Username and password
 - B. PIN
 - C. Fingerprint identification
 - D. Facial recognition

- 129.** You’re setting up new users on your network and have told them that they will need to change their user password the first time they log in, and that their password must meet complexity requirements. Which of the following is not true about password best practices?
- A. Passwords minimum length is eight characters.
 - B. Longer passwords are better.
 - C. At least one of each of these should be used: upper- and lowercase letters, numbers, and special characters.
 - D. Passwords four characters long are okay if they are complex.
- 130.** You’ve just hired a new employee who will be working at a Windows workstation on your network. You’re helping the user understand what their password should be like. Which of the following are best practices for passwords? (Choose two.)
- A. Password complexity is enforced.
 - B. Passwords should be easy to guess in case you forget, like your dog’s name.
 - C. Password expiration after 45 days
 - D. Password expiration after 180 days
- 131.** Your company has a Windows domain managed by a Domain Controller. Following best practices, what feature of the Domain Controller is used to apply permissions to users?
- A. Active Directory
 - B. User accounts
 - C. Security groups
 - D. Home folders
- 132.** You’re examining password considerations such as length, complexity, and expiration for several Windows 11 Pro workstations. What utility can you use on the workstation to configure the password requirements?
- A. Users Accounts in the Control Panel
 - B. Local Users and Groups
 - C. Administrative Tools
 - D. Local Security Policy
- 133.** Which of the following is a protocol that facilitates communication between an identification provider and a service provider, such as a web application, by passing an electronic authentication token between them, enabling single sign-on?
- A. SSO
 - B. SAML
 - C. PAM
 - D. IAM

- 134.** A computer user is setting up a new Windows 11 Home computer for the first time. They called you because they can't figure out how to set it up with a local account. What will you tell them?
- A. That option is not available. They must use a Microsoft account.
 - B. Press F10 during bootup to create a local account.
 - C. They must switch to the Pro edition if they want to use a local account after setup.
 - D. Local accounts are never available in Windows 11.
- 135.** When using a Microsoft account to log in to your Windows 11 computer, which of the following is not true?
- A. Your username is your email.
 - B. There are more recovery options if you use a Microsoft account rather than a local account to access your computer.
 - C. You won't be able to use your computer if your Internet access is down.
 - D. You can access information stored on OneDrive from another computer if you log in with your Microsoft account.
- 136.** Your friend wants to change the password for another user who has forgotten their password and is unable to log in to the PC. When they try to access User Accounts in the Control Panel, they are unable to access it. What will you tell them?
- A. They need administrator access to change or create another user's account, and their user account is only a Standard account.
 - B. They can change it in Local Users and Groups.
 - C. They need to use the command-line utility to change the user's password.
 - D. They can't change the password, but they can add a new username for the password and make the new user an administrator so they can access their data.
- 137.** You are disposing of used hard drives, and a network administrator recommends performing a low-level format. What is the difference between a low-level format and a standard format?
- A. Low-level formats are performed at the factory, and standard formats are performed using the `format` command.
 - B. Standard formats are performed at the factory, and low-level formats are performed using the `format` command.
 - C. A modern low-level format fills the entire drive with zeros, returning it to factory mode. A standard format creates the master file table (MFT) and root directory.
 - D. A standard format records the tracks and marks the start of each sector on each track. A low-level format creates the file allocation table and root directory.
- 138.** What three ways can a user sign on to a Windows system using the passwordless Windows Hello sign-on? (Choose three.)
- A. Single device PIN
 - B. MFA
 - C. Fingerprint
 - D. Facial recognition

- 139.** You work for a bank whose policy is to physically destroy, rather than recycle, hard drives that are no longer needed. Which of the following is not a physical destruction method for hard drives?
- A. Incinerating
 - B. Drilling
 - C. Zero filling
 - D. Shredding
- 140.** A friend is getting overwhelmed with the number of website passwords they need to remember and has been writing them down. But the passwords aren't very complex, and your friend has used the same ones on several sites. You offer to help them. What will you do?
- A. Clear their browser cache.
 - B. Clear their browsing data.
 - C. Update their certificates.
 - D. Show them how to use their browser's password manager.
- 141.** You work for a company that is trying to be green. The company wants to repurpose its old PCs by giving them to a charitable organization rather than destroying or recycling them. What should you do before you give them away? (Choose two.)
- A. Wipe all the drives.
 - B. Low-level-format the drives.
 - C. Standard-format the drives.
 - D. Delete all the PCs' users and all their files and leave a generic Administrator account active.
- 142.** You're donating a Windows PC to a charity but first want to remove all your data and restore the PC's OS to its original factory installation. You've booted into the Windows recovery environment (WinRE). What does Microsoft call the recovery option to reinstall the OS and delete all user files and data?
- A. Refresh Your PC
 - B. Reset Your PC
 - C. Restore Your PC
 - D. Repair Your PC

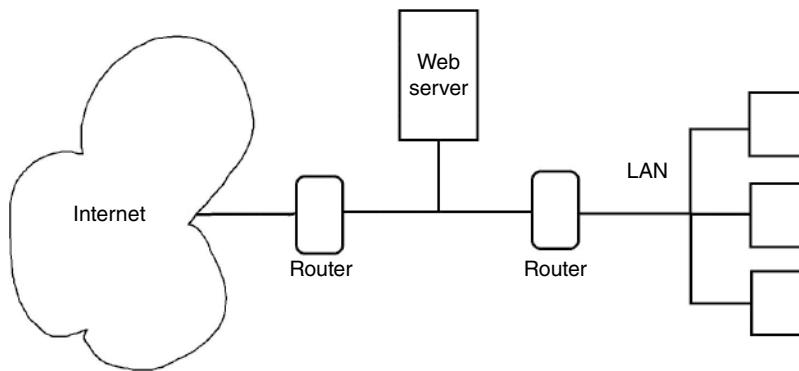
- 143.** You are setting up a Windows 11 Pro computer that will house data shared by several people. How will you establish security for this group?
- A. Use the Local Users and Groups app to create groups such as Accounting, Office, and so on. Then set up permissions for each group on shared files. Add users to and remove them from the group as needed.
 - B. In the Control Panel, User Accounts, make all the users Administrators so they can do what they need.
 - C. Use the Local Users and Groups app to create groups such as Accounting, Office, and so on. Then set up permissions for each person on the shared files. Add users to the groups just for organizational purposes.
 - D. Groups are only used on servers, so set up each person with their specific NTFS permissions on the shared data folders.
- 144.** You're providing system training to new employees, and they want to know where they should keep their passwords. What will you tell them? (Choose two.)
- A. Passwords should be written on a sticky note and attached to the bottom of their keyboard.
 - B. Passwords will be saved in password manager software, and multifactor authentication is used for network access.
 - C. Passwords should be taped to the monitor where they can see them.
 - D. They need to memorize their password and not write it down.
- 145.** One of your suppliers called today to tell you that its customer database and purchase order system have been compromised, and your company is one of the few whose information has been tampered with. The supplier is providing you with new authentication information and suggests that you change the passwords you're using to access its systems. What has happened here?
- A. QR code phishing
 - B. Ransomware
 - C. Whaling
 - D. Supply chain/pipeline attack
- 146.** Workers have been instructed to log off or lock their computers whenever they walk away from them, but as you walk around the company, you notice computers unlocked when no one is sitting there. Which of the following are the best ways to mitigate this problem? (Choose two.)
- A. Fire people who won't lock their computer.
 - B. Enforce screensaver locks after a short time of inactivity.
 - C. Train users on the importance of locking their PCs.
 - D. Enforce password complexity.

- 147.** Data encryption has been established for data that travels across the network, but you work in a secure environment and want to encrypt all the data on users' storage drives, including laptop drives, to prevent dissemination of information if the drives are compromised or stolen. Which of the following would not be a good solution to encrypt this data-at-rest?
- A. Use EFS and let the employee choose what to encrypt.
 - B. Use a third-party encryption solution.
 - C. Use MDM software.
 - D. Use BitLocker on desktop systems.
- 148.** You have a new smartphone that can authorize a transaction by using your phone's camera while you are simply looking at it. What is this technology called?
- A. PIN code
 - B. Fingerprint scanner
 - C. Device encryption
 - D. Facial recognition
- 149.** Which method of logging in to a mobile device may make it easy for someone to guess your password based on marks left by the oils in your skin?
- A. Facial recognition
 - B. Fingerprint
 - C. Pattern
 - D. Swipe
- 150.** Which of the following is the least secure way to access a mobile device whose screen is locked?
- A. Facial recognition
 - B. PIN code
 - C. Swipe
 - D. Pattern
- 151.** You just installed a security camera that communicates on port 4150. The video camera is connected to your SOHO router. With the camera set up, you can view the video stream from your computer that is on the same SOHO router, but not remotely on your phone or another computer. What did you forget to do?
- A. Configure port forwarding on the router
 - B. Close port 4150
 - C. Connect the camera to the router
 - D. Disable the firewall

- 152.** You are installing a SOHO router and a wired network for a small office. The manager is concerned that employees will visit websites with objectionable material. Which feature should you look for in a router to help prevent such access?
- A.** Content filtering
 - B.** Disabling ports
 - C.** VPN access
 - D.** Port forwarding/mapping
- 153.** Your office is in a building with several other companies. You want to configure the wireless network so that casual users in the building are not able to easily see your network name. What should you do to configure this?
- A.** Enable WPA3.
 - B.** Enable MAC filtering.
 - C.** Disable SSID broadcasts.
 - D.** Reduce radio power levels.
- 154.** You're changing some configuration settings on your SOHO router and notice that WPA3 is not available. What might you be able to do to resolve this issue?
- A.** Configure port forwarding.
 - B.** Configure content filtering.
 - C.** Update the SSID.
 - D.** Update the router's firmware.
- 155.** Which of the following are very fast and very secure ways to access your mobile device? (Choose two.)
- A.** PIN code
 - B.** Fingerprint
 - C.** Swipe
 - D.** Facial recognition
- 156.** In most browsers, where will you find the ability to enable or disable plug-ins/extensions and features?
- A.** Browser history
 - B.** The browser's website
 - C.** The browser's settings
 - D.** Windows Settings
- 157.** What method of securing a mobile device requires entering a series of numbers?
- A.** PIN code
 - B.** Fingerprint
 - C.** Pattern
 - D.** Facial recognition

- 158.** Your company has a policy that allows you to use your personal smartphone for company work because it will save the company money and is convenient for you. The IT manager installed some company software on it, and now you can't get into your favorite fantasy football gambling site. What has happened?
- A. Remote wipe
 - B. Content filtering
 - C. Application updates
 - D. Malware attack
- 159.** You own a small company with a SOHO router and a web server that is used to sell your products. You don't want the IP address of your web server to change, so you've paid the ISP for a specific IP address that is yours and will not change. What would you configure on your router for your ISP connection?
- A. Dynamic WAN IP
 - B. Static WAN IP
 - C. UPnP
 - D. Screened subnet
- 160.** What is the protocol that allows devices on your LAN, such as your laptop and printer, to find each other?
- A. WPA3
 - B. WPA2
 - C. PIN
 - D. UPnP
- 161.** You are configuring a new SOHO router that replaced a failed one. Your network has a mixture of devices purchased several years ago and newer ones purchased in 2025. Which of the following encryption options should you choose?
- A. WPA3
 - B. WPA2
 - C. WPA2/WPA3
 - D. WEP
- 162.** You perform very confidential work as a government contractor, and you work from home. Your contract specifies that the only external computers your computer can communicate with are the government computers involved in the project. What can you configure on your router to block all other computers from communicating with your network?
- A. IP address filtering
 - B. Untrusted sources
 - C. Hashing
 - D. Port filtering

- 163.** Your company has decided to allow users to use their own devices for company business. This decision will save the company money on hardware. To use their personal devices, the company will require that employees sign an agreement. What would this agreement be called?
- A. BYOD policy
 - B. MDM policy
 - C. Cell phone policy
 - D. Remote work policy
- 164.** Your iPhone requires a passcode to unlock it. Because of recent phone thefts around your office, you want to set your phone so that all data is destroyed if incorrect passcodes are entered 10 times in a row. Which feature allows you to do this?
- A. Failed login attempts restrictions
 - B. Screen locks
 - C. Remote wipes
 - D. Locator applications
- 165.** You own a small company with a SOHO router and a web server that is used to sell your products. You are concerned about the security of your LAN, so your IT consultant is going to set up a two-router system like the one shown in the graphic, to protect your LAN from web server traffic. What is this arrangement called?



- A. Dynamic WAN IP
- B. Static WAN IP
- C. UPnP
- D. Screened subnet

- 166.** You turned your back for a minute in the coffee shop, and your mobile device is now missing. Which one of the following is not a way to achieve a remote wipe on a mobile device?
- A.** Exceeding failed login attempts restrictions
 - B.** Using Google Find My Device or the Apple Find My app
 - C.** Using MDM software
 - D.** Disabling guest access
- 167.** You are setting up a router and network for a SOHO business. The router has wired and wireless connections. Which of the following is not a method for configuring secure management access or a secure location for the router?
- A.** Place the router in the kitchen area for easy access.
 - B.** Disable any guest accounts on the network. If guests need access, set up a separate VPN for them.
 - C.** Restrict IP addresses that can manage the router.
 - D.** Place the router in an area that can be locked.
- 168.** You're setting up a new wireless router for your company. Which of the following security settings should you not do?
- A.** Ensure that encryption is enabled (WPA2/WPA3).
 - B.** Create a VLAN for guest users.
 - C.** Turn your wireless signal power to maximum to decrease interference.
 - D.** Update the router's firmware.
- 169.** A user needs to download a new video card driver for their HP laptop. They find the driver on the HP support website and ask you if they can download it. The HP site is an example of what?
- A.** Part of an access control list
 - B.** An authenticator website
 - C.** A trusted source
 - D.** An untrusted source
- 170.** You're explaining browser synchronization to a coworker. Which of the following are true about synchronizing browser data? (Choose three.)
- A.** You must be logged in to devices so they will synchronize.
 - B.** You can disable or enable synchronization on individual devices.
 - C.** Synchronization happens in the background.
 - D.** You can't synchronize between Windows devices and Apple devices.

- 171.** You receive an email from an overseas bank notifying you that a relative has left you a generous inheritance. You need to respond with your bank routing information so the bank can electronically transfer the funds directly to your account. What is this most likely an example of?
- A. Phishing
 - B. Ransomware
 - C. Spoofing
 - D. Whaling
- 172.** Which of the following are methods to keep your mobile device safe? (Choose three.)
- A. Use a swipe to unlock a mobile device.
 - B. Accept and install OS updates as soon as possible.
 - C. Install antivirus/anti-malware software.
 - D. Use a remote backup application to safeguard your data in the event that you must wipe your phone.
- 173.** A coworker has been having some trouble with their browser being slow and some often-used web pages that won't load. You tell them to clear their browser's data. Which data should they clear? (Choose two.)
- A. Their browser cache
 - B. Tracking and cookies
 - C. History
 - D. Passwords
- 174.** You're visiting your mother-in-law and need to use her computer. The idea of her knowing what websites you use for work makes you uncomfortable. How can you ensure that she will not know what websites you've visited while there?
- A. Enable private browsing mode.
 - B. Update the certificates.
 - C. Change the computer's date to a different one, and then set it back when you're done.
 - D. Use a proxy browser.
- 175.** A user is complaining that so many ads are popping up on their screen when they're doing Internet research that they can't get their work done. What can you configure in their browser to mitigate this problem?
- A. Private-browsing mode
 - B. Pop-up blocker
 - C. Password manager
 - D. Certificates

- 176.** You work as a contractor for a government entity that requires proof of data destruction when decommissioning old hard drives and computers. What is the best way to do this?
- A.** Hire a third-party vendor to do the destruction and provide a certificate of destruction and recycling.
 - B.** Have the recycling center give you a receipt for the drives.
 - C.** Destroy them within your company, and show pictures of the destroyed drives to the government entity.
 - D.** Zero-write all the drives.
- 177.** Which of the following is a physical security measure that will trigger an alarm of some sort when it detects anything moving within its observation area?
- A.** Lighting
 - B.** Equipment locks
 - C.** Motion sensors
 - D.** Authenticator application
- 178.** Which of the following types of physical security is used to lock, unlock, and start vehicles and lock or unlock building and room doors?
- A.** Lighting
 - B.** Equipment locks
 - C.** Motion sensors
 - D.** Mobile digital keys
- 179.** You have identified sensitive information in your company that needs to be monitored, whether it's being stored, accessed, or moved. What solution will you employ?
- A.** Firewall
 - B.** VPN
 - C.** Group policy
 - D.** DLP
- 180.** Which of the following manages identities and their access to resources using adaptive MFA?
- A.** SSO
 - B.** SAML
 - C.** PAM
 - D.** IAM

- 181.** You believe your computer has contracted a boot sector virus. Which command-line tool permits someone to make changes to the operating system without having to boot up Windows?
- A. WinRE (also known as the recovery console)
 - B. RADIUS
 - C. Administrative Tools
 - D. Active Directory
- 182.** Your company allows you to use your personal smartphone for company work, because it will save the company money on hardware. You gave a week's notice that you're accepting a job with a different company, and suddenly your productivity applications are missing, along with your company files. What has happened?
- A. Remote wipe
 - B. Content filtering
 - C. Application updates
 - D. Malware attack
- 183.** Which of the following are important methods of patch management on mobile devices? (Choose two.)
- A. Application updates
 - B. Content filtering
 - C. Screen locks
 - D. OS updates
- 184.** Your friend wants to know what Secure DNS is, so you're attempting to explain it to them. Which of the following is not true?
- A. It's encrypted DNS information that uses HTTPS.
 - B. It's probably on by default on their browser.
 - C. It's only available in corporate versions of browsers.
 - D. It protects your information in transit between you and a website.
- 185.** What login OS option typically requires a domain and uses Kerberos?
- A. PIN
 - B. SSO
 - C. Facial recognition
 - D. Username/password

- 186.** You right-click a folder in Microsoft Windows, choose Properties, and click the Security tab. What are you now looking at?
- A.** Path
 - B.** Content filtering
 - C.** ACL
 - D.** UAC
- 187.** Where is folder redirection configured in Active Directory?
- A.** Home folder
 - B.** Group policy
 - C.** OU
 - D.** VPN
- 188.** You perform very confidential work as a government contractor, and you work from home. You use a browser interface to perform some of your work. What can be configured in a browser to ensure that the data you receive is not altered between a web server and you?
- A.** IP address filtering
 - B.** Trusted sources
 - C.** Hashing
 - D.** Port filtering
- 189.** A few users have been accessing material on restricted websites via your company's network. What type of server can you install to block content from a list of prohibited websites?
- A.** DNS server
 - B.** Authentication server
 - C.** Proxy server
 - D.** Web server
- 190.** A coworker is being blocked from a website that they have used in the past. A message on their browser says, "Your connection is not private." What do you suspect is the problem? (Choose two.)
- A.** Their browser cache needs clearing.
 - B.** Their browser history needs clearing.
 - C.** The website needs to update their certificates.
 - D.** The coworker's computer has the wrong date/time.

- 191.** A company visits your location when called to destroy old hard drives and paper copies. What are the advantages of paying someone else to do this? (Choose two.)
- A. They can provide a certificate of destruction and recycling.
 - B. You can prove compliance with regulations and environmental requirements.
 - C. You have to pay for expensive equipment.
 - D. You must zero-write all the drives first.
- 192.** Your company allows employees to bring their own devices to work. Security is a concern, so how can your company enforce compliance with corporate policies for remote workers? (Choose two.)
- A. Have the employees bring in the device so you can configure it.
 - B. Send the employees instructions on how to configure their device.
 - C. Use MDM software.
 - D. Require the installation of configuration profiles.
- 193.** You're setting up group policies for passwords. Which of the following policies will you configure to ensure that users can't reuse old passwords until some time has passed?
- A. Maximum Password Age
 - B. Enforce Password History
 - C. Minimum Password Age
 - D. Password Complexity Requirements
- 194.** A new IT hire has asked you what they should do about services running in the background of their OS, and which ones are necessary. Because you're focused on cybersecurity, what will you tell them about background services?
- A. They should all be on.
 - B. They should all be off.
 - C. Unused/unneeded services should be disabled.
 - D. Other services should be set to turn on only when needed.
- 195.** A temporary employee called the IT department because they were unable to log in to their account. Their work contract was set to be completed yesterday, but it was extended. What will you check in Active Directory?
- A. Account expiration dates
 - B. Group membership
 - C. Signs of a malware attack
 - D. That their computer is in the system

- 196.** You want to ensure that your workstations are hardened so that unauthorized users can't load the OS, and if they do, that they won't be able to launch malware by inserting a USB drive. Which two of the following are hardening techniques to ensure that they are blocked?
- A. Configure a BIOS/UEFI password
 - B. Restrict login times
 - C. Disable guest accounts
 - D. Disable AutoRun/AutoPlay
- 197.** Your system is infected with malware. You have verified the symptoms, quarantined the infected system, and disabled System Restore. Which are good choices to do next? (Choose two.)
- A. Boot into safe mode to clean out the malware files.
 - B. Reboot Windows as normal.
 - C. Rebuild the Registry.
 - D. Use updated bootable anti-malware tools to remove malicious files.
- 198.** You are training technicians on the creation and use of restore points. Restore points can sometimes fix problems with slow, infected, or unresponsive systems. Which of the following is not a way in which restore points are created?
- A. Windows creates them automatically by default.
 - B. You manually create them.
 - C. Windows creates them before a system crashes.
 - D. Some installation utilities will create them before installing a new program.
- 199.** A technician is fixing a Windows Home workstation that has contracted a virus. They are following the best practices for malware removal and have enabled System Restore and created a restore point. What is the next step that should be taken?
- A. Educate the end user.
 - B. Disable System Restore.
 - C. Quarantine the infected system.
 - D. Remediate the infected system.
- 200.** A network user with an Android tablet wants to back up and synchronize their data with their phone. Which service should they use to perform these tasks?
- A. Google Sync
 - B. Google Cloud
 - C. Sync My Phone
 - D. Bogus Cloud

- 201.** A step in the malware removal best practices is to manually create a restore point in Windows. What will the restore point do?
- A. Create a copy of the entire hard drive.
 - B. Create a copy of the `Users` folder and system configuration data.
 - C. Create a copy of system configuration data.
 - D. Create a bootable media with copies of key system files.
- 202.** You are troubleshooting a Windows 11 workstation that might have malware on it. To follow the best practices for malware removal, what is the first step you should take?
- A. Quarantine the infected system.
 - B. Update the anti-malware software.
 - C. Enable System Restore and create a restore point.
 - D. Investigate and verify malware symptoms.
- 203.** You are troubleshooting a workstation on your network and believe it has malware. To follow the best practices for malware removal, after you investigate and verify malware symptoms, which step should you take?
- A. Update anti-malware software.
 - B. Disable System Restore.
 - C. Quarantine the infected system.
 - D. Scan for and remove the malware.
- 204.** Which type of security method allows you to bring your security device near a reader (but does not require touching) to validate access?
- A. PIN code
 - B. Badge reader
 - C. Soft token
 - D. Biometrics
- 205.** Which of the following authentication encryption protocols is older than the others and was developed by Cisco, but became an open protocol in the 1990s, and can be found on Linux distributions?
- A. AES
 - B. TACACS+
 - C. Kerberos
 - D. RADIUS

- 206.** Which type of security device displays a randomly generated code that a user enters for access to computer resources?
- A. ID badge
 - B. RFID badge
 - C. Smart card
 - D. Key fob
- 207.** Your company's web server has been compromised because a malicious actor placed code into a name input field in the company's website. What type of attack has been perpetrated?
- A. Keylogger
 - B. Stalkerware
 - C. SQL injection
 - D. Trojan
- 208.** You receive an SMS from an overseas bank notifying you that you have won a random drawing. You need to respond with your bank routing information so the bank can electronically transfer the funds directly to your account. What is this most likely an example of?
- A. Phishing
 - B. Ransomware
 - C. Whaling
 - D. Smishing
- 209.** You have just transformed a Windows workgroup into a small domain and are configuring user accounts. Which of the following is considered a best practice for managing user account security?
- A. Require every user to log on as a Guest user.
 - B. Allow all users Read and Write access to all server files.
 - C. Follow the principle of least privilege.
 - D. Place all user accounts in the Administrator group.
- 210.** An employee scanned a QR code with their company smartphone to visit a potential supplier's website and input their contact information. Suddenly, they receive notice that their name and phone number have been spotted on the dark web. What type of attack were they a victim of?
- A. QR code phishing
 - B. Ransomware
 - C. Whaling
 - D. Smishing

- 211.** A malware attack was recently thwarted by your payroll manager. The malicious actor was trying to get them to give up the company's banking information. What type of attack was attempted?
- A. Spear phishing
 - B. Spyware
 - C. Virus
 - D. Whaling
- 212.** An employee receives an email from someone claiming to be from the IT department, asking for their network password, claiming that it needs to be reset because it's expired. If they provide the existing email, the new password then would be sent back to them via email. The employee has been to cybersecurity training, so they take a screenshot of the email and call the IT department immediately. What type of attack is it?
- A. Spear phishing
 - B. Spyware
 - C. BEC
 - D. Whaling
- 213.** Which of the following practices for managing user accounts are in line with following the principle of least privilege? (Choose two.)
- A. Restrict user permissions.
 - B. Restrict login times.
 - C. Enable the Guest account.
 - D. Give all users administrative access.
- 214.** Your friend called you and said that they're suddenly being sent to an online store that they've never used whenever they try to access their favorite online store. You ask if they've installed any software recently. They confirmed that they recently installed a new game. What type of attack is your friend a victim of?
- A. SQL
 - B. Smishing
 - C. PUP
 - D. OS
- 215.** Your company installed a new appliance that scans email and isolates potential phishing attacks, malware, and the potential dissemination of sensitive information. What type of appliance has been installed?
- A. SQL
 - B. EDR
 - C. Proxy server
 - D. Email security gateway

- 216.** You've been working on a compromised computer to eradicate malware. You've tried using multiple malware removal tools, but the system is still behaving erratically. The system is backed up daily, so data backups are available. What is your best option at this point?
- A. SQL
 - B. EDR
 - C. OS reinstallation
 - D. PUP
- 217.** Your department is interviewing vendors for a system that will monitor computers, smartphones, servers, and any other company endpoint devices for potential malware attacks. When a malware attack is discovered, the system will then automatically launch countermeasures to protect the company's data and endpoints, and monitor, report on, and mitigate the spread of potential problems.

What type of system are you examining?

- A. MDR
 - B. EDR
 - C. DDoS
 - D. PUP
- 218.** You've decided that an EDR system isn't enough. You need to monitor multiple places where endpoints exist, such as in the cloud and email. You've decided to use software that leverages AI and automation to identify, investigate, report, and respond to threats. What type of system are you installing?
- A. EDR
 - B. MDR
 - C. XDR
 - D. MXDR
- 219.** Which of the following is not a way to run a program as an administrator when you're logged on as a standard user?
- A. Right-click a program and choose Run as Administrator.
 - B. Launch a program that requires administrator privileges, and type the administrator password in the UAC box.
 - C. Press the Windows Key+the R key, and in the Run dialog box, type a command followed by admin and press Enter.
 - D. Press the Windows Key+the R key, and in the Run dialog box, type `cmd`. Press Ctrl+Shift+Enter to open a command prompt as an administrator. Enter the password in the UAC box and press Enter.

- 220.** Which security model requires that, rather than assuming a user is who they say they are because they're logged in to a network, they must continually authenticate who they are to access or continue accessing resources?
- A. Zero-trust
 - B. Principal of least privilege
 - C. Inheritance
 - D. UAC
- 221.** Which logical security tool provides a password or code that expires in a short time period?
- A. SSO
 - B. TOTP
 - C. Zero-trust
 - D. PAM
- 222.** Which security feature provides a password that is often delivered via email or SMS and can only be used once to grant access to a resource?
- A. SSO
 - B. JIT
 - C. OTP
 - D. PAM
- 223.** Which of the following is a feature of PAM that grants access to a system only when it is needed for a limited period of time?
- A. SSO
 - B. JIT
 - C. OTP
 - D. IAM



Chapter 8

Software Troubleshooting

THE COMPTIA A+ 220-1202 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

✓ **3.1 Given a scenario, troubleshoot common Windows OS issues.**

- Blue screen of death (BSOD)
- Degraded performance
- Boot issues
- Frequent shutdowns
- Services not starting
- Applications crashing
- Low memory warnings
- USB controller resource warnings
- System instability
- No OS found
- Slow profile load
- Time drift

✓ **3.2 Given a scenario, troubleshoot common mobile OS and application issues.**

- Application fails to launch
- Application fails to close/crashes
- Application fails to update
- Application fails to install
- Slow to respond
- OS fails to update
- Battery life issues



- Randomly reboots
- Connectivity issues
 - Bluetooth
 - Wi-Fi
 - Near-field communication (NFC)
- Screen does not autorotate

✓ **3.3 Given a scenario, troubleshoot common mobile OS and application security issues.**

- Security concerns
 - Application source/unofficial application stores
 - Developer mode
 - Root access/jailbreak
 - Unauthorized/malicious application
 - Application spoofing
- Common symptoms
 - High network traffic
 - Degraded response time
 - Data-usage limit notification
 - Limited Internet connectivity
 - No Internet connectivity
 - High number of ads
 - Fake security warnings
 - Unexpected application behavior
 - Leaked personal files/data

✓ **3.4 Given a scenario, troubleshoot common personal computer (PC) security issues.**

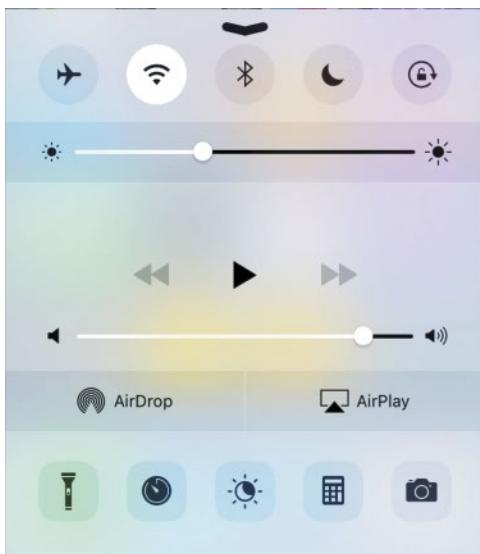
- Common symptoms
- Unable to access the network
- Desktop alerts
- False alerts regarding antivirus protection
- Altered system or personal files



- Missing/renamed files
- Inability to access files
- Unwanted notifications within the OS
- OS update failures
- Browser-related symptoms
 - Random/frequent pop-ups
 - Certificate warnings
 - Redirection
 - Degraded browser performance

1. A coworker is having problems with the Bluetooth connection between a device and their laptop. Which of the following can you do to check connectivity between the laptop and the device? (Choose two.)
 - A. Ensure that Bluetooth is turned on in Settings.
 - B. Ensure that Airplane mode is on.
 - C. Ensure that Airplane mode is off.
 - D. Go to a command prompt or terminal and type **Bluetooth** to enable it.
2. You just installed a new sound card and its drivers in a Windows workstation. Now, the computer has crashed and given you a blue screen of death. You turn the computer off. What should you try to resolve the issue?
 - A. Reinstall Windows.
 - B. Boot to the Windows installation media and start the WinRE.
 - C. Boot to safe mode and uninstall the sound card driver.
 - D. Remove the sound card from the computer and reboot.
3. An iPad user reports that when they are in a certain part of the building, their wireless connection intermittently drops. What are the most likely causes of this? (Choose two.)
 - A. Poor wireless buffering in the iPad
 - B. Interference with the wireless signal
 - C. Weak signal strength from the wireless access point
 - D. Retracted Wi-Fi antenna on the iPad
4. You noticed that your browser is running much more slowly than normal, even though you have a strong Wi-Fi connection. Which of the following are likely causes? (Choose three.)
 - A. Too many tabs open
 - B. Cache needs clearing
 - C. Too much RAM
 - D. Poorly written extension or add-on
5. On your MacBook Pro, you use the Safari browser to surf the Internet. Yesterday, a friend borrowed your laptop. Today, when you try to browse the Web, no matter what site's URL you type into the address bar, you are sent to a different website. What is most likely happening to your computer?
 - A. A practical joke by your friend
 - B. Browser redirection
 - C. Rogue antivirus
 - D. Spam infection

6. Your company purchases a custom database software package from an outside vendor. You install the client software on a Windows workstation, and it crashes when you try to open it. You remove the software and reinstall it, but again it crashes when you open it. What should you do next?
- A. Run an anti-malware remediation on the workstation.
 - B. Contact the vendor to see whether an update or patch is available.
 - C. Delete and reinstall Windows.
 - D. Enable Software Compatibility through the Control Panel.
7. An iPhone user reports that their phone will not connect to their wireless headset for hands-free phone calls. The headset is powered on and has worked previously. Their iPhone screen is shown in the graphic. What is most likely the problem?



- A. The headset is not paired with the iPhone.
 - B. Bluetooth is turned off.
 - C. Wi-Fi is turned off.
 - D. Airplane mode is turned on.
8. A user reports that their Windows Start menu looks wrong and takes too long to load. You know the environment relies on roaming profiles. What is a reliable solution to the user's problem?
- A. Rebuild the desktop image.
 - B. Rebuild the Windows user profile.
 - C. Delete the Registry on the local machine.
 - D. Reboot the machine.

9. While working on a Windows workstation, a user receives a flashing pop-up message saying that their computer has been infected with ransomware and they need to download an anti-malware update now to fix it. What will most likely happen if they click the button to download the recommended anti-malware?
- A. It will download malware to their computer.
 - B. It will download an anti-malware program to their computer and remediate it.
 - C. The anti-malware program they download will scan their computer and find nothing because their company already uses an anti-malware program.
 - D. It will take them to a website that will allow them to purchase an anti-malware program to remediate the system.
10. You have 20 Windows 11 workstations on your network. You want to create bootable media that will allow you to fix Windows boot issues. Where can you create this media?
- A. Use Windows Security in the Settings app.
 - B. Back up and sync your settings in the Settings app.
 - C. Download and use Microsoft's media creation tool.
 - D. Copy the contents of the C drive to a USB.
11. Your Windows system doesn't appear to be stable. It's slow to respond when you want it to open a file. You just installed a new software application yesterday. What actions can you take to fix this problem? (Choose two.)
- A. Reinstall Windows.
 - B. Run an anti-malware scan.
 - C. Use WinRE to reformat the drive.
 - D. Restore from a recent system restore point.
12. Your Windows system is running sluggishly. When you look at the storage drive, you notice that there is very little space available. Which tool should you run to attempt to free some space on the drive?
- A. Optimize and Defragment Drive
 - B. Disk Cleanup
 - C. regedit
 - D. SFC
13. A user reports that a Word document they need will not open. Other documents open as they should. They have not made a backup of this file. Which of the following statements is true?
- A. The file is probably corrupted, and its contents are lost.
 - B. They can use a restore point to get the file back.
 - C. They can use the command-line utility to open the document.
 - D. They can use WinRE to repair the file and then open it.

- 14.** You've been working very hard and have several Word documents open on your desktop. Luckily, you've been saving them often, because suddenly the Word app is showing all sorts of strange characters on the screen, even in the ribbon at top. It appears to be corrupted, and it won't respond to any commands, including Close. How can you force the app to close, so you can reopen the saved files and continue your work? (Choose two.)
- A.** Double-click the program file.
 - B.** Right-click anywhere in the program window and choose Close.
 - C.** Open Task Manager and select the Processes tab. Then right-click the program name and choose End Task.
 - D.** Reboot the computer.
- 15.** Your iPad is experiencing slow performance. What are the best two options to increase performance speed? (Choose two.)
- A.** Close open apps.
 - B.** Perform a reset to the factory default.
 - C.** Increase the RAM.
 - D.** Perform a soft reset.
- 16.** You just downloaded an app to connect to your bank on your mobile device. You weren't sure which app to choose, so you picked the one that looks most like your bank. After installing the app, something didn't look right, and you noticed misspelled words on the screen where it's asking for your username and password. What should you do next?
- A.** Enter your username and password.
 - B.** Call the bank and ask them about the app.
 - C.** Uninstall the app immediately and run an anti-malware scan.
 - D.** Run a spell checker on the app.
- 17.** You are visiting a website using your favorite browser, and without you clicking anything, a new browser window opens in front of it with an advertisement. Which of the following is the most likely explanation?
- A.** Your computer has been infected with adware.
 - B.** Your computer has been infected with spyware.
 - C.** Your computer has been infected with a virus.
 - D.** The website is programmed to show a pop-up advertisement.
- 18.** You are talking to a friend about purchasing a gift, and they recommend a website to purchase it. When you put the website's secure address into your browser, you receive a message stating that there is an invalid certificate. What should you do?
- A.** Visit the website anyway; it's probably okay.
 - B.** Do not visit the website.
 - C.** Visit the secure version of the website by changing the address to start with `HTTPS://`.
 - D.** Visit the unsecure version of the website by changing the address to start with `HTTP://`.

- 19.** Your favorite restaurant locator app on your iPhone won't load. You closed it and tried to reopen it a few times, and it still doesn't work. What should you try next?
- A.** Remove and reinstall the app.
 - B.** Perform a factory reset.
 - C.** Force-stop the app.
 - D.** Reboot the phone and try the app again.
- 20.** You're using your smartphone. When is it generally necessary to force-close running apps?
- A.** When you receive out-of-memory errors
 - B.** When the phone is sluggish
 - C.** When an app locks up
 - D.** When you are done using them for the day
- 21.** You receive an email warning you of a new form of ransomware. It contains a link to receive more information on how to protect yourself from this terrible threat. What should you do next?
- A.** Click the link to receive more information.
 - B.** Check your antivirus provider's website for information on the threat.
 - C.** Check to ensure that your system has a rogue antivirus installed.
 - D.** Forward the email to everyone in your contacts list.
- 22.** Mobile device users on your network are required to use a VPN app to connect to the corporate network when they are out of the office. A user reports that the app will not open for them. They're using a tablet, which they have turned off and back on again, and the app still will not open. What should be tried next?
- A.** Cycle the power.
 - B.** Reset the device to factory defaults.
 - C.** Uninstall and reinstall the app.
 - D.** Perform a force-stop.
- 23.** Your Windows desktop system is running sluggishly. You have a magnetic hard drive and an M.2 drive. What could you do that might improve system performance? (Choose two.)
- A.** Run Optimize and Defragment Drive on the magnetic media drive.
 - B.** Run Disk Cleanup on both drives.
 - C.** Run Optimize and Defragment Drive on the M.2 drive.
 - D.** Run SFC.
- 24.** You are visiting a website using your favorite browser. You haven't clicked anything, yet you can barely read the page because there are so many pop-ups. Which of the following is most likely causing the random, frequent pop-ups?
- A.** Your computer has been infected with adware.
 - B.** The website is poorly written.
 - C.** The website uses pop-ups to interact with you.
 - D.** The website is programmed to show a pop-up advertisement.

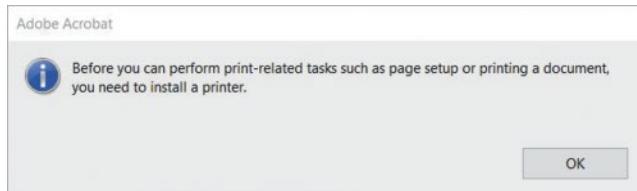
- 25.** Client computers on your network connect to the Internet through a proxy server. Recently, a Windows client was infected with adware and a browser redirector. You have removed the malware, and now the computer will not connect to the Internet. What should you do to resolve the problem?
- A.** Disable the network card. Reboot and enable the network card.
 - B.** Perform malware remediation again.
 - C.** Disable the proxy server configuration to connect directly to the Internet.
 - D.** Check the IP configuration to ensure that it's pointing to the correct proxy server address.
- 26.** Your company has recently made changes to infrastructure services such as DNS. Since then, a number of users have reported that they are no longer able to connect to internal servers by name. What can be done at each affected workstation to fix the problem? (Choose two.)
- A.** Reboot.
 - B.** Manually update network settings.
 - C.** Disable the software firewall.
 - D.** Boot to safe mode.
- 27.** Your windows computer has not been functioning properly since you installed a new application. You believe the application was poorly written and is causing the issue. You want to refresh your Windows installation but keep your personal files. Where can this be done? (Choose three.)
- A.** System Recovery in the Settings app
 - B.** Safe mode
 - C.** Emergency repair disk
 - D.** WinRE
- 28.** A Windows user's vertical market application has crashed. They reboot the computer and try to open it again, and it crashes again. What should be done next to solve the problem? (Choose two.)
- A.** Look for a patch or update on the manufacturer's website.
 - B.** Delete the application and reinstall it.
 - C.** Remove and reinstall Windows.
 - D.** Repair the application through Programs and Features in the Control Panel.
- 29.** A user reports that an application has been crashing on their mobile device. They said an error pop-up window flashes on the screen briefly, but they are unable to read it. What would be your next step?
- A.** Wait for the next crash to read the error pop-up yourself.
 - B.** Install and run a screen recorder to capture the next pop-up.
 - C.** Reinstall the application.
 - D.** Check the application log for error messages.

30. A user reports that the battery life on their smartphone is very short. It works for only about three hours before it needs to be recharged. What can you recommend they do to extend their phone's battery life? (Choose two.)
- A. Turn off unnecessary wireless connections.
 - B. Perform a reset to factory defaults.
 - C. Set the screen to automatically dim.
 - D. Install an antivirus app.
31. A laptop user is unable to access the Wi-Fi network and is receiving an error message that a duplicate IP exists on the system. You are confused because you have a DHCP server. What do you need to do next?
- A. Manually configure the IP address.
 - B. Ensure that this computer is set to obtain an IP address automatically.
 - C. Ping the IP address from another computer to find out the name of the duplicate computer.
 - D. At a command prompt, enter ipconfig /release and then ipconfig /renew.
32. You are working on your Windows computer and a security alert pops up, as shown in this graphic. What should your next action be?



- A. Click the Protect Now button.
 - B. Click the X in the upper-right corner to close the alert.
 - C. Shut down your computer. Reboot it using an anti-malware boot device, and then initiate a malware scan.
 - D. Use System Restore to create a snapshot, and then click the Protect Now button.
33. You have a Windows workstation that is spontaneously shutting down and restarting. What should you do to troubleshoot and resolve the issue?
- A. Check the system BIOS/UEFI settings to ensure that the boot order is set properly.
 - B. Boot to the Windows installation media, and navigate to the WinRE command prompt.
 - C. Boot into safe mode and see if the problem still persists.
 - D. Reinstall Windows.

- 34.** A Windows desktop computer always shuts down about 10 minutes after the user boots it up. The computer works fine for those first 10 minutes, and if they boot up again a few minutes after a shutdown, it works fine again for 10 minutes. How might you fix this? (Choose two.)
- A.** Reinstall Windows.
 - B.** Use compressed air or an ESD vacuum to clean dust and debris from the system.
 - C.** Use SFC to search for and repair corrupted system files.
 - D.** Replace the thermal paste on the processor.
- 35.** Your Windows computer was working fine yesterday, but today it is exhibiting slow (degraded) performance. Which of the following tools should be used to check for a potential problem causing the slowdown? (Choose two.)
- A.** Anti-malware software
 - B.** Event Viewer
 - C.** Task Manager, Processes tab
 - D.** Programs and Features in the Control Panel
- 36.** A user on your Active Directory domain is complaining that their profile is taking a long time to load. They've been waiting several minutes. Upon questioning, you find out that this is their first logon at a different computer. What is happening here?
- A.** They are not listed as a user on this computer.
 - B.** Their roaming profile is downloading to this computer, and it takes longer the first time a user logs on to a different PC.
 - C.** A peripheral is not connected as it should be, causing a loop in the boot process.
 - D.** They entered the wrong password.
- 37.** A Windows user at your office receives the message shown in the graphic when trying to print a document. They know that there were two printers listed yesterday. What is most likely the problem?



- A.** Someone has deleted their printers.
- B.** Both printers are offline.
- C.** Both printers are out of paper.
- D.** The print spooler service needs to be restarted.

- 38.** The time on your Windows computer is always off by a few minutes, called time drift. You need to ensure that it will keep the right time, because an incorrect time will not allow it to log in to your server. Which of the following actions will not help?
- A.** In Settings, select Time & Language, then Date & time, and ensure that Set Time Zone Automatically and Set Time Automatically are set to On.
 - B.** Right-click on the time on the taskbar and choose Internet Time, and then choose a different time server.
 - C.** Open the Services console and ensure that the Windows Time service start is set to Automatic and that the service is started.
 - D.** In Settings, select Time & Language and then Date & Time, and click Sync Now.
- 39.** A Windows workstation that is set to boot from the C: drive, and normally boots just fine, will not boot properly. Instead, there is an error message stating that no OS is found. What steps should you take to fix this problem?
- A.** Boot to installation media, navigate to a command prompt, type `startup repair`, and press Enter.
 - B.** Boot to the installation media, open SFC, and choose Startup Repair.
 - C.** Boot to the installation media, and then navigate to Startup Repair.
 - D.** Boot to safe mode.
- 40.** A Windows workstation is running slowly. You have already verified that there is no malware in the system. What will you do next? (Choose two.)
- A.** Check available physical memory.
 - B.** Check available virtual memory.
 - C.** Roll back the OS update to a prior one.
 - D.** Restore from a restore point.
- 41.** An application on your Windows workstation isn't working properly, and when you research the error message online, the result is that you need to update the application. Where can you go to do this? (Choose two.)
- A.** Check for an Update option in the software.
 - B.** In the Control Panel, click Programs and Features.
 - C.** Check the application's company website.
 - D.** In the Settings app, select Apps and then Apps & Features.
- 42.** You're trying to launch an application on your Windows workstation, but the application won't load. You've tried uninstalling and reinstalling the application, but it didn't help. Which of the following should you do next?
- A.** Check the application's website for updates.
 - B.** Verify that your system meets the application requirements.
 - C.** Choose a different application that does the same thing.
 - D.** Reinstall Windows.

- 43.** You’re in Microsoft Word and want to open a file that you used yesterday. You know that you saved the file, and it shows in the list of recently used files, but when you click on it a message says that the file can’t be found. You then go to the folder where the file is stored and see that the file extension has been changed. What should you immediately suspect?
- A.** The drive is corrupted, and you need to reinstall Windows.
 - B.** The Word program is corrupted, and you need to reinstall Word.
 - C.** A coworker has been playing with your computer and opened and saved your file using a different program.
 - D.** Your computer has been infected by malware.
- 44.** A Windows 11 computer user receives an error message that a needed service failed to start. Where can that user go to start the service? (Choose two.)
- A.** The Services tab of Task Manager
 - B.** Computer Management
 - C.** The Services console
 - D.** Device Manager
- 45.** A Windows system is running slowly. Which of the following is not likely to be the culprit?
- A.** The PC has too little RAM.
 - B.** The paging file is too large.
 - C.** The system is infected with malware.
 - D.** The hard drive is too large.
- 46.** You are trying to apply Windows Updates to a Windows client computer. The update fails and gives you an error message. What should you do next?
- A.** Run the Windows Update troubleshooter in the Settings app.
 - B.** Wait until the next Windows Update comes out in six months.
 - C.** Reinstall the operating system.
 - D.** Purchase an updated computer.
- 47.** You work for a government entity, and it insists that you use the government time server, `time.NIST.gov`, to sync the time on your computer system. Where will you go to do this?
- A.** In the Settings app, select Time & Language and then Date & Time. Ensure that Set Time Automatically and Set time Zone Automatically are both set to On.
 - B.** Open the Services console, and ensure that Windows Time is set to `time.NIST.gov` and that the service is started.
 - C.** In the Control Panel, select Date and Time; on the Internet Time tab, click Change Settings; and then, under Server, choose `time.NIST.gov`.
 - D.** Double-click the time in the task bar, and on the Internet Time tab, under Servers, choose `time.NIST.gov`.

- 48.** A Windows user complains that every day they get a message that a service they need for a particular program has not started, and they must open the Services console and start it. What will you tell the user?
- A. Some services behave that way. You'll need to start it every day.
 - B. Open the Services console, double-click the service, and on the General tab, change the Startup Type to Automatic.
 - C. Open the Services console, double-click the service, and on the General tab, change the Startup Type to Manual.
 - D. Open the application and look for a place to have it start the service for the user.
- 49.** You've noticed that lately your games freeze or crash more often, and you received a message stating that your computer is low on memory. What can you do to resolve this? (Choose two.)
- A. Increase virtual memory.
 - B. Decrease virtual memory.
 - C. Increase physical memory.
 - D. Buy a bigger hard drive.
- 50.** You're attempting to install an application, and it warns you that it needs 4 GB of RAM. Where will you go to see if you have sufficient RAM to run this application? (Choose two.)
- A. Open the case and see how many modules are installed.
 - B. Use the System Information utility.
 - C. Use the Performance tab in Task Manager.
 - D. In the Control Panel, select Memory.
- 51.** A user reports that their PC was fine until an OS update was installed. However, the update had not been tested yet and is found to be incompatible with a necessary business application. What is your next step? (Choose two.)
- A. Roll back the update.
 - B. Update the business application.
 - C. Do nothing; have the user take awareness training.
 - D. Go to the Control Panel, Programs and Features, and click on View Installed Updates.
- 52.** While booting up a Windows PC, you find it takes a long time at the Welcome screen. A message stating “Your roaming profile isn’t synchronized with the server...” appears. Which of the following are true? (Choose two.)
- A. The User Profile service detected a slow connection.
 - B. A locally cached profile was loaded.
 - C. User Profile Service is not running.
 - D. Screen resolution is not compatible with the user profile.

53. You just installed new external speakers on a Windows computer, and you've received an error message saying "Not enough USB Controller Resources." What would most likely cause this error? (Choose two.)
- A. The motherboard is damaged.
 - B. The USB devices are drawing more power than the limit.
 - C. There are too many devices on a USB 3.0 hub controller.
 - D. The speaker drivers are conflicting with the USB hub controller drivers.
54. A smartphone user has complained that their phone won't let them look at anything in landscape—no matter how they turn it, it will not automatically rotate. You look at their screen, and it appears as shown in the graphic. Why isn't their phone letting them look at pictures in landscape view?



- A. Their Bluetooth is off.
- B. Their focus is off.
- C. Their camera is not on.
- D. Their orientation is locked.

- 55.** Mobile device users on your network report that the network has a very slow response time. Which of the following are likely contributors to this problem? (Choose two.)
- A. Low battery life
 - B. Signal interference
 - C. Unintended Wi-Fi connections
 - D. Weak signal
- 56.** Several mobile device users have reported that when they eat lunch in the garden next to the office building, they have limited Internet connectivity. What is the most likely fix for this?
- A. Boosting WAP signal strength
 - B. Having all the users reboot their devices
 - C. Rebooting the WAP
 - D. Having the users turn on Wi-Fi on each of their devices
- 57.** You've been looking for a specific Android app and found it at an amazing price. It almost seems too good to be true, which makes you pause to consider whether it is the real app or not. Which of the following should you do before paying for and downloading this app? (Choose three.)
- A. Check the reviews and the number of reviews.
 - B. Check the developer's name and how long the app has been available.
 - C. Verify the spelling of the app name.
 - D. Install the free version and see if there are any problems.
- 58.** A user on your network complains that they see a message for a long time that says "Waiting for the User Profile Service." and their profile is very slow to load. What could be the problem?
- A. There is a slow link between the domain controller and the client, but it was not correctly detected by the User Profile service.
 - B. The user has never logged in to this computer before.
 - C. Windows needs to be updated.
 - D. The user entered an invalid password.
- 59.** You're working on a Windows client and have received an error message saying "Not Enough USB Controller Resources." Which of the following is not a possible remedy for this situation?
- A. Plug a USB cable from a power block into one of the USB ports on the motherboard.
 - B. Purchase an external hub or docking station that is separately powered, and plug devices into it.
 - C. Move devices that don't need USB 3.X speed to USB 2.0 ports.
 - D. Disable the XHCI Mode option in the BIOS/UEFI settings.

60. Your friend has complained that they can't connect their phone to their Wi-Fi network at home and they've used all their cellular data. You look at their screen, and it appears as shown in the graphic, where the image backgrounds are as follows: airplane is gray, cellular is green, and Bluetooth is blue. What is the problem?



- A. Airplane mode is on.
 - B. Their Bluetooth is turned off.
 - C. Their Wi-Fi is turned off.
 - D. Their cellular service is turned off.
61. You're using the most recent version of Microsoft Edge to browse the Internet on your Windows workstation. It has been working fine, but today, when you visit any website, you receive an error message that there is an invalid certificate. It happens regardless of the site you visit. What should you do?
- A. Check your computer's time and date.
 - B. Refresh your certificate through the Security settings in the Control Panel.
 - C. Set your Security Level to low for the Internet Zone in Internet Properties in the Control Panel.
 - D. In Microsoft Edge, turn off Enhance Your Security on The Web.

- 62.** You use an iPad and an iPhone at work. Which of the following represent the greatest threats to leaking personal files or data? (Choose two.)
- A.** Unauthorized root access (i.e., jailbreak)
 - B.** Unintended Wi-Fi connections
 - C.** Unauthorized location tracking
 - D.** High resource utilization
- 63.** You receive a notice from your wireless provider that you are about to exceed your data transmission limit for the month. What type of risk does this present?
- A.** Your account might be deactivated.
 - B.** You might incur a security breach.
 - C.** You might have to pay high fees.
 - D.** Your phone might be locked out of the system.
- 64.** Your Android-based phone has recently started rebooting randomly. Which of the following might be the cause? (Choose two.)
- A.** You've installed a poorly written app.
 - B.** The phone's battery is at room temperature.
 - C.** Auto-restart is enabled.
 - D.** You're typing too fast on the keyboard.
- 65.** A smartphone user calls to report that their phone has no wireless connectivity. What is the first thing you should tell them to do?
- A.** Turn the phone off and back on again.
 - B.** Check whether Airplane mode is on.
 - C.** Perform a reset to factory default.
 - D.** Adjust the Wi-Fi signal receptivity.
- 66.** Your network has several dozen mobile device users. Several of them have reported that there are areas within your office where network access is very slow. Which of the following is not likely something you can do to help them?
- A.** Install a new WAP.
 - B.** Test the network with a Wi-Fi analyzer.
 - C.** Check for network interference and congestion.
 - D.** Get new devices for those having problems.
- 67.** A user on your network is suddenly receiving an overwhelming number of pop-up ads on their mobile device. What is likely happening? (Choose two.)
- A.** They contracted malware.
 - B.** Their browser's pop-up blocker is turned off.
 - C.** They are the victim of an adware attack.
 - D.** They need to reinstall their browser.

- 68.** An Android phone user just received a new Bluetooth headset for phone calls. They've reported that it does not work with their phone. Both devices are powered on and appear to be operational. What is most likely the problem?
- A.** Bluetooth is turned off on the Android device.
 - B.** Bluetooth is turned off on the mobile headset.
 - C.** The devices need to be paired.
 - D.** Airplane mode is on.
- 69.** You have an unlimited data plan with your cellular provider, but today you received a notice from your provider that you are about to exceed your data transmission threshold for the month. What will likely happen?
- A.** Your account might be deactivated.
 - B.** You might incur a security breach.
 - C.** Your data transmissions will be slower than normal.
 - D.** Your phone might be locked out of the system.
- 70.** A user complains that their Apple device is randomly restarting. They haven't installed any new software recently. What steps will you take to troubleshoot the problem? (Choose two.)
- A.** Ensure that the iOS or iPadOS and apps are up to date.
 - B.** Check their battery health in Settings.
 - C.** Replace the battery.
 - D.** Reset the phone to factory default.
- 71.** A very serious-looking pop-up appears on your mobile device screen and says to click it for an update to your anti-malware software that will eradicate a virus your device has contracted. Which of the following should you not do?
- A.** Click the link to update your anti-malware.
 - B.** Restart the device in safe mode if that is an option on your device.
 - C.** Update your anti-malware as you normally do, and run a scan.
 - D.** Check online for information about this fake security warning.
- 72.** A smartphone user is concerned about their privacy and wants to ensure that others can't hack into their phone and track down their location or access their personal data and pictures. Which of the following actions will provide them with some protection to help prevent this from happening? (Choose two.)
- A.** Install an anti-malware app.
 - B.** Install OS updates as soon as they are available.
 - C.** Disable location services.
 - D.** Enable sync with a cloud provider.

- 73.** You’re trying to pay for coffee at your favorite shop using its NFC reader and Apple Pay, but your phone isn’t communicating with it. What is most likely the problem? (Choose two.)
- A.** Wi-Fi is disabled.
 - B.** NFC isn’t enabled.
 - C.** Airplane mode is on.
 - D.** Bluetooth is disabled.
- 74.** You’re attempting to share files with an iPad user by using AirDrop. You both have Wi-Fi turned on, but you can’t seem to connect. Which of the following could be causing the problem? (Choose two.)
- A.** One of you does not have Bluetooth turned on.
 - B.** You are not listed in their contacts.
 - C.** They have their AirDrop Receiving setting set to Everyone.
 - D.** They turned off their hotspot.
- 75.** An Android device user is suddenly receiving an overwhelming number of pop-up ads on their mobile device and has called you for help. What is most likely the reason for the pop-ups?
- A.** Malware
 - B.** A third-party app
 - C.** A firewall
 - D.** A proxy server
- 76.** You’re attempting to update the iOS on your iPhone, but the update fails, and you receive the message “Unable to install update. Software update requires a network connection.” What should you do first?
- A.** Retry the update using the same network connection.
 - B.** Connect the iPhone to your PC and update it that way.
 - C.** Remove apps or data to make enough room on your phone for the update.
 - D.** Connect to a different network.
- 77.** An application failed to update on a user’s phone. Which of the following are likely to be the problem? (Choose two.)
- A.** The phone is plugged into power.
 - B.** There is insufficient space on the phone.
 - C.** They’re using Wi-Fi instead of Ethernet.
 - D.** The Internet connection is weak.

- 78.** A user reports that their mobile phone has been experiencing higher-than-normal use of resources for about a week. What two things should you immediately suspect could be causing the problem? (Choose two.)
- A.** Unauthorized root access
 - B.** Failing battery
 - C.** Excessive number of open apps
 - D.** Stuck sync operation
- 79.** You are visiting a customer's office in a large city high-rise building. You need to make a call on your mobile phone, but you have only one bar and the call will not complete. What should you do?
- A.** Wait a few minutes and try again.
 - B.** Cycle the power off and on.
 - C.** Reset to factory defaults.
 - D.** Step outside or near a window.
- 80.** The GPS app on your mobile phone keeps popping up randomly on the screen, and your phone seems to be running very slowly. Which choice will likely not help in this situation?
- A.** Restart the phone in safe mode.
 - B.** Force-stop the application.
 - C.** Perform a malware scan.
 - D.** Uninstall the app.
- 81.** While driving through the remote countryside, you notice that your mobile phone battery has quickly drained of power. What is the most likely cause of this?
- A.** The battery needs to be replaced.
 - B.** The phone has been searching for a signal.
 - C.** You need to cycle the power off and on again.
 - D.** You need to replace the phone.
- 82.** A user wants to use developer mode on their Android device to make some tweaks to the system. What settings will you tell them they should not leave on? (Choose two.)
- A.** USB configuration
 - B.** Show Touches
 - C.** Developer mode
 - D.** Debugging

- 83.** You're trying to update your iPhone's iOS, but there is not enough free space on your phone to do the update. Which of the following should you do? (Choose two.)
- A.** Use your computer to perform the update.
 - B.** Remove content and apps that you don't use.
 - C.** Purchase more internal memory for your iPhone.
 - D.** Purchase an SD card for your iPhone.
- 84.** You're trying to install a new application from the Play Store on your Android mobile device, but the installation isn't working. Which of the following might be the problem? (Choose two.)
- A.** The Play Store cache is empty.
 - B.** The network speed is too fast.
 - C.** The date and time on your device are wrong.
 - D.** There are other downloads or updates pending in the Play Store queue.
- 85.** A user is complaining that they see a lot of ads popping up on their screen in the bottom right (i.e., the notifications area). They have run a scan using their anti-malware software, and it says their computer is clean. The constant pop-ups are interfering with their work, and they ask you what can be done about it. Which of the following is not true?
- A.** These are push notifications, not pop-ups.
 - B.** Nothing can be done about them.
 - C.** The user allowed them at some point.
 - D.** The user can disable or block all or some.
- 86.** You're attempting to update an Android phone but receive an error message that the update failed. Which of the following could be the problem? (Choose two.)
- A.** The device has insufficient storage space.
 - B.** There is a good Wi-Fi connection.
 - C.** There is insufficient battery power.
 - D.** The device is plugged into its charger.
- 87.** You're considering installing a desktop alert system for your business, which has both in-house and remote workers. Which of the following are true regarding desktop alerts? (Choose two.)
- A.** Desktop alerts are limited to desktops.
 - B.** Desktop alerts provide an excellent emergency communication system such as weather alerts.
 - C.** Desktop alerts are text only, not graphics.
 - D.** Desktop alert software can be made interactive and can become a security threat.

- 88.** A friend asks you what jailbreaking a device is and if they should do it. Which of the following is not true about jailbreaking?
- A.** Jailbreaking is like cracking software or gaining root access to a phone, which makes your device more vulnerable to attack.
 - B.** Jailbreaking might be illegal depending on where you are in the world.
 - C.** Jailbreaking is a safe way to get more out of your device.
 - D.** Jailbreaking gives the user full access to the device, and on an iPhone, it allows the user to download apps not approved by Apple.
- 89.** A user is attempting to install new features for an app from the developer’s website instead of from the Google Play app store, where they originally downloaded the app. The update with the new features fails to install. Why? (Choose two.)
- A.** The signatures don’t match.
 - B.** The update is an APK format.
 - C.** Only Google can write apps for Android devices.
 - D.** The website is likely spoofed.
- 90.** Recently you’ve noticed a suddenly high volume of traffic on the VLAN that is used by mobile devices at your business. You know that the number of mobile devices hasn’t increased that much. What should you suspect?
- A.** A mobile device is malfunctioning.
 - B.** One or more mobile devices is infected with malware.
 - C.** Devices are experiencing limited connectivity.
 - D.** Your monitoring software is infected.
- 91.** What is one of the best ways to prevent malware from being spread by desktop alerts?
- A.** Educate the end users.
 - B.** Block all desktop alerts.
 - C.** Always log in as an administrator.
 - D.** Update anti-malware once a month.
- 92.** You’re attempting to boot a computer that worked fine yesterday, but today it says “OS not found” or a similar message. What will you do first?
- A.** Verify the boot options in BIOS/UEFI.
 - B.** Verify there are no USB drives inserted.
 - C.** Restart the computer.
 - D.** Remove the HDD.

- 93.** A user complains that their Windows 11 laptop seems to be unstable. They had installed some software, and although they have removed it, the system is still behaving strangely. You have examined the system and determined that it is not infected with malware. What will you do next?
- A.** Boot to installation media and reformat the hard drive, and then reinstall the operating system.
 - B.** Hold the Shift key and restart the computer. The computer will restart in WinRE.
 - C.** Perform a system restore from the restore point created immediately before the software was installed.
 - D.** Delete the Registry and restart the computer.
- 94.** You are donating some old mobile devices to charity. What should you do before you give them away?
- A.** Replace the storage media with new media, and destroy the old storage media.
 - B.** Delete all your personal/company files.
 - C.** Perform an in-place update.
 - D.** Perform a Factory Image Restore.
- 95.** Your company uses an Active Directory domain to control resources on your network. It also uses a PC image to prepare computers for first use within your organization. One of your computer users complains that they can't print, and a few other activities are working strangely. You have determined that there is no malware on the system. What will you do to restore this computer to working order?
- A.** Back up the user files and reinstall the operating system.
 - B.** Reinstall the company's PC image.
 - C.** Boot into WinRE and reset the PC, keeping the user files.
 - D.** Boot into WinRE and perform a Factory Image Restore.

Chapter 9



Operational Procedures

THE COMPTIA A+ 220-1202 TOPICS COVERED IN THIS CHAPTER INCLUDE THE FOLLOWING:

- ✓ 4.1 Given a scenario, implement best practices associated with documentation and support systems information management.
 - Ticketing systems
 - User information
 - Device information
 - Description of issues
 - Categories
 - Severity
 - Escalation levels
 - Clear, concise written communication
 - Issue description
 - Progress notes
 - Issue resolution
 - Asset management
 - Inventory lists
 - Configuration management database (CMDB)
 - Asset tags and IDs
 - Procurement lifecycle
 - Warranty and licensing
 - Assigned users
 - Types of documents
 - Incident reports



- Standard operating procedures (SOPs)
 - Software package custom installation procedure
 - New-user/onboarding setup checklist
 - User off-boarding checklist
 - Service-level agreements (SLAs)
 - Internal
 - External/third party
 - Knowledge base/articles

✓ **4.2 Given a scenario, apply change management procedures.**

- Documented business processes
 - Rollback plan
 - Backup plan
 - Sandbox testing
 - Responsible staff member
- Change management
 - Request forms
 - Purpose of the change
 - Scope of the change
 - Change type
 - Standard change
 - Normal change
 - Emergency change
 - Date and time of change
 - Change Freeze
 - Maintenance windows
 - Affected systems/impact
 - Risk analysis
 - Risk level
 - Change board approvals
 - Implementation
 - Peer review
 - End-user acceptance



✓ **4.3 Given a scenario, implement workstation backup and recovery methods.**

- Backup
 - Full
 - Incremental
 - Differential
 - Synthetic full
- Recovery
 - In-place/overwrite
 - Alternative location
- Backup testing
 - Frequency
- Backup rotation schemes
 - On site vs. off site
 - Grandfather-Father-Son (GFS)
 - 3-2-1 backup rule

✓ **4.4 Given a scenario, use common safety procedures.**

- Electrostatic discharge (ESD) straps
- ESD mats
- Electrical safety
 - Equipment grounding
- Proper component handling and storage
- Cable management
- Antistatic bags
- Compliance with government regulations
- Personal safety
 - Disconnect power before repairing PC
 - Lifting techniques
 - Fire safety
 - Safety goggles
 - Air filtration mask



✓ **4.5 Summarize environmental impacts and local environment controls.**

- Material safety data sheet (MSDS) documentation for handling and disposal
 - Proper battery disposal
 - Proper toner disposal
 - Proper disposal of other devices and assets
- Temperature, humidity-level awareness, and proper ventilation
 - Location/equipment placement
 - Dust cleanup
 - Compressed air/vacuums
- Power surges, under-voltage events, and power losses
 - Uninterruptible power supply (UPS)
 - Surge suppressor

✓ **4.6 Explain the importance of prohibited content/activity and privacy, licensing, and policy concepts.**

- Incident response
 - Chain of custody
 - Informing management/law enforcement as necessary
 - Copy of drive (data integrity and preservation)
 - Incident documentation
 - Order of volatility
- Licensing/digital rights management (DRM)/end-user license agreement (EULA)
 - Valid licenses
 - Perpetual license agreement
 - Personal-use license vs. corporate-use license
 - Open-source license
- Non-Disclosure Agreement (NDA)/mutual non-disclosure agreement (MNDA)



- Regulated data
 - Credit card payment information
 - Personal government-issued information
 - PII
 - Healthcare data
 - Data retention requirements
- Acceptable Use Policy (AUP)
- Regulatory and business compliance requirements
- Splash screens

✓ **4.7 Given a scenario, use proper communication techniques and professionalism.**

- Present a professional appearance and wear appropriate attire
 - Match the required attire of the given environment
 - Formal
 - Business casual
- Use proper language and avoid jargon, acronyms, and slang, when applicable
- Maintain a positive attitude/project confidence
- Actively listen and avoid interrupting the customer
- Be culturally sensitive
 - Use appropriate professional titles and designations, when applicable
- Be on time (If late, contact the customer)
- Avoid distractions.
 - Personal calls
 - Texting/social media sites
 - Personal interruptions
- Appropriately deal with difficult customers or situations
 - Do not argue with customer and/or be defensive
 - Avoid dismissing customer issues
 - Avoid being judgmental



- Clarify customer statements (i.e., ask open-ended questions to narrow the scope of the issue, restate the issue, or question to verify understanding)
- Use discretion and professionalism when discussing experiences/encounters
- Set and meet expectations/timeline and communicate status with the customer
 - Offer repair/replacement options, as needed
 - Provide proper documentation on the services provided
 - Follow up with customer/user at a later date to verify satisfaction
- Appropriately handle customers' confidential and private materials
 - Located on a computer, desktop, printer, etc.

✓ **4.8 Explain the basics of scripting.**

- Script file types
 - .bat
 - .ps1
 - .vbs
 - .sh
 - .js
 - .py
- Use cases for scripting
 - Basic automation
 - Restarting machines
 - Remapping network drives
 - Installation of applications
 - Automated backups
 - Gathering of information/data
 - Initiating updates
- Other considerations when using scripts
 - Unintentionally introducing malware
 - Inadvertently changing system settings
 - Browser or system crashes due to mishandling of resources



✓ **4.9 Given a scenario, use remote access technologies.**

- Methods/tools
 - RDP
 - VPN
 - Virtual network computer (VNC)
 - Secure Shell (SSH)
 - Remote monitoring and management (RMM)
 - Simple Protocol for Independent Computing Environments (SPICE)
 - Windows Remote Management (WinRM)
- Third-party tools
 - Screen-sharing software
 - Video-conferencing software
 - File transfer software
 - Desktop management software
- Security considerations of each access method

✓ **4.10 Explain basic concepts related to artificial intelligence (AI).**

- Application integration
- Policy
 - Appropriate use
 - Plagiarism
- Limitations
 - Bias
 - Hallucinations
 - Accuracy
- Private vs. public
 - Data security
 - Data source
 - Data privacy

1. You're talking with employees about using AI productively in their jobs. Which of the following is not an appropriate use of AI?
 - A. Generating ideas
 - B. Performing repetitive tasks
 - C. Prescribing medicine
 - D. Data analysis
2. Which of the following is a way to provide proof that a computer user is aware of regulatory and business compliance requirements, and agrees to the AUP and any changes to it every time they log in to a computer connected to your network?
 - A. Incident report
 - B. Splash screen notice
 - C. The act of logging in
 - D. Signature on an AUP
3. You are upgrading a video card in a desktop computer. You are following appropriate safety procedures. When you open the case, what is the most common danger that you should watch out for?
 - A. Electrical shock
 - B. Sharp edges
 - C. Burns
 - D. Flying debris
4. Whenever you onboard someone into the Research and Development (R&D) department of your organization, there are several software packages that need to be installed, and configuration must be done differently than the default. What can you do to make this process easier? (Choose three.)
 - A. Install an image via a network share.
 - B. Create an installer package for the applications.
 - C. Use third-party configuration management tools.
 - D. Install each package individually.
5. You open a desktop computer case and discover some dust, particularly around the fans. What is the most appropriate way to perform dust cleanup in this desktop computer system and its fan? (Choose two.)
 - A. Denatured isopropyl alcohol
 - B. Demineralized water
 - C. Computer vacuum
 - D. Compressed air

6. What feature of third-party software would allow a technician to demonstrate to a user how to use an application on the local desktop?
 - A. File sharing
 - B. SSH
 - C. Browsing
 - D. Screen-sharing
7. Which of the following is both a protocol and a suite of utilities that allow network administrators to remotely access and manage systems, while maintaining the confidentiality of authentication credentials and data?
 - A. RDP
 - B. SSH
 - C. HTTPS
 - D. FTP
8. You are installing a new piece of software on your computer, and you do not agree with terms in the end-user license agreement (EULA). Which of the following statements is true?
 - A. You can skip the EULA and continue the installation.
 - B. You will not be able to install the software unless you agree to the terms in the EULA.
 - C. You can click that you agree with the EULA and then provide notes to the parts you disagree with and will not be bound to those terms.
 - D. You can install the software but will be provided with limited functionality.
9. Your company has a policy prohibiting illegal content on work computers. You have seized a workstation from an employee after finding illegal content. You're creating a document to show who has had access to the workstation since you seized it to ensure that the illegal material is managed in the correct way and that it is delivered to the proper authorities. What are you documenting? (Choose the best answer.)
 - A. Use and storage
 - B. Chain of custody
 - C. Change management
 - D. Asset management
10. You just got off a repair job at a customer's site, and it was difficult. To make matters worse, the customer was argumentative and difficult to work with. Which of the following should you not do to maintain professionalism and discretion when talking about experiences and customer encounters?
 - A. Document the situation in your work log.
 - B. Try to put the experience out of your mind and focus on your next call.
 - C. Call your manager and explain the situation.
 - D. Post the experience on social media.

11. You are fixing a broken printer on the second floor of your office building. When you get the printer running again, you notice that it's printing employee paychecks. What should you do?
 - A. Take pictures of the paychecks and post them on social media.
 - B. Look to see how much everyone gets paid compared to what you get paid.
 - C. Ignore the information and focus on making sure the printer is fixed.
 - D. Text your friends and tell them that you make more than they do.
12. When you are working at a client's site, which of the following is the most appropriate behavior you should exhibit?
 - A. Taking personal calls
 - B. Actively listen; don't interrupt
 - C. Visiting social media sites
 - D. Talking to coworkers
13. You are in the field replacing a defective PCIe network card in a desktop computer. You realize that you forgot your ESD strap. The computer needs to be fixed quickly. What is the best way to put yourself and the computer at the same electrical potential so that you won't damage the equipment with ESD?
 - A. Touch the ground before working on the PC.
 - B. Touch the plastic front of the case while working on the PC.
 - C. Stay in contact with the computer's desk while working on the PC.
 - D. Stay in contact with the metal part of the case while working on the PC.
14. What Microsoft protocol allows you to connect your local system to a different Microsoft client, complete with a graphical user interface?
 - A. RDP
 - B. SSH
 - C. FTP
 - D. VPN
15. When working with a customer, which of the following demonstrates proper communication technique and professionalism?
 - A. Staring at religious artifacts hanging on the wall
 - B. Imitating the client's accent when speaking to them
 - C. Using the client's professional title when speaking to them
 - D. Laughing at the client's choice of clothing

- 16.** You are practicing appropriate safety procedures as you fix computers. Which of the following are times you should wear an ESD strap? (Choose two.)
 - A.** Working inside a desktop case
 - B.** Working inside a power supply
 - C.** Working inside a laser printer
 - D.** Working inside a laptop case
- 17.** While cleaning out an old filing cabinet, you discover a box filled with discarded batteries. What is the proper way to dispose of them?
 - A.** Burn them.
 - B.** Throw them in the trash.
 - C.** Crush them.
 - D.** Recycle them.
- 18.** Your company has a policy prohibiting illegal content on work computers. A user reports that another user has illegal content, and you are the scene's first responder. What are your first priorities as the first responder? (Choose two.)
 - A.** Document the chain of custody.
 - B.** Preserve the data or device.
 - C.** Identify the illegal content.
 - D.** Ask the user to delete the material.
- 19.** When communicating with customers, which of the following should you do?
 - A.** Use jargon and acronyms to prove your abilities.
 - B.** Interrupt and ask questions often to clarify.
 - C.** Use appropriate professional titles.
 - D.** Assume you know what the customer wants, even if it's not what they said.
- 20.** You are transporting several sticks of RAM and a few video cards from one of your offices to another. Which safety device should you use to help avoid electrically damaging components?
 - A.** Antistatic bags
 - B.** ESD strap
 - C.** ESD mat
 - D.** Rubber gloves

- 21.** You have identified illegal content on a user’s computer and reported the incident to your supervisor. The workstation has been moved from the user’s desk to a secure location. Because the incident involved illegal activities, not just company policy violations, what will someone do next?
- A.** Walk the employee out of the building.
 - B.** Notify the proper authorities.
 - C.** Follow the chain of custody.
 - D.** Delete the illegal material.
- 22.** You are working onsite and trying to fix a client’s workstation. Their computer has a defective video card, and it will take about three days to receive a new one. Which of the following is the best course of action for you to take to set and exceed customer expectations?
- A.** Tell them it will take three days for the video card to arrive, and you will return then to replace it.
 - B.** Tell them that the video card is defective, not fixable, and it will take a week for the new one to arrive. Then when you replace it in three days, you will have overdelivered and exceeded their expectations.
 - C.** Tell them it will take three days for the new video card to arrive, and you’ll call them then to make an appointment. Offer to supply a loaner computer, which they can use in the meantime, and call them in three days.
 - D.** Tell the customer that the computer is not working, and you’ll be back to fix it whenever you can fit it into your schedule.
- 23.** You are troubleshooting a difficult problem that you have never seen before. Even after an hour, you’re still not sure what is causing the problem. The customer asks what’s wrong. Which of the following will you tell the customer to project a positive attitude and confidence?
- A.** “I have no idea, and it’s a hard one. This is going to take a while.”
 - B.** “I’m not sure yet, but I’m confident that we will have you up and running soon.”
 - C.** “It’s bad. It’s really bad. I’m not sure if I will ever get it fixed.”
 - D.** “Not even our escalation line could figure it out, so I’m leaving and you’re on your own.”
- 24.** You are advising a startup that handles payment transactions to employ additional security controls on credit card information. What type of compliance affects how these security controls are implemented?
- A.** PII
 - B.** PCI DSS
 - C.** VPN
 - D.** SSH

- 25.** You just purchased a software package whose EULA allows you to use the software as long as you wish, without paying anything extra. What type of license did you purchase?
- A. Perpetual
 - B. Subscription
 - C. Open-source
 - D. Personal use
- 26.** The graphics department has called because they're out of solid ink in one of their solid-ink laser printers. What type of change is this?
- A. Normal
 - B. Incremental
 - C. Emergency
 - D. Standard
- 27.** A desktop computer you are working on has a failed power supply. Another technician suggests that it could just be a failed capacitor inside the computer's power supply, and that you could fix it. What could you do that's in keeping with electrical safety procedures?
- A. Open the power supply and test the capacitors with a multimeter.
 - B. Do not open the power supply; dispose of it properly.
 - C. Open the power supply and test the capacitors with a voltmeter.
 - D. Open the power supply and test the capacitors with an electrical probe.
- 28.** You are having a conversation with your manager about corporate security best practices. They ask what the company should do if users are found to have adult content or content advocating hate crimes on their workstations. How should you answer?
- A. Users should be allowed to keep it if it is for personal use only.
 - B. The company should implement an AUP that forbids such material and specifies consequences for violating the policy.
 - C. The company should not condone adult- or hate crime-related content but can't legally prevent users from having it.
 - D. The company should ignore the content that users have on their workstations.
- 29.** You are training a new group of technicians on power issues. One asks if an undervoltage event or complete power failure can affect the company's computer systems. What should you say? (Choose two.)
- A. A complete loss of power can damage electrical components.
 - B. An undervoltage event will not be detected by computer equipment because there is no complete power loss, so equipment won't be damaged.
 - C. Both complete power losses and undervoltage events can damage electrical components.
 - D. An undervoltage event might cause a monitor to flicker, but it won't damage electrical components.

- 30.** Which remote access method uses token authentication, making it subject to the vulnerability of a lost token?
- A.** SPICE
 - B.** VNC
 - C.** SSH
 - D.** RMM
- 31.** You have downloaded open-source software onto your personal laptop. Which of the following statements are true regarding open-source licenses? (Choose two.)
- A.** You can modify the application in any way you like.
 - B.** You usually do not need to pay for the application.
 - C.** You can make changes to the applications only if they are approved by the originator.
 - D.** You pay a fee for every user of the application.
- 32.** You want to install an electrical device that lets you plug in multiple devices at the same time. It should have a fuse in it so that if there is a power surge (overvoltage event), the fuse will blow and the electronics plugged into the device won't be damaged. It does not need a battery backup. What type of device do you need?
- A.** UPS
 - B.** Power strip
 - C.** Battery backup
 - D.** Surge suppressor
- 33.** When dealing with a customer and demonstrating proper communication techniques, what is meant by actively listening? (Choose two.)
- A.** Taking notes and making eye contact
 - B.** Repeating back to the customer what you believe they just said, starting with something like, "If I understand you correctly..."
 - C.** Walking over to the computer with the problem and starting to open it while listening
 - D.** Answering texts while listening
- 34.** You are troubleshooting a desktop computer that is prone to shorting out and rebooting. When you open the case, there is a layer of grime and dust on all the internal components. When you remove the expansion cards and memory, what should you use to clean the metal contacts on the cards?
- A.** Demineralized water
 - B.** Mild soap and water
 - C.** Denatured isopropyl alcohol
 - D.** Compressed air

- 35.** You are installing a server for a small company. The company wants to be sure that the server can be shut down properly in the event of a power failure so the company doesn't lose data. Which device should you recommend that the company plug the server into?
- A.** UPS
 - B.** Voltage regulator
 - C.** Surge suppressor
 - D.** Power strip
- 36.** You need to upgrade the RAM in a desktop computer. Which of the following should you do before beginning the procedure?
- A.** Leave the computer running.
 - B.** Put the desktop into hibernate mode.
 - C.** Turn the PC off and unplug the power cord.
 - D.** Put the desktop into standby mode.
- 37.** You are moving computer equipment from an old office to a new office. Which of the following are good personal safety measures to follow to avoid injuries? (Choose two.)
- A.** Bend at the knees and lift with your legs.
 - B.** Bend at the waist and lift straight up.
 - C.** For heavy items, get a partner to help you lift and/or use a cart to move the item.
 - D.** When lifting, lift objects as high as possible to avoid running into things.
- 38.** You have opened a desktop computer case and will be upgrading the memory. To help prevent ESD, you put an ESD strap on your wrist. Where should you connect the other end?
- A.** RAM
 - B.** Antistatic mat
 - C.** Power supply
 - D.** Plastic table
- 39.** You are purchasing new spreadsheet software for your company. Your manager has instructed you to ensure that you purchase enough licenses for everyone in the office to use the product. What type of license will you likely purchase, designed for large groups of users? (Choose two.)
- A.** Corporate
 - B.** Single user
 - C.** Concurrent
 - D.** Shareware

- 40.** You have several old computers of which you need to dispose. What should you do with them? (Choose two.)
- A.** Throw them in the trash.
 - B.** Overwrite or physically destroy storage drives.
 - C.** Donate or dispose of them in compliance with government regulations.
 - D.** Put them at the curb for someone to take for free.
- 41.** You fixed a customer’s laptop about three days ago. Which of the following demonstrates proper communication techniques and professionalism? (Choose two.)
- A.** Call the customer to see whether they are satisfied with the repair.
 - B.** Post “Another satisfied customer!” on your social media sites with a picture of their office building.
 - C.** Provide accurate documentation for the services you provided.
 - D.** Call the customer and ask if they have additional work you can do.
- 42.** You are troubleshooting problems in a client’s office, and the client starts arguing with you as to what the problem is. What should you do?
- A.** Avoid arguing and becoming defensive.
 - B.** Argue back to prove that you are correct.
 - C.** Tell the client that they are making you uncomfortable and leave immediately.
 - D.** Tell the client that if they know so much, they can fix it themselves. Then leave.
- 43.** Your company has a policy prohibiting illegal content on work computers. You have identified illegal content on a company-owned workstation. What is your next step?
- A.** Remove the data from the offending party.
 - B.** Shut down the computer.
 - C.** Ask the user to delete the material.
 - D.** Document the incident.
- 44.** You are going to be upgrading the RAM on several desktop computers. Which of the following environmental conditions increases the risk of ESD damaging computer components?
- A.** High temperature
 - B.** Low temperature
 - C.** High humidity
 - D.** Low humidity

- 45.** Your company has a policy prohibiting illegal content on work computers. You have found illegal content on a user’s workstation. What is the proper way to preserve the data or device?
- A.** Ask the user to not delete the data from the device.
 - B.** Take a picture of the illegal content and email it to your manager.
 - C.** Take a picture of the illegal content and email it to yourself.
 - D.** Remove the data or device from the possession of the offending user and preserve it in a safe location.
- 46.** Your company maintains a database of customers’ names, vehicle license plate numbers, and driver’s license numbers. What type of policy should your company have regarding this information?
- A.** This information can’t be used in any damaging way; therefore, no special policy is needed.
 - B.** This information is related to motor vehicle operation, and no special policy is needed.
 - C.** This information is public information, and no special policy is needed.
 - D.** This is PII and personal government-issued information and should be kept confidential and secure.
- 47.** You are looking for a new software application for your company’s financial data users, but you have a limited budget. Which of the following types of software licensing would you expect to not have to pay for? (Choose two.)
- A.** Corporate
 - B.** Freeware
 - C.** Personal-use
 - D.** Open-source
- 48.** You are setting up a repair shop for PCs. To reduce the risk of damaging computer components with static electricity, which of the following devices should you use? (Choose two.)
- A.** Magnetic screwdrivers
 - B.** ESD mats
 - C.** ESD straps
 - D.** A dehumidifier
- 49.** You have chosen to use compressed air to clean away dirt and debris from the inside of a desktop computer case. What is the recommended safety gear you should wear?
- A.** Safety goggles and an air filter mask
 - B.** Safety goggles and a respirator
 - C.** Safety goggles, a respirator, and a hair net
 - D.** A biohazard suit

- 50.** What type of information likely needs access safeguards per regulatory requirements as it relates to an individual's medical records?
- A.** Personally identifiable information
 - B.** Protected healthcare data
 - C.** Driver's license number
 - D.** Place of employment
- 51.** You need to dispose of a chemical solvent but are unsure how to properly do so. Where will you find information on this, as well as the potential dangers the solvent possesses?
- A.** MSDS/SDS
 - B.** OSHA
 - C.** Warning label
 - D.** Bottom of the container
- 52.** You are discussing the placement of several new computers with one of your coworkers. Which of the following are the best places to put them? (Choose two.)
- A.** In the corner of a room that is typically about 15° warmer than room temperature
 - B.** In an open area at room temperature
 - C.** In a room that is typically about 15° colder than room temperature
 - D.** In an enclosed kiosk so that no users can damage the system
- 53.** A user's work area is littered with debris and crumbs, and they report that keys on their keyboard stick or sometimes make a crunching sound. What should be the first option for cleaning this keyboard?
- A.** Denatured isopropyl alcohol
 - B.** Demineralized water
 - C.** Vacuum cleaner
 - D.** Compressed air
- 54.** You are performing a safety audit for your company and are examining the company's fire extinguishers. Which type of fire extinguisher is designed to put out electrical fires?
- A.** Class A
 - B.** Class B
 - C.** Class C
 - D.** Class D

- 55.** You have a set meeting time with a client to upgrade their computer. Your prior service call runs long, and you will be late for the meeting. What should you do?
- A.** Get to the meeting as soon as you are able.
 - B.** Take your time; you're already late and a few more minutes won't matter.
 - C.** Don't show up. Call the client later and tell them you were tied up.
 - D.** Call the client, apologize for being late, and explain that your last call went over. You will be there as soon as possible or can reschedule if they would prefer.
- 56.** You are asked to help a client who is unable to send or receive email. When you get to the client's desk, what should you do?
- A.** Tell them that this issue is nothing and you have dealt with far worse issues today.
 - B.** Ask what they did to cause the issue.
 - C.** Tell them that you would rather be working on updating the server, but you suppose you'll deal with this issue first.
 - D.** Clarify the scope of the issue and verify that you understand exactly what isn't working correctly.
- 57.** Which of the following small devices should not be disposed of at a normal landfill but instead be regarded as containing toxic chemicals? (Choose two.)
- A.** Tablet computer
 - B.** Phone packaging
 - C.** Light cardboard
 - D.** Cell phone
- 58.** While changing a laser printer's toner cartridge, a technician spilled toner on a desk. What should they use to clean the mess up?
- A.** Compressed air
 - B.** Mild soap and water
 - C.** Toner vacuum
 - D.** Denatured isopropyl alcohol
- 59.** You are holding a laptop for someone who will be out of the country for a year or so. What is the best way to store their laptop battery to preserve its life?
- A.** Store it in a cool, dry area.
 - B.** Store it in a closet.
 - C.** Store it at room temperature.
 - D.** Store it in a freezer.

- 60.** You are repairing a desktop PC and upgrading the memory. What is the main reason that equipment grounding is an important safety procedure?
- A.** To prevent an electrical shock to yourself
 - B.** To prevent an electrical shock from damaging components
 - C.** To prevent a fire from starting inside the case
 - D.** To prevent the desktop PC from slipping off the workspace
- 61.** What type of script has the filename extension .ps1?
- A.** PowerShell
 - B.** Bash
 - C.** JavaScript
 - D.** Python
- 62.** What type of editor would you normally use to view a script with the filename extension .vbs?
- A.** Vi
 - B.** Notepad
 - C.** Nano
 - D.** CoffeeCup
- 63.** What file extension is used with a plain-text script file that can be run or edited in a Windows command prompt?
- A.** .js
 - B.** .sh
 - C.** .py
 - D.** .bat
- 64.** What programming language uses files with the .js extension?
- A.** JavaScript
 - B.** Java
 - C.** Juice
 - D.** Joomla
- 65.** You and the Research and Development department are writing a formal document regarding the service that the IT department will provide, and what IT won't (or can't) provide for them because of confidentiality. What type of agreement is this?
- A.** Internal SLA
 - B.** External/third-party SLA
 - C.** SOP
 - D.** KB

- 66.** You just took a new IT manager job and are sorting out a company that doesn't have a good inventory list. What best practice will you employ that helps your department in keeping track of the hardware found throughout the workplace?
- A.** Knowledgebase articles
 - B.** Asset tagging
 - C.** Password policy
 - D.** Incident reporting
- 67.** Your IT technician is looking for a solution to an error that popped up on a user's screen. What will they likely be using to help determine what to do about the error?
- A.** Brown bagging
 - B.** Knowledgebase articles
 - C.** Change board documentation
 - D.** Change management policy
- 68.** You're working through the change management system for a change request that has been made by a manufacturing department. Before the change is implemented in the computer system, how will you ensure that the change will work?
- A.** Identify the scope of the change.
 - B.** Receive change board approval.
 - C.** Perform risk/risk level analysis.
 - D.** Perform sandbox testing.
- 69.** What change management detail is not necessary to document?
- A.** Purpose of the change
 - B.** Scope of the change
 - C.** Unaffected applications
 - D.** Change board approvals
- 70.** You work for a retailer and are near the end of a planned change implementation. People are still making suggestions to add to the project, but the busy season is about to start, and you tell them their changes will not be implemented at this time. What is happening?
- A.** Rollback plan
 - B.** Change freeze
 - C.** Risk analysis
 - D.** End-user acceptance

- 71.** A network administrator wrote and documented business continuation procedures, including a backup plan. Finally, critical data was backed up as required. What should be done next before the implementation can be considered reliable?
- A.** Backup testing
 - B.** Documenting a checklist
 - C.** End-user acceptance
 - D.** Approval of the policy
- 72.** In a geographical area prone to tornados, what option for storing backups seems most sensible?
- A.** Tape backups in the basement
 - B.** Tapes distributed among offices
 - C.** Off-site cloud storage
 - D.** Storage on a server against an inside wall
- 73.** Your company uses a ticketing system to track repair calls. Which of the following might not be included in the information gathered for the ticketing system when the client/customer calls?
- A.** User information
 - B.** Device information
 - C.** Description of issues
 - D.** Inventory lists
- 74.** What change-management document describes the procedures that will occur if you reach a critical go/no-go point in a project that makes a change to your network and you decide that it's a no-go?
- A.** Sandbox testing
 - B.** Rollback plan
 - C.** Request forms
 - D.** Risk analysis
- 75.** What type of backup includes all files, whether or not the archive bit is set?
- A.** Complete backup
 - B.** Incremental backup
 - C.** Full backup
 - D.** Differential backup

- 76.** On Sunday, your system will automatically create a full backup of your data. At the end of each weekday, Monday through Friday, a differential backup is created. It is now Thursday morning, and you discover that your system crashed during the night. You need to restore your data. Which backups will you need to restore to get all of your data back?
- A.** Only Wednesday's backup
 - B.** Sunday and Wednesday backups
 - C.** Sunday, Monday, Tuesday, and Wednesday backups
 - D.** Sunday and Thursday backups
- 77.** Which of the following statements comparing differential and incremental backups are true? (Choose two.)
- A.** Incremental backups are created faster than differential.
 - B.** Differential backups are created faster than incremental.
 - C.** Incremental backups are more fault tolerant than differential backups.
 - D.** Differential backups are simpler to restore than incremental backups.
- 78.** Which of the following is true about how computer components such as expansion cards and processors should be stored?
- A.** In antistatic bags, with protective packing material
 - B.** In zippered plastic bags, stacked on plastic shelves
 - C.** In antistatic bags, neatly stacked on a grounded shelf
 - D.** On top of antistatic bags, on a shelf in a closet
- 79.** What should always be done before moving a laser printer?
- A.** Remove the printhead.
 - B.** Remove the stapler assembly.
 - C.** Remove the toner cartridge(s).
 - D.** Remove the paper.
- 80.** A manufacturing facility asked to have a computer installed on the floor for workers to access so that they can check production information. About a week later, they called you down because the computer isn't working. When you arrive, you find that someone has wrapped the computer in plastic to protect it from the dust, and it's about 100° Fahrenheit on the plant floor. Why did the computer stop working? (Choose two.)
- A.** Too much dust on the plant floor
 - B.** Lack of ventilation/airflow
 - C.** Overheating
 - D.** No electricity

- 81.** You are about to retire a computer because it's being replaced with a faster one that the new updated software needs. Which of the following needs to be done with this computer before it is recycled or donated? (Choose two.)
- A.** Ensure that all data is removed/destroyed.
 - B.** Take it to the sandbox testing area.
 - C.** Remove it from the asset management inventory list.
 - D.** Install the new software update.
- 82.** You work as the lead IT network engineer at an IT services company that designs and installs networks for your Fortune 500 clients. Today, you're meeting with the CIO of a large accounting firm. Which of the following are likely to be appropriate attire for your position and interaction with clients? (Choose two.)
- A.** Matching suit coat and pants/skirt, and tie, if appropriate
 - B.** Khaki pants and polo shirt
 - C.** Business casual attire
 - D.** Business formal attire
- 83.** You've just finished repairing a customer's printing problem and shown them how to avoid the problem in the future. What steps do you still need to take before the job is considered complete? (Choose two.)
- A.** Provide proper documentation on the services provided.
 - B.** Tell them if they call you directly, they can get the same service for less money in the future.
 - C.** Follow up with the customer a few days later to ensure that they are satisfied.
 - D.** Leave without saying anything.
- 84.** A coworker has called the Help Desk because they have a problem with their PC. When you start to sit down at their desk, you see a job application there. What do you do?
- A.** Ask them politely if they would mind moving their paperwork while you are working there; explain that you don't want to see anything that might be confidential.
 - B.** Go to their boss and tell them that the person is looking for another job.
 - C.** Snap a picture of the job application to post on social media.
 - D.** Ask them about the job for which they are applying.
- 85.** Your company needs an occasional full backup, but your data is so large that the time it takes to back it up is considerable. Rather than do a full backup daily, you have elected to use software that combines incremental backups and a prior full backup to create a new full backup. What type of backup is this?
- A.** Incremental
 - B.** Differential
 - C.** Synthetic full
 - D.** Grandfather-father-son

- 86.** You know that a backup is only good if you can restore from it, so the backups need to be tested periodically to ensure that data can, in fact, be restored from them. Which of the following is not true regarding testing data backups?
- A.** Test whenever there have been big system changes like new software, major updates, or major data changes.
 - B.** Test after every single backup.
 - C.** Test whenever there are going to be big system changes, like merging databases or software installations or updates.
 - D.** Test once a month.
- 87.** You work for an IT services company, and today you're acting as the lead network installer. In this job, you'll be running wires through ceilings and walls, and possibly interacting with your customer. What would be the appropriate attire to wear?
- A.** Casual graphic T-shirt and jeans
 - B.** Sneakers
 - C.** Business formal
 - D.** Business casual
- 88.** In the United States, there is a government entity that oversees safety in the workplace and has the authority to shut down businesses that don't comply with these safety standards. What is that entity?
- A.** OSHA
 - B.** The NEC
 - C.** FEMA
 - D.** IRS
- 89.** Which information technology rule states that you need three copies of data, on two different media, with one copy off-site?
- A.** Grandfather-father-son (GFS)
 - B.** On-site/off-site backup rule
 - C.** The rule of 78
 - D.** The 3-2-1 backup rule
- 90.** You forgot to bring a file that you need for a presentation today. It's on your Windows Pro computer at home. Which of the following could you use to retrieve it?
- A.** RMM
 - B.** VPN
 - C.** VNC
 - D.** MSRA

- 91.** You're having a first meeting with a potential customer at a company where you have been told that everyone wears jeans and T-shirts to work, even the CEO. What would be the appropriate attire for this meeting?
- A.** Jeans and a T-shirt with their company logo
 - B.** Casual attire
 - C.** Business casual
 - D.** Business formal
- 92.** What term means a company follows state, local, federal, and even international government rules and regulations that relate to its work?
- A.** Disobedience
 - B.** Compliance
 - C.** Information technology governance
 - D.** Information security
- 93.** Which backup scheme ensures that there are short-term, medium-term, and long-term backups, which a business could restore from, and that in theory the business would never lose more than a day's worth of data and would always have a year's worth of backups?
- A.** Grandfather-father-son (GFS)
 - B.** On-site/off-site backup rule
 - C.** Moore's law
 - D.** The 3-2-1 backup rule
- 94.** Part of the HIPAA regulations state that if a health-related document is created, it must be maintained for a minimum period of six years from when it was created or last in effect. What is this an example of?
- A.** IT governance
 - B.** Data retention requirements
 - C.** GFS
 - D.** License agreement
- 95.** You and your best friend intend to start an MSP company providing technical computer support to business clients. What software will you need to invest in that will enable you to manage those clients and fix many software-related issues without leaving your office?
- A.** RMM
 - B.** VPN
 - C.** VNC
 - D.** RDP

- 96.** An employee has a personal-use license for some free diagramming software that they feel would be beneficial for your company. You have evaluated the software and determined that the software company also has corporate licenses for more than one user, for an annual licensing fee. Which of the following is most likely what the employee is allowed to do, under the terms of their personal use license?
- A.** Make as many copies as they want.
 - B.** Bring it into work for everyone to use.
 - C.** Sell the software for download online.
 - D.** It depends on the exact terms of the software license, but most likely, they can use the software on their personal computer(s) at home only.
- 97.** What technology lets authors, musicians, artists, and other creators of copyrighted material control access to their content so that it is not stolen or illegally shared?
- A.** Personal licenses
 - B.** Digital rights management
 - C.** Corporate licenses
 - D.** Nonexpired licenses
- 98.** Which of the following may be undesirable results of using scripts? (Choose three.)
- A.** Unintentionally introducing malware
 - B.** Installing applications and updates
 - C.** Inadvertently changing system settings
 - D.** Crashing browsers or systems
- 99.** You need to remotely configure, monitor, and manage several servers on your own network. Which of the following are tools that will help you manage your company's endpoints? (Choose three.)
- A.** WinRM
 - B.** RDP
 - C.** SSH
 - D.** RMM
- 100.** You're considering whether to use public or private AI. Which of the following is not an advantage of private AI?
- A.** Keeping data secure
 - B.** Lower costs, greater speed
 - C.** Choosing the data source(s)
 - D.** Maintaining the privacy of confidential data

- 101.** Which of the following would not be a possible consequence of the failure to maintain compliance with government regulations?
- A. Fines and fees
 - B. Business shutdown
 - C. Extra paid holidays
 - D. Lives lost
- 102.** Which of the following is not an example of regulated data?
- A. Credit card payment information
 - B. Software licensing data for software that you use
 - C. Healthcare data
 - D. PII
- 103.** Which of these third-party tools allows multiple users in diverse locations to see one another, possibly share a screen, and discuss information with one another as if they were in the same room?
- A. Screen-sharing software
 - B. File transfer software
 - C. Desktop management software
 - D. Videoconferencing software
- 104.** Which of the following file extensions is used by software in the Linux/UNIX environment?
- A. .sh
 - B. .py
 - C. .vbs
 - D. .ps1
- 105.** Which of the following is not a type of information recorded in a ticketing system that must have very clear, concise, written communication?
- A. Issue descriptions
 - B. Progress notes
 - C. Valid licenses
 - D. Issue resolution
- 106.** What is used to initiate the change management process?
- A. Affected systems/impact form
 - B. Request form
 - C. Risk analysis documentation
 - D. Change board approval

- 107.** Which of the following would not be included in change management documentation?
- A.** End-user acceptance
 - B.** Responsible staff member
 - C.** Affected systems and the impact on them
 - D.** Scope of the change
- 108.** What type of software includes programs like batch files, Visual Basic, PowerShell, and so on and is used for activities like basic automation, remapping network drives, automating backups, gathering information/data, and restarting machines based on triggers?
- A.** RMM
 - B.** Screen-sharing software
 - C.** Scripting programs
 - D.** Remote access technologies
- 109.** You are newly hired at a company's Help Desk. Which one of the following is a type of information that does not need to be included on every ticket in a Help Desk's ticketing system?
- A.** Category of the issue
 - B.** Severity of the issue
 - C.** Escalation levels
 - D.** Procurement lifecycle
- 110.** Which process is designed to enable changes that benefit an organization with as little disruption as possible to the IT services, to maintain the efficient function of that organization?
- A.** Asset management
 - B.** Change management
 - C.** Ticketing systems
 - D.** Knowledgebases and articles
- 111.** What part of asset management includes processes such as a request for information (RFI), a request for proposal (RFP), and identifying the business need?
- A.** Configuration Management Database (CMDB)
 - B.** Assigned users
 - C.** Procurement lifecycle
 - D.** Warranty and licensing

- 112.** What feature of change management examines all the possible positive and negative events that might impact a project and then identifies a response plan if the event occurs and assigns a score to the possible event?
- A.** Scope of the change
 - B.** Change board approval
 - C.** Risk analysis and risk level
 - D.** Sandbox testing
- 113.** Part of your job is managing IT for new hires and terminations. What items can be used to facilitate the onboarding and offboarding of employees to ensure that new employees have everything they need to do their job and that exiting employees aren't able to damage systems or take company information with them? (Choose two.)
- A.** Incident report
 - B.** New user onboarding setup checklist
 - C.** User offboarding checklist
 - D.** Splash screens
- 114.** When you are working at a client's site, which of the following are examples of distractions that should be avoided? (Choose three.)
- A.** Taking personal calls
 - B.** Actively listening to the customer
 - C.** Texting your coworker for "just a minute"
 - D.** Telling the client about the last customer
- 115.** You want to ensure that employees aren't installing whatever software packages they want to because of licensing concerns and possible impacts to the company's network. What document will you use to identify and explain what the procedures are for custom installation of software packages?
- A.** End-user termination checklist
 - B.** New-user onboarding checklist
 - C.** CMDB
 - D.** SOP
- 116.** Which of the following is not important to keep track of as part of your inventory management system, and to ensure compliance with local, regional, national, or perhaps international regulations?
- A.** Valid licenses in use by your company
 - B.** Perpetual license agreements
 - C.** Technical jargon used by your company
 - D.** Open-source licenses being used by your company

- 117.** Which of the following would not constitute an invalid, and quite possibly illegal, use of software?
- A.** Using a personal license in a corporate setting
 - B.** Having more software users than the license allows
 - C.** Using software whose license has expired
 - D.** Modifying open-source software
- 118.** You found that someone left the company with confidential information. What document will you file as a part of the SOP?
- A.** Incident report
 - B.** New user onboarding setup checklist
 - C.** User offboarding checklist
 - D.** Splash screens
- 119.** You are updating the list of procedures that will be followed for various situations such as security incidents and new hires. What is the document that you're updating?
- A.** CMDB
 - B.** ITAM
 - C.** SOP
 - D.** KB
- 120.** The computer that manages the timing of the conveyor belt in the packaging department has failed and requires replacement as soon as possible because it's affecting production. It hasn't happened before and wasn't expected. What type of change is this?
- A.** Normal
 - B.** Incremental
 - C.** Emergency
 - D.** Standard
- 121.** You're the manager of an IT department. You've created a step-by-step plan that your department can follow to recover from either a planned change that has failed, or something unexpected that has caused a problem with your computer systems, network, or data. What type of plan have you created?
- A.** Contingency
 - B.** Backup/backout
 - C.** Emergency
 - D.** Standard

- 122.** Your office uses five HP LaserJet printers. An administrator has placed used toner cartridges in boxes and stacked them in the storage room. Which of the following statements is true regarding toner cartridge disposal?
- A.** Toner is not harmful, but because the cartridges contain plastic, they should be recycled.
 - B.** Toner is not harmful, and the cartridges are made of biodegradable plastic, so they can be thrown away.
 - C.** Toner will make a mess if it gets out of the cartridge, so to avoid making a mess, cartridges should be burned.
 - D.** Toner is a carcinogen, so cartridges should be taken to an authorized recycling center.
- 123.** You're excited because the change that you recommended has gone through the change approval process and is about to start. What type of change is this?
- A.** Normal
 - B.** Incremental
 - C.** Emergency
 - D.** Standard
- 124.** You're working on creating a change management document for a proposed project. Which of the following will you include? (Choose two.)
- A.** Date and time of change
 - B.** Incremental change
 - C.** Backstage testing
 - D.** Peer review
- 125.** The change that you proposed has gone through all of the parts of the change management approval process. Now you're ready to begin making the change happen. What stage have you reached?
- A.** Risk analysis
 - B.** Implementation
 - C.** Sandbox testing
 - D.** Peer review
- 126.** You've implemented a change, and it's being tested by several people who will actually be using the new process. Getting their feedback and approval is critical to the project's success and needed before the system goes live across all your company locations. What stage have you reached?
- A.** Risk analysis
 - B.** Peer review
 - C.** Sandbox testing
 - D.** End-user acceptance

- 127.** Your company shuts down two weeks a year to perform a deep cleaning of its cheese-processing equipment. You'll be updating systems and performing standard changes during this time. What is this period of time known as?
- A. Risk analysis
 - B. Maintenance window
 - C. Sandbox testing
 - D. Peer review
- 128.** One of your servers had an issue, and several files need to be restored so they can be used. You've decided to put them on a different volume so you still have the original files to analyze what went wrong. What type of restore from backup are you performing?
- A. Incremental
 - B. In-place/overwrite
 - C. Alternative location
 - D. Differential
- 129.** You're working on a computer and need to plug a second monitor into the computer. There are no power outlets at the desk, but there is one just on the other side of the aisle. Which of the following is appropriate and safe cable management? (Choose two.)
- A. Run the cable across the floor—it's only for a minute.
 - B. Run the cable across the top of the cubicle dividers, across the walkway. It's about five feet high. People can duck under it if they need to.
 - C. Plug in a power strip where you're working, and plug both monitors into it.
 - D. Run an extension cord across the floor, but cover it with a pedestrian cable cover.
- 130.** You've discovered inappropriate content on a computer system. You leave it powered on to preserve data. According to the order of volatility, which of these should you preserve first?
- A. Data in the CPU and cache
 - B. Data in memory
 - C. Data on a hard drive
 - D. Notes you've taken on the incident
- 131.** Your company just finished negotiations with another company, and the companies want a legally binding contract stating that confidential, proprietary information about each other will not be disclosed. What type of document will they be signing?
- A. AUP
 - B. NDA
 - C. MNDA
 - D. BYOD

- 132.** You're troubleshooting an issue at an end-user's computer. What is one of the best ways to find out what the problem is?
- A. Ask close-ended (yes/no) questions.
 - B. Don't ask questions; examine the computer.
 - C. Ask open-ended questions.
 - D. Ask what they think is wrong.
- 133.** You're looking at a program that's causing an issue. You've noticed that the file extension is .py. What program was this written in?
- A. Batch Scripting
 - B. Python
 - C. JavaScript
 - D. Shell
- 134.** You're looking for an open-source solution for remotely accessing computers on your LAN. Which of the following options is designed to meet your goal?
- A. JavaScript
 - B. Linux
 - C. macOS
 - D. SPICE
- 135.** You're considering what to use for remote access. What are the biggest security concerns with methods like RDP, VNC, RMM, WinRM, and VPNs? (Choose two.)
- A. Misconfiguration
 - B. Inadequate passwords/authentication
 - C. Open-source
 - D. Open ports
- 136.** Which remote access method requires opening port 5900 for HTTP and adds a display number, which makes securing it with a firewall more difficult, and is vulnerable because by default, remote traffic is not encrypted?
- A. RDP
 - B. VNC
 - C. SSH
 - D. RMM

- 137.** When dealing with a customer, which of the following demonstrates the communication technique for using proper language?
- A.** Use computer jargon.
 - B.** Use acronyms.
 - C.** Use slang terms.
 - D.** Use basic terms.
- 138.** You have an application, and you would like to add AI to enhance it. What is this process called?
- A.** Application integration
 - B.** Artificial integration
 - C.** Updating
 - D.** Facilitating
- 139.** Which of the following are limitations of using AI in a business setting? (Choose three.)
- A.** Bias
 - B.** Hallucinations
 - C.** Manifestations
 - D.** Accuracy
- 140.** You're setting up a CMDB. Which of the following will you include? (Choose three.)
- A.** Router configuration information
 - B.** Networks and interrelationships
 - C.** Knowledgebase
 - D.** Warranty and licensing
- 141.** You're using AI while working on a research paper for your job. Which of the following constitutes plagiarism? (Choose two.)
- A.** Using AI to check grammar on something you've written
 - B.** Using AI to find information online
 - C.** Using an AI rephrasing tool
 - D.** Asking AI for information and posting the output as your own
- 142.** One of your management employees works from home most days, but they need to have access to the server as if they were sitting there in the office, and the connection must be secure. What technology will you employ to do this?
- A.** RMM
 - B.** VPN
 - C.** RDP
 - D.** VNC

Chapter **10**

A black and white photograph of a lighthouse situated on a rocky coastline. The lighthouse is white with a dark lantern room and a black band near the top. It stands next to a large, multi-story keeper's house with a dark roof. In the foreground, there are large, light-colored, layered rocks. The ocean is visible in the background, with waves crashing against the rocks. The sky is overcast with dramatic clouds.

Practice Exam 1 (220-1201)

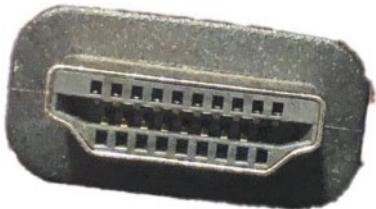
1. You have a laptop with a dead hard drive. You want to replace it with a newer SSD but have a few concerns. What disadvantage do SSDs have versus HDDs?
 - A. They produce more heat.
 - B. They are slower.
 - C. They are more susceptible to damage.
 - D. They cost more per gigabyte.
2. Your friend is an artist, and they have recently purchased a new convertible laptop. It can be used as a regular laptop or it can be folded into a tablet computer. You've recommended they purchase a stylus to use with their new computer. Which of the following is not an advantage of a stylus?
 - A. They don't leave greasy fingerprints on your screen.
 - B. There are never compatibility issues.
 - C. They can make more precise lines than fingers can.
 - D. You can use them in cold weather and have gloves on your hands.
3. In a tablet computer with an LCD, which component is responsible for providing the right kind of energy to light the display?
 - A. Inverter
 - B. LCD
 - C. Backlight
 - D. Screen
4. A friend just purchased a stylus that uses Bluetooth connectivity. They aren't very tech savvy, so you have offered to set it up for them. What step of the Bluetooth connection process will you do *after* the laptop has found the stylus for pairing?
 - A. Enable pairing.
 - B. Test connectivity.
 - C. Enter the appropriate PIN code.
 - D. Enable Bluetooth.
5. You're hiking in the mountains and have brought along a mobile device that has an app with all local trail maps on it to ensure that you don't get lost. You look at the map and notice that the blue dot indicating where you are hasn't moved since you left home. What do you need to enable in your mobile device for the app to work properly?
 - A. Airplane mode
 - B. GPS
 - C. Wi-Fi
 - D. Location services

6. What protocol/type of protocol guarantees delivery of a packet of information across a network (or networks) and will resend the packet if its arrival is not acknowledged? (Choose two.)
 - A. TCP
 - B. UDP
 - C. Connectionless
 - D. Connection-oriented
7. Which two port numbers need to be opened to enable communications for FTP?
 - A. 20/21
 - B. 21/22
 - C. 22/23
 - D. 23/25
8. Which Internet appliance stands between a PC and the Internet and can include stateful packet inspection (i.e., packet filtering) and act as a gateway translating traffic between networks or protocols? (Choose two.)
 - A. Spam gateway
 - B. Unified Threat Management (UTM)
 - C. Load balancers
 - D. Proxy servers
9. In IPv6, which of the following identifies the multicast range?
 - A. ::1
 - B. 2001:dba:45c:1::5/64
 - C. FE80::abc:1:2/64
 - D. FF00::/8
10. Several Bluetooth devices are connected in an ad hoc (without a hub, switch, or WAP) network. Which acronym best describes this type of network?
 - A. LAN
 - B. WAN
 - C. PAN
 - D. MAN

11. Users on your network complain of poor wireless network access in a certain part of your building. They say that the connection is slow and disconnects frequently. You are using 802.11ac wireless routers and access points. What tool should you use to troubleshoot the situation?

- A. Wi-Fi analyzer
- B. Loopback plug
- C. Tone generator and probe
- D. Multimeter

12. What type of audio/video connector is shown in the graphic?



- A. DisplayPort
 - B. DVI
 - C. HDMI
 - D. VGA
13. The computer users in your accounting department have called you stating that their laser printer keeps jamming and have asked that you resolve the issue. Which of the following are common reasons for jamming that you can check? (Choose two.)
- A. Incorrect paper thickness or the tray is too full
 - B. Ink cartridges need cleaning
 - C. Debris in the paper path
 - D. Printhead needs cleaning
14. About four computer users in the HR area of the building are complaining that their Wi-Fi connection is very slow. You use your Wi-Fi analyzer and find out that they are on the same channel as your neighbors in the office next door. What can you do?
- A. Set the radio signal to maximum.
 - B. Change the channel that the WAP uses.
 - C. Add another WAP.
 - D. Check the cable from the WAP to the router.

15. Which type of connector, shown in the graphic, is used for network connections?



- A. RJ11
 - B. RJ45
 - C. F-type
 - D. ST
16. You're reading the documentation for a desktop motherboard, which says it uses 240-pin DIMMs. What type of DIMM does it use?
- A. DDR3
 - B. DDR4
 - C. DDR5
 - D. SODIMM
17. You don't have enough ports on your laptop for all the devices that you want to connect. What should you purchase?
- A. Port replicator
 - B. Trackpad
 - C. Docking station
 - D. Stylus
18. A user reports that their smartphone will not make any sounds. They have turned the phone off and back on, and the problem is still there. You check the settings, and the phone is not in silent mode and the volume is set to maximum. What can you do to fix this problem?
- A. Reset the phone to factory specifications.
 - B. Replace the speakers.
 - C. Replace the sound card.
 - D. Replace the phone.

- 19.** A laser printer you are working on is producing images with vertical black streaks running the length of the page. Which of the following could be causing this? (Choose two.)
- A.** There is a scratch in the EP drum.
 - B.** The fusing assembly is not heating up properly.
 - C.** The paper exit rollers are worn.
 - D.** The charging corona wire is dirty.
- 20.** The motherboard documentation you are reading says that the RAM modules for this motherboard must be purchased in identical sets of four. What type of motherboard is this?
- A.** Dual channel
 - B.** Triple channel
 - C.** Quad channel
 - D.** Single channel
- 21.** You have installed an 802.11ac Wi-Fi network. The network has three overlapping wireless access points. What channel width should the access points be set to in order to avoid communications problems while providing the best bandwidth?
- A.** 20 MHz
 - B.** 40 MHz
 - C.** 80 MHz
 - D.** It doesn't matter in 802.11ac.
- 22.** A user complains that their desktop computer randomly shuts down. No error messages are displayed before it happens, and there is not a specific program that triggers the reboot. Which of the following components is most likely to be causing this problem?
- A.** RAM
 - B.** Storage drive
 - C.** BIOS/UEFI
 - D.** Network adapter
- 23.** A user calls the Help Desk to report that their display is black. It was working yesterday, but when the desktop computer was booted this morning, nothing showed on the display. They did hear a beep like normal when the computer booted up. What is the first thing you should do?
- A.** Reseat the plug on the video card.
 - B.** Replace the video card.
 - C.** Ask the user to press the display's power button.
 - D.** Refresh the operating system.

- 24.** In your company's lobby, there is a desktop computer with an LCD that plays a continuous loop of a welcome video. The display is enclosed in a cabinet. Recently, the display shuts itself down near the end of the day for no apparent reason. What is likely causing this problem?
- A.** Backlight failure
 - B.** Incorrect video resolution
 - C.** Display card failure
 - D.** Display overheating
- 25.** Your pet's veterinarian has implanted a microchip under their skin so that if your pet is lost, whoever finds the pet can take them to almost any veterinarian and the pet's name as well as your name and contact information can be read from the microchip using a special reader device. This tag does not provide GPS tracking. What type of technology is in this chip?
- A.** NFC
 - B.** RFID
 - C.** HDD
 - D.** GPU
- 26.** The design of the micro-ATX motherboard makes which of the following statements true?
- A.** It will fit in standard ATX cases.
 - B.** It will fit in standard ATX cases when used with a mounting adapter kit.
 - C.** It will fit in standard ATX cases but can't support full-length expansion cards.
 - D.** It will not fit in standard ATX cases.
- 27.** You are examining an existing coaxial cable installation and notice that the previous technician installed a splitter. Which of the following statements is true?
- A.** The splitter will cause the network connection to fail.
 - B.** The splitter will increase the distance the network signal will travel.
 - C.** The splitter will degrade the quality of the network signal.
 - D.** The splitter will have no effect on the network signal.
- 28.** A desktop computer will not retain the system time or date. The user always needs to reset them after the system is powered off. What should you do to fix the problem?
- A.** Flash the BIOS/UEFI.
 - B.** Replace the BIOS/UEFI chips.
 - C.** Replace the CMOS battery.
 - D.** Use the jumper on the motherboard to reset the BIOS/UEFI to factory settings.

- 29.** A new technician trainee just turned a computer on, and it beeped once. They had heard about motherboard beep codes and ask you what that single beep means. What will you tell them?
- A.** Bad RAM
 - B.** CPU issue
 - C.** Video isn't working
 - D.** POST completed successfully
- 30.** A user has turned in a tablet computer that has a swollen battery. What should you do to resolve the problem?
- A.** Turn the tablet off, let it cool down, and then return it to the user.
 - B.** Order a new tablet for the user, drain the excess electrolyte from the battery, and then dispose of the defective one in the trash.
 - C.** Order a new tablet for the user, and take the defective one to a recycling center.
 - D.** Order a new tablet for the user, and throw the defective one in the trash.
- 31.** You have multiple web servers and want to ensure that the web traffic is equally distributed between them to maintain fast response times. What network appliance will you employ to achieve the desired result?
- A.** Spam gateway
 - B.** Proxy server
 - C.** Load balancer
 - D.** UTM
- 32.** Your motherboard supports up-plugging for PCIe adapter cards. Which of the following statements is true?
- A.** You can't put an x8 card into an x16 slot.
 - B.** You can put an x8 card into an x16 slot, but it will run at x1 speed.
 - C.** You can put an x8 card into an x16 slot, but it will run at x8 speed.
 - D.** You can put an x8 card into an x16 slot, and it will run at x16 speed.
- 33.** Your company needs a fast Internet connection, so it has purchased a fiber-optic connection from an ISP. You need to connect your router to the ISP using an Ethernet cable. Where will this connection take place?
- A.** At the DSL
 - B.** At a NIC
 - C.** At a PoE
 - D.** At the ONT

- 34.** Your coworker needs to transfer files from a mobile device using a memory card reader and an SD memory card. They quickly discover that the maximum capacity on their SD card is 1 TB. Which technology does the coworker have?
- A. SD
 - B. SDXC
 - C. SDHC
 - D. SDLC
- 35.** A user reports that when they press the L key on their laptop keyboard, the L character repeats across the screen and doesn't stop until the L key is pressed several more times. When you look at the laptop, it does not appear that the key is physically sticking. What should you do next?
- A. Replace the keyboard.
 - B. Replace the L key.
 - C. Clean under the key with compressed air.
 - D. Reboot the laptop.
- 36.** You're working on a stormy night and the power in your house goes out, but your cellular service (i.e., smartphone) is working. You have a report on your laptop that absolutely must be submitted tonight, and luckily your laptop is fully charged. What can you do to submit your report?
- A. Connect your laptop to your car's antenna to send via Wi-Fi.
 - B. Use your smartphone's hotspot feature.
 - C. Go out in the storm and drive to the nearest place with power that has public Wi-Fi.
 - D. Call and let them know that the report won't be submitted because your power is out.
- 37.** You have determined that you need to replace the Wi-Fi antenna in your laptop. Where will you most likely find it?
- A. In the housing with the display
 - B. Under the keyboard
 - C. Under a removable panel on the back/bottom of the laptop
 - D. Plugged into a USB port
- 38.** Which of the following are common components of cloud storage applications that can be used to store and synchronize data on all of your devices, including smartphones, laptops, desktop computers, and other devices? (Choose three.)
- A. Calendar
 - B. Contacts
 - C. Microsoft 365 Copilot
 - D. Cloud Mail

- 39.** You pay a premium for faster Internet service at home but have noticed that the download times have slowed considerably, and you see a spinning wheel indicating slow downloads more than normal. What is likely the problem?
- A. You have reached a data cap.
 - B. You didn't pay your last bill, so they're slowing the service down.
 - C. You're synchronizing too much data all at once.
 - D. The Internet is down.
- 40.** You have a small office with frequent visitors and want to provide a separate VLAN to segregate the visitor traffic from your network traffic for security reasons. What is the minimum connectivity device needed to accomplish this?
- A. Hub
 - B. Bridge
 - C. Managed switch
 - D. Unmanaged switch
- 41.** You are creating a virtual machine (VM) host that will support multiple VMs. The host software will be installed directly on the computer hardware, not in an operating system. What type of hypervisor is being used?
- A. Type 1
 - B. Type 2
 - C. Sandbox
 - D. Storage
- 42.** Which of the following IP addresses is not routable on the Internet?
- A. 192.169.1.1
 - B. 192.168.1.1
 - C. 168.192.1.1
 - D. 169.192.1.1
- 43.** When setting up your network, you configured your clients to obtain IP addressing information automatically from a DHCP server. You set the group of numbers that it can assign from 192.168.100.11 to 192.168.100.211. What is this group of assignable numbers called?
- A. APIPA
 - B. Leases
 - C. Scope
 - D. Reservations

44. You’re considering setting up a WISP. What is an advantage of using an unlicensed frequency versus using a licensed frequency?

- A. The frequencies are not congested.
- B. The radiated power is unlimited by regulations.
- C. The performance is better than licensed frequencies.
- D. Equipment is readily available.

45. What type of port is shown in the graphic?



- A. USB-C
- B. Molex
- C. SC
- D. LC

46. Which of the following would most likely use NVMe technology?

- A. 5,400 rpm drive
- B. HDD
- C. mSATA
- D. M.2

47. Which level of RAID will provide both better performance and fault tolerance with the fewest drives possible?

- A. RAID 0
- B. RAID 1
- C. RAID 5
- D. RAID 10

48. You purchased an expansion card for your desktop that fits in a PCIe x1 slot. The documentation says that the card supports USB 3.0 with a 5 Gbps maximum transfer rate. What version of PCIe is the card?

- A. PCIe 1.0
- B. PCIe 2.0
- C. PCIe 3.x
- D. PCIe 4.x

- 49.** A user complains of a burning smell coming from their computer. After shutting it down, you notice that the motherboard has burn marks on it. You replace the motherboard. The next day, the user complains again of a burning smell, and you see this motherboard is burnt as well. What should you do next?
- A. Replace the motherboard.
 - B. Replace the power supply.
 - C. Replace the motherboard and power supply.
 - D. Plug the computer into a different wall outlet.
- 50.** You are installing an ATX12V (sometimes called ATX2) power supply with a 24-pin main power connector. Which of the following is not a voltage provided by the power supply?
- A. -3.3 VDC
 - B. +5 VDC
 - C. +12 VDC
 - D. -12 VDC
- 51.** You have a Windows 11 desktop computer that is connected directly to your office printer. Your office is running a workgroup (not a domain). You want to share the office printer with a new user. What are two places you can do this? (Choose two.)
- A. Search for printers, right-click the desired printer, and choose Share.
 - B. In the Settings app, choose Bluetooth & Devices and then Printers & Scanners. Select the printer to share, and then, on the window that displays, choose Printer Properties, and choose the Sharing tab.
 - C. In the Control Panel, choose Devices and Printers, which will take you to Bluetooth & Devices in the Settings app.
 - D. In Device Manager, click the printer and select the Sharing tab.
- 52.** Your company produces software and employs about 20 developers. They need to program apps for different operating systems. You decide to purchase cloud-based services to support the development team. What type of service should you purchase so that they can develop their programs and then test them in environments other than where they were developed?
- A. IaaS
 - B. SaaS
 - C. PaaS
 - D. NaaS
- 53.** Your RAID array is beeping steadily. What could be the problem? (Choose two.)
- A. Faulty NIC
 - B. Controller problem
 - C. Failed VM
 - D. Missing or nonworking drive

- 54.** What feature of cloud computing means that you can expand your network immediately as needed?
- A.** Shared resources
 - B.** Metered utilization
 - C.** Elasticity
 - D.** File synchronization
- 55.** A client complains about the occupied space, profuse power usage, and hardware costs of the multiple machines used in its small data center. Still, the client does not wish to lose control over any of the machines. What might you recommend to the client to resolve all of those issues?
- A.** Establish clusters for high availability.
 - B.** Create virtual machines.
 - C.** Outsource to an IaaS provider.
 - D.** Shut down the nonessential machines.
- 56.** A computer is making a grinding noise and is working but seems to be very slow in accessing information. Which component will you likely need to replace?
- A.** HDD
 - B.** SSD
 - C.** NIC
 - D.** LED
- 57.** You have configured two hard drives so that when you write to one, it makes an exact copy on the other, and it looks like one drive in your operating system. What level of RAID is this?
- A.** RAID 0
 - B.** RAID 1
 - C.** RAID 5
 - D.** RAID 10
- 58.** A technician is troubleshooting a computer in the field and calls you to report that they are getting a S.M.A.R.T. error ID 188 and command timeout. Which component is likely to be causing this error?
- A.** CPU
 - B.** RAM
 - C.** Motherboard
 - D.** HDD

- 59.** You just took a new display out of the box and set it up. Now, you notice that it has two dead pixels. What do you do?
- A.** Return the display for a refund.
 - B.** Keep the display but ask for a discount.
 - C.** Calibrate the display.
 - D.** Keep the display; it is fine.
- 60.** A user complains that the color on their display is strange. It was working fine yesterday. What will you do first?
- A.** Check for a loose cable connection at both ends.
 - B.** Replace the display.
 - C.** Turn the display off and back on.
 - D.** Check the settings on the display itself.
- 61.** A mobile device user dropped their smartphone, and now the charging port is damaged. The device is fairly new, but they didn't pay for a warranty to cover user error. They don't typically plug it into a computer or anything else. What should you do first?
- A.** Take the phone apart and replace the charging port.
 - B.** Return the phone to the store for a refund.
 - C.** See if the device supports wireless charging.
 - D.** Replace the phone.
- 62.** A grinding noise is coming from your office printer. You know that can't be good, and you just put new toner in two days ago. What do you do?
- A.** Try replacing the toner cartridge.
 - B.** Take all the paper out and reload it.
 - C.** Thoroughly clean the printer.
 - D.** Check for any loose rollers or gears.
- 63.** Several users who access the network through the same WAP are complaining that they have limited connectivity. They can see each other on the network but not any network resources like printers and servers. Everything was working fine yesterday, and network users in other parts of the building are not having problems. What should you troubleshoot first?
- A.** The power of the radio signal from the WAP
 - B.** The connection between the WAP and the router
 - C.** Their IP configuration
 - D.** The default gateway

- 64.** You just bought a new laptop and were told that it uses biometrics to log you in. Which of the following might they be? (Choose two.)
- A.** Face scanner
 - B.** Entering your password
 - C.** Fingerprint reader
 - D.** Entering a code from your phone
- 65.** There is a white streak down all of the printouts of your inkjet printer. What will you do to fix it? (Choose two.)
- A.** Change the toner cartridge.
 - B.** Clean the printheads (nozzle-cleaning routine).
 - C.** Clear debris from the paper path.
 - D.** Use different paper.
- 66.** The company president is presenting at a meeting in the conference room, and the projector there keeps shutting down after a few minutes. What will you do to remedy the problem? (Choose two.)
- A.** Unplug the projector and plug it in again.
 - B.** Remove dust from the vents.
 - C.** Allow the fan to run and cool down the system.
 - D.** Change the input source.
- 67.** Users at your workplace are complaining that the audio over their VoIP phones is of poor quality. It's often choppy and difficult to understand. Which of these would help with that and could be done fairly quickly? (Choose two.)
- A.** Configure QoS to give the VoIP phones priority.
 - B.** Upgrade the cabling on the network.
 - C.** Set up the VoIP phones on their own VLAN.
 - D.** Set up the VoIP phones using a VPN.
- 68.** You notice that your friend's smartphone is swollen. They said that it happens all the time. What should be done?
- A.** Replace the battery.
 - B.** Replace the device.
 - C.** Unplug it and let it cool down, and then plug it back in.
 - D.** Use a different power outlet.
- 69.** What are the benefits of virtualization? (Choose two.)
- A.** Saves power
 - B.** Requires more licenses
 - C.** Less hardware to pay for
 - D.** Distributed management

- 70.** All the users on your network, wired and wireless, are complaining that they're getting a limited-connectivity message. Where will you start troubleshooting? (Choose the best answer.)
- A.** WAP
 - B.** Default gateway
 - C.** Switch
 - D.** Router
- 71.** You're shopping for a wireless speaker to use with your smartphone and considering different connection methods. Which of the following wireless connection types generally has a functional communication distance of 10 meters?
- A.** NFC
 - B.** IR
 - C.** Bluetooth
 - D.** Wi-Fi
- 72.** What type of display is increasingly being used in smaller mobile devices for its picture quality, lower power consumption, and foldability?
- A.** IPS
 - B.** OLED
 - C.** LED
 - D.** VA
- 73.** Your company allows workers to use their personal devices for company business. What will you, as the IT director, use to ensure that company information is safe on those personal devices?
- A.** MDM
 - B.** BYOD
 - C.** PRL
 - D.** GSM
- 74.** Which of the following would not be considered authentication in a system using MFA?
- A.** Key fob
 - B.** Authenticator app
 - C.** Username
 - D.** Soft token
- 75.** Which two TCP/IP protocols are designed to download email from mail servers? (Choose two.)
- A.** SMTP
 - B.** POP3
 - C.** IMAP
 - D.** SMB

- 76.** Which TCP/IP protocol is responsible for resolving IP addresses to MAC addresses?
- A.** IP
 - B.** SSH
 - C.** DHCP
 - D.** ARP
- 77.** You need a WAP in a loading dock, but there is not an appropriate power receptacle close enough to plug it into, so you decided to use a PoE WAP. The problem is that your switch is not PoE compliant. Which of the following will you need to purchase in addition to the PoE WAP?
- A.** Very long extension cord
 - B.** PoE injector
 - C.** New switch
 - D.** New router
- 78.** Which wireless networking (Wi-Fi) standards can use both the 2.4 GHz and 5 GHz frequencies? (Choose two.)
- A.** 802.11g
 - B.** 802.11n
 - C.** 802.11ac (Wi-Fi 5)
 - D.** 802.11ax (Wi-Fi 6)
- 79.** When setting up your network, you configured your clients to obtain IP addressing information automatically from a DHCP server. Which of the following configuration items can the DHCP server provide?
- A.** IP address
 - B.** IP address and subnet mask
 - C.** IP address, subnet mask, and default gateway
 - D.** IP address, subnet mask, default gateway, and DNS server address
- 80.** A computer on your network is not able to reach the DHCP server. The DHCP server assigns addresses in the 200.100.1.11–200.100.1.110 range. What address might this computer get when it boots up? (Choose two.)
- A.** APIPA
 - B.** Class C
 - C.** 169.254.1.101
 - D.** 200.100.1.15
- 81.** Which of the following is not true about DNS servers?
- A.** They translate IP addresses to domain names like Sybex.com.
 - B.** AAAA DNS records identify IPv6 addresses.
 - C.** A records identify IPv4 addresses.
 - D.** There is a setting in the IP configuration to identify the DNS server to use.

82. A UTP cable just failed and needs to be replaced. You have a spool of cable and connectors but no premade cables. Which tool do you need to use to make a new cable?
- A. Toner probe
 - B. Punchdown tool
 - C. Multimeter
 - D. Crimper and cable stripper
83. You need to create several UTP patch cables from a roll of bulk cable. Your company uses the T568A standard. What is the correct order for wires in the connectors?
- A. Orange stripe, orange, green stripe, blue, blue stripe, green, brown stripe, brown
 - B. Orange stripe, green, green stripe, blue, blue stripe, orange, brown stripe, brown
 - C. Green stripe, green, orange stripe, blue, blue stripe, orange, brown stripe, brown
 - D. Green stripe, green, orange, blue, blue stripe, orange stripe, brown stripe, brown
84. You need a cable that will run a distance of 200 feet and support speeds up to 10 Gbps. Which cable will you use?
- A. Cat 5e
 - B. Cat 6
 - C. Cat 6a
 - D. Plenum
85. A new technician on your team has been asked to replace memory in a laptop. They removed a card and brought it to you; it's shown here. What did they remove?



- A. SODIMM
- B. ECC
- C. DIMM
- D. M.2
86. The people in your office want a printer that will print on both sides of the paper automatically. What feature is this?
- A. Duplex
 - B. Orientation
 - C. Tray settings
 - D. Print quality

- 87.** A receipt printer is unable to print receipts because it has run out of paper. You'll be replacing a roll of thermal paper to fix the problem. What type of printer are you working on?
- A. Inkjet
 - B. Impact
 - C. Laser
 - D. Thermal
- 88.** A friend has asked for your help because their smartphone thinks they're clicking where they aren't. It seems like the touch calibration is incorrect. What is the first step to resolve their problem?
- A. Calibrate the screen.
 - B. Replace the screen protector.
 - C. Clean the screen.
 - D. Look for damage.
- 89.** You're comparing current performance to a baseline on a computer system and have noticed that the drive's read/write times are extended. Which of the following would be your last resort?
- A. Check for low available disk space.
 - B. Replace the drive.
 - C. Check for malware.
 - D. Defragment if it's an HDD.
- 90.** Identify the connectors shown here.



- A. ST
- B. SC
- C. LC
- D. BNC

- 91.** A technician has two hard drives and wants to increase the data access speed of a computer. You tell them to install both drives, but which of the following configurations is their best option?
- A.** Configure them as separate volumes.
 - B.** Implement RAID 0.
 - C.** Implement RAID 1.
 - D.** Implement RAID 6.
- 92.** You’re setting up a virtual machine for a developer who needs three instances of Windows 11, plus the host OS, which is also Windows 11. How many licenses will you need?
- A.** One
 - B.** Two
 - C.** Four
 - D.** None
- 93.** What are the three major categories of cloud computing? (Choose three.)
- A.** SaaS
 - B.** RaaS
 - C.** PaaS
 - D.** IaaS
- 94.** A user calls the Help Desk because their printer isn’t printing. They tell you that “nothing happens” when they send a print job. Which of the following is the least likely solution?
- A.** Help them choose the right printer.
 - B.** Replace the paper with paper designed for the printer.
 - C.** Stop and restart the print queue.
 - D.** Troubleshoot a connectivity issue.
- 95.** The Help Desk receives a call that the printout from a printer is garbled, with strange characters printing. What will you do?
- A.** Replace the paper.
 - B.** Clear a paper jam.
 - C.** Clean the pickup rollers.
 - D.** Replace the printer driver.
- 96.** Your company has grown drastically, and rather than adding more networking devices and computers, it wants to move its network’s hardware to the cloud so employees can access it from anywhere. What is the company using?
- A.** IaaS
 - B.** SaaS
 - C.** PaaS
 - D.** NaaS

- 97.** What must be defined when wanting to maintain confidentiality, integrity, and availability of the system resources and should be a part of the decision when choosing a cloud solution?
- A.** Scalability
 - B.** Security requirements
 - C.** Elasticity
 - D.** Emulation ability
- 98.** A company using cloud services wishes to better prepare for surges in the services it needs from the cloud services provider. What sort of capacity provisioning by its cloud provider should the company ask for?
- A.** Elasticity
 - B.** IaaS
 - C.** Metered utilization
 - D.** Multitenancy
- 99.** A group of real estate agents has realized that they have similar computing resource needs. They've reached out collectively to your IT services company and asked if there is a solution that will enable them to pool their resources and save money, possibly sharing industry-specific software, but still have their servers and information held securely and locally. What will you recommend?
- A.** Community cloud
 - B.** Public cloud
 - C.** Private cloud
 - D.** Hybrid cloud
- 100.** An employee travels between multiple offices, using a desktop system in each office. What technology would ensure that the employee's desktop icons, files, and applications stay uniform across systems in all the offices?
- A.** On-demand desktop streaming
 - B.** VDI in the cloud
 - C.** Desktop emulation
 - D.** Synchronized folders

Chapter **11**

A black and white photograph of a lighthouse situated on a rocky coastline. The lighthouse is white with a dark lantern room and a black band near the top. It stands next to a large, multi-story keeper's house with a dark roof. In the foreground, there are large, light-colored, layered rocks. The ocean is visible in the background, with waves crashing against the rocks. The sky is overcast with dramatic clouds.

Practice Exam 2 (220-1202)

1. Your Windows computer is experiencing frequent shutdowns. It typically runs five minutes and then shuts down. These shutdowns are not scheduled in the OS. What will you do first?
 - A. Boot with an anti-malware boot media and check for malware.
 - B. Reinstall the OS.
 - C. Run SFC.
 - D. Check the temperature in the case or on the CPU.
2. You are on-site fixing a client's laptop that will not load the OS. You are waiting to hear about your friends' awesome party that they are hosting this weekend, and your phone starts to vibrate and keeps vibrating. You're sure that all your friends are texting information about the party. What should you do? (Choose two.)
 - A. Turn your phone off and apologize to the client. Tell them that the phone was distracting you from your job, but it won't be a problem now.
 - B. Ignore your phone.
 - C. Text your friends back and tell them that you are working.
 - D. Call your friend and tell them to wait until after this job before planning all the details because you want to help.
3. You are planning on formatting a hard drive with NTFS that will be used to share files between Windows 10 and Windows 11 Pro computers. Which of the following features are present in NTFS? (Choose two.)
 - A. Linux OS support
 - B. File and folder encryption
 - C. File compression
 - D. Enhanced flash drive support
4. You are logged in to a Linux workstation with a regular user account. You need to execute a command with root permissions. Which command do you need to use?
 - A. su
 - B. sudo
 - C. grep
 - D. man
5. A security consultant recommends that your secure facility implement biometrics as a form of building access control. Which of the following systems might they be referring to?
 - A. RFID badges
 - B. Key fobs
 - C. Palm print scanner
 - D. Guards

6. You are looking online to find pictures to use in promotional materials that your company wants to make. Which of the following statements is true regarding online content?
 - A. Online content is considered open-source; therefore, you may use whatever you find.
 - B. Online content can be protected through the use of DRM.
 - C. Online content is protected through the use of the EULA.
 - D. Online content is protected through terms established by Microsoft.
7. In which type of security threat will someone try to gain access to a secure area without credentials by following someone else who used their access rights into the secured area?
 - A. Brute-force
 - B. Shoulder surfing
 - C. Evil twin
 - D. Tailgating
8. A management directive requires that you keep hard copies of all your workstations' system configurations. You have all Windows workstations. Which command can you use to easily gather this information for remote workstations and save a report as a text file?
 - A. msinfo32
 - B. compmgmt
 - C. mmc
 - D. perfmon
9. You have a situation that requires installing Windows 11 from installation media. You'll be launching Setup on the media while you are on the existing Windows 10 desktop. Which of the following is not an option?
 - A. Full upgrade
 - B. Keep data only
 - C. Forensic install
 - D. Clean install
10. You are configuring a wireless router for a home office. Which of the following changes will have the least impact on improving the security of the network?
 - A. Disabling guest access
 - B. Disabling the SSID broadcast
 - C. Configuring WPA3
 - D. Changing the default username and password

- 11.** You are going to move a desktop computer from one office location to another. It's on the floor, underneath the desk. Which of the following are good personal safety procedures to follow? (Choose two.)
- A.** Bend at the waist and lift straight up.
 - B.** Bend at the knees and lift with your legs.
 - C.** Tie back any loose jewelry, long hair, or neckties.
 - D.** Leave the computer plugged in to avoid ESD.
- 12.** A user calls the Help Desk saying that they have tried to boot their computer several times but keep receiving "No OS found" errors. What will you ask them first?
- A.** Was it working yesterday?
 - B.** What did you do to it?
 - C.** Is there a USB drive in one of the USB ports?
 - D.** Do you know how to enter UEFI?
- 13.** Which feature of Windows Pro or higher editions is designed to encrypt storage volumes, must be activated by an administrator, and can encrypt operating system startup files?
- A.** BitLocker
 - B.** EFS
 - C.** OneDrive
 - D.** ShadowDrive
- 14.** Your iPhone has been stolen. To ensure that the thief does not have access to your data, what should you do?
- A.** Perform a remote backup.
 - B.** Enable full-device encryption.
 - C.** Enable BitLocker.
 - D.** Perform a remote wipe.
- 15.** You have installed a second hard drive in a Windows workstation. In Disk Management, what type of partition can you create that will allow you to create an unlimited number of logical partitions in it?
- A.** Extended
 - B.** Dynamic
 - C.** Logical
 - D.** GPT

- 16.** You have some older drives that you intend to donate to a nonprofit organization. You want to set all data on the drive to be nothing but 0s. What should you use to accomplish this?
- A.** Drive-wiping software
 - B.** format command
 - C.** Degaussing
 - D.** Incinerating
- 17.** A small business has two servers in its telecommunications room. The business has come seeking your advice because the area has frequent power outages and the company has lost important data on its servers as a result. What will you recommend for it to protect against this issue?
- A.** Surge suppressor.
 - B.** Power strip.
 - C.** UPS.
 - D.** Line conditioner.
- 18.** You are working on a Windows workstation that is operating very slowly. You want to quickly check the system's CPU and RAM usage to see whether anything appears amiss. Which utilities can you use to do this? (Choose two.)
- A.** Resource Monitor
 - B.** Performance Monitor
 - C.** System
 - D.** Device Manager
- 19.** As the network administrator, you have set account lockout policies so that an account is locked out after five unsuccessful login attempts. What type of security threat will this deter?
- A.** Shoulder surfing
 - B.** Brute-force attack
 - C.** Zero-day attack
 - D.** Spear phishing
- 20.** Occasionally when visiting websites using Google Chrome, you receive a pop-up window in front of your browser. Generally, it's an advertisement trying to sell you something. Which of the following actions will stop this from happening?
- A.** Enable Chrome's pop-up blocker.
 - B.** Install an antivirus program.
 - C.** Install an anti-malware program.
 - D.** Enable Windows Firewall.

- 21.** Your company works with confidential government files. It is illegal for employees to copy any files to flash drives. Where do you specify this rule as well as the penalties for not complying with it?
- A.** APK
 - B.** ACL
 - C.** ADF
 - D.** AUP
- 22.** A Windows computer user reports that their computer just completely locked up. On the screen is a message saying that the person pictured has participated in an illegal activity. The webcam turned on by itself, and the computer user was pictured. The message also says they can resolve the charges against them by paying a \$500 fine. They are understandably shaken by the incident. What should you do next?
- A.** Tell the user that if they performed an illegal activity with their work computer, their employment will be terminated.
 - B.** Boot to a bootable media from your anti-malware provider, and run a remediation.
 - C.** Delete and reinstall Windows.
 - D.** Pay the fine.
- 23.** One of your technicians just touched a plastic bottle containing chemicals with which you are unfamiliar. Their hand starts to feel like it's burning. Where can you find information on how to properly wash the technician's hands without making the problem worse, and how to dispose of the chemicals?
- A.** OSHA
 - B.** Container's bottom
 - C.** Warning label
 - D.** MSDS
- 24.** You want to protect mobile device users on your network from potentially leaked files or data. Which of the following should you do to help reduce this risk? (Choose two.)
- A.** Disable network autoconnection.
 - B.** Enforce data transmission over limits.
 - C.** Enable device encryption.
 - D.** Install mobile firewalls.
- 25.** You are at a Windows command prompt. The folder you are in has hundreds of files, so when you view a folder listing, you want it to only show one page of files at a time. Which command should you use to do this?
- A.** dir /p
 - B.** dir /o:s
 - C.** dir /w
 - D.** dir /s

- 26.** You have assigned the Finance group Modify permissions on the D:\MonthlyReports folder. You then create a folder named D:\MonthlyReports\January. What level of permissions does the Finance group have to the D:\MonthlyReports\January folder?
- A.** No access, because no permissions were explicitly set
 - B.** Full control, because no permissions were explicitly set
 - C.** Modify, because the folder inherits permissions from its parent folder
 - D.** Modify, because the folder inherits permissions from the Finance Group, and the Finance Group members can grant permissions to other users or groups for this folder
- 27.** Your company has a policy prohibiting illegal content on company computers. You have identified and verified illegal content on a user's workstation. What is the next step you should take?
- A.** Ask the user to delete the material.
 - B.** Delete the illegal material yourself.
 - C.** Document the situation.
 - D.** Report the incident through proper channels.
- 28.** Your Windows workstation is having intermittent video issues. The manufacturer's website suggests you install the latest driver. Which utility should you use to check the driver version installed on your computer?
- A.** Display Settings
 - B.** Device Manager
 - C.** Services
 - D.** Disk Management
- 29.** On a MacBook Pro running macOS, what is the name of the bar of icons that runs along the bottom of the screen, enabling you to quickly open apps?
- A.** Remote Disc
 - B.** Finder
 - C.** Spotlight
 - D.** Dock
- 30.** A Windows workstation is not booting properly, and you believe it's a problem with system files. Which utility can scan and repair corrupt Windows system files?
- A.** chkdsk
 - B.** diskpart
 - C.** tracert
 - D.** sfc

- 31.** An Android phone user reports that their phone can't connect to the company's wireless network, but they have a cellular signal. What is the first thing to have them try?
- A. Check whether the phone is in Airplane mode.
 - B. Check whether the phone's Wi-Fi is enabled.
 - C. Adjust the phone's Wi-Fi signal receptivity.
 - D. Reset the phone to factory defaults.
- 32.** You are troubleshooting a Windows Home workstation with malware on it. Following the best-practice procedures for malware removal, you have gotten to the point where you've scheduled system scans and run anti-malware updates. What is the next step you should take?
- A. Educate the end user.
 - B. Enable System Restore and create a restore point.
 - C. Disable System Restore in Windows Home.
 - D. Remediate the infected system.
- 33.** When configuring NTFS permissions on a Windows workstation, what is the recommended method?
- A. Grant permissions to user accounts.
 - B. Put user accounts into groups. Grant folder permissions to groups and file permissions to users.
 - C. Put user accounts into groups. Grant folder permissions to users and file permissions to groups.
 - D. Put user accounts into groups. Grant permissions to groups.
- 34.** You are at a Windows command prompt in the D:\users folder. You want to use the copy command to copy the D:\users\jdoe folder to the D:\files folder. Which of the following statements is true?
- A. You need to use the robocopy command to perform this task.
 - B. You can use the command copy d:\users\jdoe*.* d:\files.
 - C. You can use the command copy d:\users\jdoe d:\files.
 - D. You can use the command copy d:\users\jdoe d:\files /y.

35. You are working on your Windows computer and a security alert pops up, as shown in this graphic. What should your next action be?



- A. Click the Continue Unprotected button.
B. Click the Remove All Threats Now button.
C. Create a restore point and then click the Remove All Threats Now button.
D. Shut down your computer, reboot, and initiate a malware scan using your anti-malware software.
36. You are instructing a new Mac user on the features of macOS. They ask if the system is capable of storing their passwords to various Internet sites. Which feature would they use for that?
A. Keychain
B. Mission Control
C. FileVault
D. Terminal
37. You are troubleshooting a malware problem with a Windows 11 computer and find that you need to boot into safe mode/safe boot, which loads with minimal drivers. Which management tool can you use to force the system to boot into safe mode when it reboots?
A. Task Scheduler
B. Computer Management
C. System Configuration
D. Task Manager

- 38.** Which of the following is an advantage of using share permissions over using NTFS permissions?
- A.** Share permissions will override NTFS permissions if there is a conflict.
 - B.** Share permissions can be enabled to secure resources across the network that are not on an NTFS partition.
 - C.** Share permissions apply when users access a resource across the network, but NTFS permissions apply only to local users.
 - D.** Share permissions can be set at the file level, whereas NTFS permissions can be set only at the folder level.
- 39.** Your manager is concerned that your company could divulge PII. Which of the following types of data is not considered PII?
- A.** First name
 - B.** Home address
 - C.** Family member names
 - D.** Employee ID number
- 40.** You are training mobile users on potential security risks. Which of the following could make users more susceptible to an on-path attack?
- A.** Unintended Wi-Fi connection
 - B.** Unauthorized account access
 - C.** Unauthorized location tracking
 - D.** Unauthorized camera activation
- 41.** The network you manage has a dozen Windows workstations. You want to ensure that users do not have the ability to change the boot order, so that they can't boot to an unauthorized device. Which step should you take?
- A.** Disable AutoRun.
 - B.** Restrict user permissions.
 - C.** Set a BIOS/UEFI password.
 - D.** Enable a strong password policy.
- 42.** A user needs to travel for a presentation and wants to be sure their laptop does not run using battery power. However, they also want to leave their files and applications running so that when they turn it back on, the applications are already open. Which of the following statements is true?
- A.** The user will be unable to do this.
 - B.** The user should put their computer into standby mode.
 - C.** The user needs to activate the sleep power plan.
 - D.** The user should have their computer hibernate.

- 43.** A user calls the Help Desk and tells you that when they type Wiley.com, the browser goes to a site that looks similar but has a strange name at the top. What's happening to this user? (Choose two.)
- A.** Browser redirection
 - B.** Malware infection
 - C.** Desktop alert
 - D.** Browser update failure
- 44.** You have a Windows Pro workstation installed in a workgroup. There is no centralized security. Which tool should you use to help protect yourself against malicious network attacks?
- A.** Software firewall
 - B.** NTFS Permissions
 - C.** Local Security Policy
 - D.** Computer Management
- 45.** You are working on a client's desktop computer, and the video card is dead. You can get a warranty replacement, but it will take three days to arrive. Or you can replace it with a more expensive card today, but the customer would need to pay the cost difference. Which of the following is the best way for you to continue the service call?
- A.** Tell the customer that the video card is dead. It will take three days for the video card to arrive, and you will return then to replace it.
 - B.** Tell the customer that the video card is dead. It will take three days for a warranty replacement to arrive (at no cost), or you can replace it with an upgraded model today if they want to pay the difference in cost.
 - C.** Tell the customer that the video card is dead. Offer to replace it today with a more expensive video card, and they can pay the difference in cost.
 - D.** Tell the customer that they will be without a computer for three days, but then you will come back and fix it.
- 46.** You are attempting to update a Windows 11 workstation using Windows Update. The update fails with this message: "Failure configuring Windows updates. Reverting changes." You reboot and try again but receive the same error. What should you try next? (Choose two.)
- A.** Wait until changes are reverted. Unplug removable media from your computer and try again.
 - B.** Wait until changes are reverted. Run a malware scan and try again.
 - C.** Wait until changes are reverted. Run the Windows Update Troubleshooter.
 - D.** Ignore the update.

- 47.** A user calls and complains that they can't see any printers when they try to print a document from their Windows computer. They say that they had three network printers showing yesterday, and they can access the server across the network. What will you do first?
- A. Reinstall the network printers.
 - B. Check the status of the Print Spooler service.
 - C. Reinstall Windows.
 - D. Repair Windows.
- 48.** A user calls the Help Desk because they are not able to access the Internet. After asking a few questions, you discover that if they type an IP address in the browser, then the website pops up. Other users on the same switch aren't having this problem. Where will you start looking for the problem?
- A. File server
 - B. Web server
 - C. DNS settings
 - D. DHCP settings
- 49.** Whenever you log in to a computer at work, a screen with the company's name and some text appears. You must click OK before you can access the company network. What is a common security purpose of a company's custom splash screen?
- A. Announce upcoming events
 - B. Advertising their products
 - C. Tracking employee time
 - D. Confirming agreement to an AUP
- 50.** Which of the following features are not available in the Home edition of Windows but are available in Pro and higher editions? (Choose three.)
- A. File compression
 - B. Joining a Windows Domain
 - C. Group Policy Editor (`gpedit.msc`)
 - D. RDP host
- 51.** You're configuring a remote connection and need a protocol or process to ensure that both parties to a transaction are who they say they are, and to encrypt their user information as it passes from one to the other. Which of the following will you use?
- A. Multifactor authentication
 - B. Kerberos
 - C. RADIUS
 - D. TKIP

- 52.** A user called the Help Desk because their mouse pointer is moving across the screen and windows are opening and closing. They believe it's not malware, because they said they didn't do anything; they just opened an email with a strange subject. Which of the following will be most important to prevent malware on this computer going forward?
- A.** Educate users regarding threats.
 - B.** Install anti-malware and set it to update automatically.
 - C.** Enable and configure software firewalls.
 - D.** Enable and configure hardware firewalls.
- 53.** When your friend launches their new favorite game, they often get low-memory warnings. Which of the following can you do to prevent this problem from happening in the future? (Choose two.)
- A.** Use Task Manager to end unnecessary programs.
 - B.** Increase virtual memory.
 - C.** Increase physical memory.
 - D.** Put in a faster NIC.
- 54.** A friend is having trouble with the network connection on their Windows 11 computer, so you open Network and Internet in the Settings app. Which of the following is not an option there?
- A.** Advanced network settings
 - B.** Mobile Hotspot
 - C.** VPN
 - D.** Share a Printer
- 55.** You need to manually configure the IP address for a server. Which of the following pieces of information is not needed to configure IPv6?
- A.** IPv6 address
 - B.** Subnet mask
 - C.** Subnet prefix length
 - D.** Default gateway
- 56.** A user is trying to use Google Chrome on their Windows computer, but they receive the error message "Unable to access the network." If they use Microsoft Edge, they are able to access websites with no problem. What do you need to do?
- A.** Uninstall and reinstall Google Chrome.
 - B.** Instruct the user to only use Microsoft Edge.
 - C.** Ensure that Google Chrome is a permitted program in Windows Defender Firewall.
 - D.** Reinstall the operating system.

- 57.** Which of the following is not done/created before the change board approves a change?
- A. Rollback plan
 - B. Sandbox testing
 - C. Risk analysis
 - D. Change freeze
- 58.** Your company makes a full backup every Sunday. Monday through Friday, the company creates differential backups. It keeps the weekly backup for a month, the daily backups are overwritten each week, and the company creates a backup once a month that is kept for a year.
What is this backup scheme called?
- A. On-site/off-site
 - B. Grandfather-father-son (GFS)
 - C. 3-2-1 backup rule
 - D. Synthetic
- 59.** A user has called the Help Desk, and you've entered their ticket. The problem they describe is beyond your training. What do you do?
- A. Hang up and tell them to call the PC manufacturer.
 - B. Put them on hold for an hour while you figure it out.
 - C. Escalate the problem to the next level.
 - D. Tell them to perform a factory installation of their operating system.
- 60.** Your friend has a new Windows 11 computer, and they're getting way too many notifications while they're trying to work. What will you tell them?
- A. Yes, we all do. It's just something we have to deal with.
 - B. I can help you fix that. It's easy.
 - C. We can turn them all off or all on; you don't get to choose.
 - D. You have to reinstall your apps and tell them no when they ask if you want to allow notifications.
- 61.** Your client has computers using macOS and other computers that are Windows-based. They want to have a shared drive configured so that both operating systems can access it. The files are very large, some of them exceeding 4 GB. What filesystem should you use to format the shared drive?
- A. NTFS
 - B. ext4
 - C. exFAT
 - D. FAT32

- 62.** A user wants to have Full Control over their C: drive and all the contents of it, because they have one program that defaults to saving files in a folder there. Why will you not give them this access? (Choose two.)
- A.** It is a security risk.
 - B.** It violates the Windows EULA.
 - C.** Only administrators can have access to the C: drive.
 - D.** It violates the principle of least privilege.
- 63.** A user has a computer that suddenly started running very sluggishly. Upon inquiry, you find that they went to some websites yesterday that they don't normally visit, so you decide to follow the best-practice procedures for malware removal. What is the first step?
- A.** Quarantine infected systems.
 - B.** Disable System Restore in Windows Home.
 - C.** Investigate and verify malware symptoms.
 - D.** Schedule scans and run updates.
- 64.** A user tells you that they received a BSOD error on a Windows computer. No changes have been made to this computer recently. What is the best way to restart Windows to see whether you can isolate the issue?
- A.** Boot to the Windows installation media and start the WinRE.
 - B.** Boot to safe mode.
 - C.** Boot using an anti-malware boot drive.
 - D.** Boot normally and see whether the error happens again.
- 65.** A user is attempting to log in to the computer that they normally use at work. The user reports that their profile is very slow to load and then they get an error message that says "Unable to load profile." What should you suspect?
- A.** The profile is too large.
 - B.** The profile is corrupted.
 - C.** The user logged on using the wrong password.
 - D.** They need to reboot and try again.
- 66.** An app on your Android-based device won't open. What will you try first?
- A.** Check for Android updates.
 - B.** Check for app updates.
 - C.** Restart the device.
 - D.** Clear the app's data and cache.

- 67.** You’re installing a new video card in a computer. It was an expensive card, and you want to ensure that it isn’t damaged by ESD. Until you are ready to place the card in the slot, what is the safest place for the card?
- A. Lying on the antistatic mat
 - B. Lying on the antistatic bag
 - C. Inside its antistatic bag
 - D. Lying on the edge of the computer so that it’s grounded
- 68.** Your company is an MSP. A client in another state is having a problem with their Windows 11 Desktop station and wants your help. What tool will you most likely use to assist them?
- A. RDP
 - B. VPN
 - C. VNC
 - D. RMM
- 69.** You are writing a script in Microsoft PowerShell to automate some processes that you perform daily. What file extension will the script file have?
- A. .bat
 - B. .ps1
 - C. .vbs
 - D. .py
- 70.** You need to add a new user on a Windows Pro desktop computer. What tool can you use to do this? (Choose two.)
- A. Local Users & Groups
 - B. gpedit.msc
 - C. lusrmgr.msc
 - D. Certificate Manager
- 71.** A user who is less comfortable with technology is having to navigate through File Explorer to a network shared resource several times a day. The user asks if there is an easier way. What will you configure for this user?
- A. Mapped drive
 - B. Domain name
 - C. Subnet mask
 - D. Gateway

- 72.** One of the users you are responsible for called the Help Desk because when they turned the computer on this morning, instead of booting into Windows, it showed a green screen with 1s and 0s running down it. What will you do?
- A.** Turn the computer off and boot using boot media from your antivirus/anti-malware company.
 - B.** Go into WinRE and repair the operating system installation.
 - C.** Go into WinRE and perform a clean installation of the operating system.
 - D.** Boot into safe mode and restore from a recent restore point.
- 73.** Your mobile device locks after a short inactivity period for security reasons. Which of the following are common biometric devices for opening a mobile device whose screen is locked? (Choose two.)
- A.** Facial recognition
 - B.** Fingerprint readers
 - C.** PIN codes
 - D.** Swipe to unlock
- 74.** A user logs on to their computer system and notices that several of their files are missing. What should you do?
- A.** Begin the malware removal process.
 - B.** Reimage the machine.
 - C.** Restore the files from a backup.
 - D.** Restore from the last restore point.
- 75.** A new network admin wants to try their hand at writing a PowerShell script. You tell them that's fine but to show it to you before they run it. What are possible undesirable effects of running a script file? (Choose two.)
- A.** Inadvertently changing system settings
 - B.** Saving time in remapping network drives
 - C.** Browser or system crashes due to mishandling of resources
 - D.** Automating backups
- 76.** A user has called the Help Desk and told you that all of their Microsoft Word documents now have a .boo extension. What is your first course of action?
- A.** Ask the user to restart the computer.
 - B.** Ask the user to rename all the files to a .doc extension.
 - C.** Run anti-malware.
 - D.** Isolate the system from the network.

- 77.** You have a macOS computer that is behaving in an unstable manner, so you press the Command+R keys while it is booting and enter Disk Utility. What option in Disk Utility will check and repair the filesystem?
- A. First Aid
 - B. Partition
 - C. Erase
 - D. Restore
- 78.** You need to configure encryption for the data-at-rest on a new Windows Pro workstation. Which of the following are options? (Choose two.)
- A. Kerberos
 - B. EFS
 - C. BitLocker
 - D. RADIUS
- 79.** An employee using their own smartphone for work (i.e., BYOD) calls the Help Desk and tells you that they have no Internet connectivity and can't even make phone calls. They are panicking, thinking their phone is broken. What might solve the problem?
- A. Turning Bluetooth on
 - B. Turning Airplane mode off
 - C. Restarting the smartphone
 - D. Turning on their hotspots
- 80.** A user has a Windows 10 Pro laptop that they have installed and tested lots of software on, and now it will barely run. There is nothing that they want to save on it, and they've asked if you can just make it run like new again. What is the easiest way to do this?
- A. Create installation media from the Microsoft website and perform a repair installation.
 - B. Create installation media from the Microsoft website and perform a clean installation.
 - C. Boot to a recovery partition and perform a factory installation.
 - D. Install a new hard drive and perform a clean installation from Microsoft installation media.
- 81.** You're verifying settings on your router and notice that it only has WPA2, not WPA3. Your devices have all been working with WPA2, and you have some older and some newer devices. What should your next steps be? (Choose two.)
- A. Update the router's firmware.
 - B. Choose WPA2/WPA3 Transitional.
 - C. Choose WPA3 Personal.
 - D. Choose WPA2 Personal (AES).

- 82.** Your client has a computer on their network that they have configured to be a secure web server. How should you configure their router to ensure that traffic for the server is going to the server? (Choose two.)
- A.** Forward outgoing requests for port 443 to the web server's IP address.
 - B.** Forward incoming requests for port 443 to the web server's IP address.
 - C.** Set the router to use UPnP.
 - D.** Create a screened subnet for the web server.
- 83.** You've tried to access a website that you're sure is safe, but you're getting an invalid certificate warning. What should you do?
- A.** Verify the date and time on your computer.
 - B.** Run anti-malware.
 - C.** Report the website as dangerous.
 - D.** Delete the certificate from your computer.
- 84.** A friend asks you what it means to gain root access to an Android device and if they should do it. Which of the following is not true about Android root access?
- A.** Android root access is like cracking software or jailbreaking an iPhone, which makes your device more vulnerable to attack.
 - B.** Android root access might not be illegal; however, it may void your device's warranty.
 - C.** Android root access is a safe way to get more out of your device.
 - D.** Android root access gives the user full access to the device, opening the potential to accidentally make undesirable changes.
- 85.** A user calls the Help Desk and tells you that their iPhone is slow to respond. They have closed open apps, but it's still very slow. What will you check next?
- A.** If the phone is overheating
 - B.** How much data is being used
 - C.** If they're having strange pop-ups
 - D.** How much space is on the device's storage
- 86.** A user has a 32-bit application that they want to use on a 64-bit operating system, and they have asked you if that will work. What do you tell them?
- A.** Both 32-bit and 64-bit are interchangeable.
 - B.** Yes, a 32-bit application will work on a 64-bit operating system.
 - C.** No, the application must be 64-bit to run on a 64-bit operating system.
 - D.** A 64-bit application will run on a 32-bit operating system, but a 32-bit application will not run on a 64-bit operating system.

- 87.** You are required to enter a username, password, and a code from an authenticator app on your phone before you can access the company website. What type of authentication is this?
- A.** Multi sign-on
 - B.** Single sign-on
 - C.** Multifactor
 - D.** Domain
- 88.** You're troubleshooting a computer that appears to have contracted a boot sector virus. After following the best-practice procedures for malware removal, it seems to be booting okay now, and you have created a restore point in Windows. What is your next step?
- A.** Schedule scans and run updates.
 - B.** Quarantine the infected system.
 - C.** Disable System Restore in Windows Home.
 - D.** Educate the end-user.
- 89.** Computer users are often reluctant to have anything change, so gaining their acceptance prior to the change will make a transition run more smoothly. What are two ways that you can gain end-user acceptance to a change? (Choose two.)
- A.** Make them fill out request forms.
 - B.** Involve them in the planning process.
 - C.** Thoroughly explain why this change is necessary.
 - D.** Don't tell them, and just have the change done when they come in on a Monday.
- 90.** Your company does a full backup every Sunday and incremental backups all the other days of the week at the end of each day. If you come in on Wednesday morning and your system has crashed overnight, what backups will need to be restored so that your system will be fully recovered?
- A.** Sunday only
 - B.** Sunday and Monday
 - C.** Sunday and Tuesday
 - D.** Sunday, Monday, and Tuesday
- 91.** You need to make a secure connection to a remote router and perform some configuration changes. What will enable you to do that securely?
- A.** SSH
 - B.** Telnet
 - C.** Videoconferencing software
 - D.** FTP

- 92.** What is the danger in using an operating system that has reached EOL?
- A.** Lack of feature updates
 - B.** Lack of security updates
 - C.** No technical support
 - D.** Very expensive technical support
- 93.** A user calls the Help Desk and tells you that they're trying to watch a training video full screen, but the screen won't autorotate when they turn the phone. What will you have them do?
- A.** Swipe down, look for the autorotate icon, and enable it.
 - B.** Restart their smartphone.
 - C.** Watch the video on their desktop computer.
 - D.** Click the full-screen icon on the video.
- 94.** You have hired a new network administrator. Assume their name is NewUser. How many and what types of accounts will you set up for NewUser?
- A.** NewUser, an administrator account only
 - B.** NewUser, a standard user only
 - C.** NewUser_Admin, which is an administrator account, and NewUser, a standard user account
 - D.** NewUser_Admin, which is an administrator account, and NewUser_Guest, which is a guest account
- 95.** An application on your mobile device will not close and is unresponsive. What should be your first choice to fix it?
- A.** Force-close the application.
 - B.** Restart the device.
 - C.** Revert to factory defaults.
 - D.** Reinstall the application.
- 96.** You are running late because your morning appointment took longer than you thought it would. Your next client meeting is in 5 minutes, and they're 20 minutes away. What do you do?
- A.** You get there when you get there. Your time is valuable.
 - B.** Skip that meeting and go on to the next, so you're not late all day.
 - C.** Call the client and apologize. Let them know the situation and ask if they would prefer to reschedule or see you a bit later.
 - D.** Call the client and tell them you're running late.

- 97.** You have downloaded some open-source license software. What are you usually allowed to do with it?
- A.** Modify the program to suit your needs.
 - B.** Resell the software to other people for a profit.
 - C.** Make copies but credit the original source and redistribute it under the same license under which you received it.
 - D.** Run only one copy on one machine.
- 98.** You're in the middle of a major IT systems change and have gotten to a point where you realize that it's not going to work without shutting down everything for a week. This would cost the company a fortune and will put production way behind. What will you do?
- A.** Let management know, and continue with the project.
 - B.** Follow the rollback plan.
 - C.** Fire the responsible staff member.
 - D.** Follow the AUP.
- 99.** You're working at your desktop computer, viewing a web page you use often, when a website that you know should be updating doesn't seem to be. In fact, if you access it from a different device, the website looks different. What can you do to force the website to update on your computer? (Choose two.)
- A.** Clear the browser's cache.
 - B.** Clear the browser's stored cookies.
 - C.** Uninstall and reinstall your browser.
 - D.** Hold the Ctrl and F keys simultaneously while on the website.
- 100.** You're on your smartphone and notice that the apps are all responding slowly, almost jittery when you change from one to the other. What is the first thing to do?
- A.** Check the device's storage.
 - B.** Close some running apps.
 - C.** Suspect a virus.
 - D.** Check the battery charge.

Appendix



Answers to the Review Questions

Chapter 1: Mobile Devices

1. A. Smart cameras are those that have special features such as built-in wireless network connectivity for easy picture and video transfers, high-definition video recording, motion detection, and real-time alerts. Many will include Wi-Fi, Bluetooth, and Near-Field Communication (NFC) connection types. Smart cameras, such as security cameras, can also connect via Wi-Fi to your network and the Internet, and can thus be accessed and controlled by a cellphone.
2. A. A stylus often looks like a small pencil and is used for input on a digitizer or touchscreen. Compatibility is important, as not all styluses will work with all screens. Trackpads, although they can be purchased as an add-on, are generally built into laptop keyboards and wouldn't help in this situation. A digitizer is a screen designed to accept drawing from a hand or stylus, and special gloves may help, but again, they don't solve the problem of large hands and only work on certain types of screens.
3. C. Rideshare services often require that cellular Location Services be enabled on the driver and passenger phones so they can locate each other, and to provide the driver with directions to the pick-up and drop-off locations. Location services on a cellphone might use cell towers, Global Positioning System (GPS), Bluetooth, or Wi-Fi to find the phone's exact location. This is a common way for devices to provide turn-by-turn directions. Mobile Device Management (MDM) and Mobile Application Management (MAM) are methods of managing data security in a corporate environment.
4. C, D. Mobile Application Management (MAM) protects corporate data while being used on employee's personal devices. For example, it can force employees to save all work files in the company's OneDrive cloud storage, encrypt files and delete them after a period of time, and restrict employees from downloading company content. It can even delete company files when a device has become inactive. Mobile Device Management (MDM) systems can be used to remotely wipe data from a device and restore it to factory settings. Global System for Mobile Communications (GSM) and Code-Division Multiple Access (CDMA) are cellular technology communication systems.
5. A, C. If the name of their network doesn't pop up for you, click on Other Network and type in the network name they give you. You'll also need to know if it uses WPA2, WPA3, or another wireless encryption protocol, and the password that will allow you on to their network. Your device will be given an IP address by their network, and while it's possible that they have their router locked down by a Media Access Control (MAC) number, most people don't have that level of security established on their home network's router.
6. C. While it's possible that the phone could be charged with a charging pad, most often phones won't charge because the battery is worn out and needs replacing. Also, according to the Apple Support website, if a phone won't charge after checking the simple things, it likely needs servicing. Your friend should take their phone to a service center. They might be able replace the battery or fix problems they find with the phone's connector.

7. C. You should always disconnect the external power before working on any computer system. Legacy laptops may have a battery that is removable and replaceable, by sliding a connector or removing a few screws from the back of the case, but you might not be able to find a compatible replacement. Modern laptops have internal batteries. Before removing the back (bottom) cover of the laptop to gain access to the battery, you must disconnect the power to avoid getting shocked or damaging the laptop. You'll also want to be certain that you can purchase a compatible battery both in features and size/shape. Most do not require you to remove the keyboard or Liquid Crystal Display (LCD) panel to reach the battery, but again before doing either of those, research the laptop and disconnect the power.
8. A, B. Corrupted drivers and loose cables can cause all sorts of interesting output. Strange characters on the screen don't necessarily mean that the laptop needs to be replaced, and users should be discouraged from eating cookies or toast (or anything) over their laptops. Fine crumbs or other debris can cause keys to stick, but that likely wouldn't cause the type of problem that this user is experiencing. Oftentimes, a laptop keyboard can be replaced fairly easily, assuming a compatible one can be found. But in this case, the problem is most likely caused by a loose ribbon cable connecting the keyboard to the motherboard, or a corrupted driver.
9. C. Individual keys can be replaced on a laptop. If your company uses many of the same model of laptop, keeping one or two nonfunctioning ones in stock for parts is helpful. If a key is not readily available, they can be purchased from third-party vendors for much less than an entire keyboard. When ordering, ensure that it has the right type of clips, hinges, and possibly cup for the model being replaced. In the short term and as a quick fix, an inexpensive Universal Serial Bus (USB)-connected keypad might suffice.
10. D. It's most likely that Bluetooth connectivity was lost between the earpiece and the once-paired device, probably a phone. Examine the phone and troubleshoot connectivity between the phone and the earpiece. Paring the earpiece to a different device would have required action on the part of the client, and a weak Wi-Fi signal wouldn't affect Bluetooth. It is possible that the earpiece is broken, but far more likely that they simply lost connectivity.
11. A. You should always check the device's documentation *before* purchasing components to ensure compatibility. In a laptop, Random Access Memory (RAM) is often soldered directly onto the motherboard (onboard) and isn't meant to be replaced by most users. Because the maximum system RAM is 32 GB, you would need one 16 GB RAM module to bring it up to that total. Small Outline Dual Inline Memory Modules (SODIMMs) are the type of RAM module used in devices like laptops and sometimes printers. Dual Inline Memory Modules (DIMMs) are used in desktop computers.
12. C. The short answer is that no, storage on an iPhone, iPad, iPod, or almost any small device usually can't be upgraded. When you buy one of these devices, it's best to buy a device with as much storage as you can afford. Attaching the device to your PC and doing the upgrade there may work. If not, you may not have to buy a new iPad, but before you do, check to see if you have some data that you no longer need like messages from years ago, or if you have some apps that you no longer use and can delete to free up some space. You should be able to

download them again later onto a new device. iCloud is storage in the cloud, and not the same as storage on your device; however, you could store photos in iCloud Photos or use Messages in iCloud to save space on the device.

13. A. A Solid-State Drive (SSD) uses the same memory technology found in other forms of flash memory. They are much faster than traditional magnetic drives or hybrid drives but generally don't have as much capacity for the same price. An Nonvolatile Memory express (NVMe) drive is newer solid-state technology and would have to be supported by the laptop. It also uses a different connector. Note: Some people mistakenly call a storage drive a "hard drive," regardless of whether it's an SSD, NVMe, or legacy magnetic hard disk drive (HDD).
14. D. As a rule of thumb, either you can access components from the bottom of a laptop, such as the memory and Wi-Fi card, or you're going to need to remove the keyboard to access the components from the top.
15. A. If you have a cellular-enabled device such as a smartphone, you might be able to turn that phone into a mobile hotspot. By doing so, you can share your cellular Internet connection with Wi-Fi-enabled devices, such as laptops and tablets. Near-Field Communication (NFC) devices can communicate and send data and files, but only if they are within inches of each other. Bluetooth is a common wireless technology for connecting devices, such as keyboards and headsets to a computer, and Radio Frequency Identification (RFID) is a technology that enables information from a wireless tag to be accessed by a reader. Retail theft prevention systems often use RFID, and they may be used in industry for tracking assets and inventory.
16. C. The fourth generation of cellular services (4G) is also known as Long-Term Evolution (LTE). Introduced in the 2000s, it boasted downstream rates as fast as 53.3 Mbps. Prior to that, 2G came out in 1991 and added text-based short messaging services (SMS). Released in 2001, 3G transmits up to 7.2 Mbps. Still being implemented, 5G employs the use of different software and radio transmitters, is backward compatible, and is estimated to be able to reach transmission rates of 20 Gbps.
17. A. Near-Field Communication (NFC) is a wireless technology that uses Radio Frequency (RF) signals with limited range, about 4 inches (10 cm). NFC readers are the active components used in NFC transactions. They have the ability to read (and some can write) tags and communicate directly with other devices. NFC technology is most often used in smartphones for payment services; however, some smartphones (Androids and iPhone 7 or newer) can also write to NFC tags. Bluetooth and Wi-Fi have greater ranges, and a hotspot enables a user to allow another device to use the Internet by accessing the hotspot's connection.
18. C. Headsets are used for hands-free phone conversations and listening to music. Headsets can either plug into the speaker/headphone jack or be wireless. Most wireless headsets are Bluetooth. Wi-Fi is for connecting to Wireless Local Area Networks (WLANs). A hotspot enables a user to allow another device to use the Internet by accessing the hotspot device's Internet connection. Near-Field Communication (NFC) only works over truly short distances; about 4 inches (10 cm).
19. B. Near-Field Communication (NFC) is a wireless technology that uses Radio Frequency (RF) signals with limited range, about 4 inches (10 cm). NFC can operate in card emulation

mode, which lets the device act as a smartcard. This is useful for making payments at the site of a merchant who uses NFC. Bluetooth is a popular protocol for Personal Area Networks (PANs), such as a laptop and headset or speakers. Wi-Fi is used for Wireless Local Area Networks (WLANs). Hotspots enable users to allow another device to use their Internet by accessing the hotspot device's Internet connection.

20. B. Often in laptops, the antenna is housed in the laptop's display area. You would most likely need to separate the display from the laptop's motherboard section to open the display and replace the antenna cable. It will also likely have two different parts, a right and a left antenna, so make sure you choose the correct one.
21. B, C. Biometrics use parts of your body to identify you. An ID card is not biometric. Retina scanners are used in some secure environments but are not commonly found on laptops, yet facial recognition like Apple's Face ID and Windows Hello are on most modern laptops. Fingerprint readers can be found on many laptops or can be easily added.
22. B. Near-Field Communication (NFC) is a wireless technology that uses Radio Frequency (RF) signals with limited range, about 4 inches (10 cm). To read an NFC tag in a poster, you must move your phone close to the tag. The phone generates a small RF field that powers the tag, and data can then be read from the tag. There are five types of tags that vary in speed, from 106 kbps to 2424 kbps, and in maximum capacities, from 2 KB to 32 KB. Type 4 holds the most data but is slower than Type 3.
23. C, D. In devices prior to the iPhone 7, the only Near-Field Communication (NFC) capability is the ability to use Apple Pay; however, with iPhone 7 and newer devices, a third-party app can be used to read and write NFC tags. iPhone 12 and newer devices can natively read NFC tags.
24. A, C, D. Near-Field Communication (NFC) can do so much more than just pay for your coffee. In addition to securely sharing data, transferring files, photos, and video, and adding information to business cards, NFC tags can be set up to automate tasks instead of manually changing settings, such as silencing an alarm or logging into a PC. In some places, they can enable your phone to be your bus pass. They're considered secure for communication because of the short distance between devices. NFC tags are passive devices that require the power of a very close NFC reader to transfer information. An NFC tag alone is unable to beam data anywhere, and with a reader the distance is measured in inches, not feet.
25. B, C. Webcams are nearly universal on laptops. The most common placement is right above the laptop's display. Microphones are also often built into the display, next to the webcam. Both laptops and mobile devices such as smartphones and tablets are used for videoconferencing. Desktop computers can be used for videoconferencing too, but usually require adding a webcam and microphone. A digitizer converts touch input into digital format, and a number pad can connect wirelessly or via Universal Serial Bus (USB) and enables the user to enter numbers separately from the laptop's keyboard.
26. B. Common components to include in the display are the screen, Wi-Fi antenna, webcam, microphone, inverter, and digitizer. Speakers are often near the keyboard on a laptop; however, some desktop displays have built-in speakers.

- 27.** A, D. Smart cameras have built-in wireless network connectivity for easy picture and video transfers. Many include Wi-Fi, Bluetooth, and NFC. Infrared Data Association (IrDA) transmission uses infrared light for communication and is not popular, and Registered Jack (RJ) RJ-45 is a type of networking connector.
- 28.** C. Megapixels are a measure of how many unique points a digital camera is capable of storing. It's more a measure of detail than quality, but for most of us it's a quick way to compare a smartphone's photographic capabilities. Brightness and contrast are settings that affect the display, whereas the digitizer accepts analog input and converts it into digital format.
- 29.** C, D. Configuring a new Bluetooth trackpad is a fairly simple procedure. You first need to pair the device with the tablet, then configure it for speed, clicking, and such. The CompTIA A+ objectives list the steps for connecting Bluetooth devices as follows:
1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.
 4. Enter the appropriate PIN code.
 5. Test connectivity.
- 30.** B. Tethering is connecting a device to a mobile hotspot. The term used to be reserved only for when you were connected via Universal Serial Bus (USB) cable, as opposed to connecting via wireless. Some devices will not function as a mobile hotspot but will enable you to tether a mobile device to it with a USB cable, so that the mobile device can share the cellular Internet connection.
- 31.** B. The iPhone 14 series uses the proprietary connector called the Lightning connector. They can also use a compatible wireless charging pad. iPhone 15 and later use a Universal Serial Bus-C (USB-C) port.
- 32.** B. The connector shown is the Apple Lightning connector used by iPhones since the iPhone 5. Apple began using Universal Serial Bus-C (USB-C) in its iPhones with the release of the iPhone 15 and iPhone 15 Pro on September 22, 2023, after 11 years of using the Lightning connector in earlier iPhones.
- 33.** C. To connect Bluetooth devices, a user must initiate the pairing process on both devices. Bluetooth is used to create a personal area network (PAN), also known as a piconet. The range for a Bluetooth network is only about 30 feet. 802.11a is a legacy Wi-Fi standard; Lightning is a type of Apple connector for older devices; and Wi-Fi enabled refers to a device that uses a Wi-Fi connection. The CompTIA A+ objectives list the steps for connecting Bluetooth devices as follows:
1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.

4. Enter the appropriate PIN code.
 5. Test connectivity.
34. B, D. A docking station often replicates the functions of the ports on the back of a laptop, so that peripherals that don't travel with the laptop, such as displays, keyboards, printers, and so on, can remain connected to the dock and don't all have to be unplugged physically every time the laptop is removed. Docking stations effectively turn a laptop computer into a desktop computer, and the docking station may offer its own devices, such as an optical drive and speakers. It may have a generic connector such as Universal Serial Bus-C (USB-C) or a proprietary connector. Docking station can also refer to a charging cradle for a smartphone or tablet to plug in vertically that provides other functions such as built-in speakers for music playback or a clock. This differs from a port replicator, whose main function is to let the user connect several devices at once and doesn't require the laptop to be connected to offer that connectivity between the devices. A KVM switch enables you to use one keyboard, video device, and mouse (hence the name, KVM) with two or more system units. *Desktop station* is not an actual technical term.
35. B. A port replicator is an attachment that provides the same ports as, or additional ports to, a laptop. The devices can communicate with each other via the port replicator regardless of the laptop's location. Whereas a docking station may (or may not) be a proprietary device, a port replicator is not proprietary and will generally provide a connection to the external devices via a Universal Serial Bus (USB) or similar port. A KVM switch enables you to use one keyboard, video device, and mouse (hence the name, KVM) with two or more system units.
36. C. There are several different types of Universal Serial Bus (USB) connectors. The one shown here is a MicroUSB.
37. A, B. This is an audio output port and can be used to connect either speakers or a headset. Audio output ports are usually color-coded green. A microphone can use a port that looks the same but is color-coded pink.
38. D. Laptop motherboards are nearly always proprietary, meaning they are not interchangeable between manufacturers or even between models from the same manufacturer. When a laptop motherboard needs to be replaced, you most likely need a laptop motherboard from the same laptop make and model.
39. B. A Direct Current (DC) power adapter enables a user to plug the laptop into the DC power source (usually called an auxiliary power outlet) inside a car or on an airplane. Alternating Current (AC) power adapters are for plugging into standard wall outlets. Some airplanes now provide AC power outlets to their passengers as well. Check availability with the airline before your flight.
40. A, B. You should choose an Alternating Current (AC) adapter rated for the same wattage as the original. You must also pay special attention to the voltage and polarity of the plug that interfaces with the laptop. If the laptop requires the positive lead to be the center conductor, for instance, then you must take care not to reverse the polarity. It's best to find one that advertises compatibility with the device it will be charging.

- 41.** B, C. Legacy docking stations have a proprietary port that aligns with a connector, usually on the bottom or back of a laptop. The docking stations are proprietary, meaning they can only work with specific equipment. Modern docking stations connect with the fast Universal Serial Bus-C (USB-C) or Thunderbolt ports, and sometimes Universal Serial Bus-A (USB-A) ports. They often supply their own power and can make a laptop seem like a desktop by plugging in one cable that connects the laptop to multiple displays, gigabit Ethernet, audio, or almost any other port type. Docking station can also refer to a charging cradle for a smartphone or tablet to plug in vertically that provides other functions such as built-in speakers for music playback or a clock.
- 42.** C. Global Positioning Systems (GPS) systems were designed to require multiple satellites. Receivers use a process called triangulation, which they use to calculate the distance between themselves and the satellites (based on the time it takes to receive a signal) to determine their location. They require input from four satellites to provide location and elevation or three to provide location.
- 43.** A, C. An older laptop hard drive will usually be a Solid-State Drive (SSD) in the 2.5-inch form factor. Modern laptops most likely use either mSATA or M.2 drives, which are thinner than a RAM module and much smaller. Desktop computers have historically used 3.5-inch hard drives but most also support 2.5-inch or M.2 drives.
- 44.** B. Many laptops use shared video memory, meaning that system Random Access Memory (RAM) is divided up for use between the processor and the video card. On these types of systems, the amount of RAM available for video is configured in the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI). Anything reserved for the video card is unavailable to the processor. In this case, subtracting half a gigabyte from 4 GB leaves the Central Processing Unit (CPU) with 3.5 GB.
- 45.** D. Oculus VR specializes in Virtual Reality and Augmented Reality (VR/AR) headsets. Samsung and HTC, while manufacturing smartphones, also produce VR/AR headsets.
- 46.** B. The two center connectors are Thunderbolt connectors. They have the characteristic lightning bolt icon. Thunderbolt is an offshoot of DisplayPort technology and supports many types of peripherals.
- 47.** D. iPhones from the iPhone 5 to iPhone 14 have used a proprietary connector called the Lightning connector. iPhone 15 and later use a Universal Serial Bus-C (USB-C) power connector. Samsung smartphones and Fitbit watches most likely use a USB-C cable, whereas Intel-based laptops use a variety of charging jacks, depending on the device.
- 48.** A. The overwhelming majority of Wi-Fi antenna connectors for indoor-rated antennas found on laptops are type SubMiniature version A (SMA). The SMA-female connector is on the device. What makes a connector “male” is the center pin and threads on the inside, while a “female” connector has a receptor for the pin and threads on the outside. Reverse Polarity (RP) means that the pin and receptor are in opposite positions with regard to connector gender, while the outside housing remains the same. SMA-RP and SMA are, therefore, not compatible with each other. N-type connectors look similar but are weatherproof and larger than SMA connectors.

- 49.** C. The Institute of Electrical and Electronics Engineers (IEEE) standard 802.15.1 is commonly known as Bluetooth. The CompTIA A+ objectives list the steps for connecting Bluetooth devices as follows:
1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.
 4. Enter the appropriate PIN code.
 5. Test connectivity.
- Not all Bluetooth devices require entering a pin. Opening a port is done on a router to enable a particular type of traffic to pass through the router to a connected network.
- 50.** C. When pairing two Bluetooth devices, depending on the security settings, it is sometimes necessary to enter a Bluetooth Personal Identification Number (PIN) code. In security configuration menus, the PIN is sometimes referred to as the Bluetooth passcode or passkey. The CompTIA A+ objectives list the steps for connecting Bluetooth devices as follows:
1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.
 4. Enter the appropriate PIN code.
 5. Test connectivity.
- 51.** C. Apple's cloud service, called iCloud, is for users and subscribers to store their media, contacts, and so on. OneDrive is Microsoft's online cloud user storage.
- 52.** D. If you use a common email provider such as Google, Yahoo, Outlook, or iCloud, then setting up email on a device should be simple. Often, all you need is your username and password. If you're setting up a corporate account or if you must manually configure email, then you'll need more information, such as whether it's using Internet Messaging Access Protocol (IMAP) or Portable Office Protocol (POP3) and the server names for sending and receiving email. You may also need the port number and security settings.
- 53.** C. The International Mobile Equipment Identity (IMEI) is a unique number assigned to the physical phone. This unique identifier is hardcoded into the device. The Primary Rate Interface or Product Release Instructions (PRI) describe how your device connects to the network. An International Mobile Subscriber Identity (IMSI) number uniquely identifies the account holder, and a Media Access Control (MAC) address uniquely identifies a network interface card.
- 54.** B. A cellphone's Electronic Subscriber Identification Module (eSIM) identifies a person on a cellular number and can be transferred from one phone to another. eSIMs have largely replaced physical SIM cards. The International Mobile Subscriber Identity (IMSI) is a unique number that identifies you, the user, to the cellular service. The International Mobile Equipment Identity (IMEI) is a unique number assigned to the physical phone. A phone may

have more than one IMEI (IMEI2), which enables the user to install more than one SIM/eSIM and use more than one phone number on a cellphone.

- 55.** A. Synchronization means to duplicate or back up data from a device. Synchronization can be done to the local desktop, to the cloud service off-premises, or even to an automobile. A virtual private network (VPN) uses encryption protocols to safeguard communications across a shared transmission medium (like the Internet) and mimics the network connection you would have if you were in the same building as your server. Encryption is using algorithms to change data, so that it can't be read by unauthorized people or devices, thus protecting your data and logins. Updating is a generic term for modernizing and adding features to something.
- 56.** C. When you synchronize calendars between devices, appointments and entries are copied and readily available on each device. Synchronization can be accomplished in multiple ways, depending on the service or third-party software being used. The same synchronization can be done for several media types, such as videos, music, pictures, and documents.
- 57.** A. Synchronizing calendars between devices and users is an easy and reliable option for ensuring that all parties have the same information. Passwords should never be shared.
- 58.** B. ActiveSync was developed by Microsoft to make synchronization of data easier and enables users to access their data even when they're not online. The other options are not part of the CompTIA A+ objectives, but for the curious: MSync is an internal working of the operating system that synchronizes memory and storage. SyncTime is a third-party application, and Timewarp is a name given to several software utilities, a song, and at least one event venue.
- 59.** D. As with any device installation in IT, the last step is to verify that the device works as intended. The CompTIA A+ objectives list the steps for connecting Bluetooth devices as follows:
1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.
 4. Enter the appropriate PIN code.
 5. Test connectivity.
- 60.** A. Any device that has a Global Positioning System (GPS) receiver has the ability to ping satellites, which will correspond with at least two others to triangulate the position of the device, and they are quite accurate. (A fourth satellite is needed to determine elevation.) This is a common way for devices to provide turn-by-turn directions. While cellular location services work the same way, that wouldn't be the answer unless the vehicle has its own cellular service. Mobile Device Management (MDM) and Mobile Application Management (MAM) are methods of data security in a corporate environment.
- 61.** A, C. Both Global Positioning System (GPS) and cellular location services can be used to pinpoint the location of any device on Earth that has a GPS receiver or cellular service. GPS finds your location by pinging satellites, whereas cellular location services use three or more

cellphone towers in a process called triangulation to determine your location. (A fourth tower is needed to determine elevation.) Mobile Application Management (MDM) is a type of data security for mobile devices, and Radio Frequency Identification (RFID) is often used for inventory management.

62. A. Some applications need to know your location to work properly, while others don't. Luckily turning off location services is not an "all or nothing" situation. You can turn location services off and on by application and maintain discrete control over who is allowed to see where you are, and who is not, in the privacy settings of your phone.
63. B. While it's possible that the server has too many requests, the more likely culprit to your slow downloads is that you've reached your Internet service's data cap, and your service has slowed. This can happen whether it's home service or cellphone service. Some services may cut you off completely, and others merely send you a text message stating you've reached your limit, so they'll be slowing your connection or billing you more. If the router needed to be reset, the symptoms would be different. If the laptop was overheating, it would most likely shut down.
64. A, B. Mobile Application Management (MAM) protects corporate data while being used on employee's personal devices. It can force employees to save all work files in the company's OneDrive, encrypt files and delete them after a period of time, and restrict employees from downloading company content. It can even delete company files when a device has become inactive. Mobile Device Management (MDM) systems can be used to wipe data from a device and restore it to factory settings. Global Systems for Mobile Communication (GSM) and Code-Division Multiple Access (CDMA) are cellular communication technology systems.
65. C. 5G, which is still being implemented, employs the use of different software and radio transmitters, and is backward compatible. It's estimated that it will be able to reach transmission rates of 20 Gbps. The fourth generation of cellular services (4G) is also known as Long-Term Evolution (LTE). It was introduced in the 2000s. It boasted downstream rates as fast as 53.3 Mbps. Prior to that, 2G came out in 1991 and added text-based Short Messaging Service (SMS). 3G was released in 2001 and transmits up to 7.2 Mbps. Wi-Fi 6 is not a cellular communication technology.
66. A, C. While any of the given options are possible, the two most likely are to provide cloud access to the application, or to install the software on their device and manage it remotely using Mobile Device Management (MDM) or Mobile Application Management (MAM) software.

Chapter 2: Networking

1. A. Cable testers are indispensable tools for any network technician. Usually, you use a cable tester before you install a cable to verify it works. Of course, you can test them after they've been run as well, such as when a cable is run from a wiring closet to a work area. Multimeters are used to test power supplies and wall outlets. Loopback plugs are used to test

network interface cards, and a tone generator and probe are used to locate a wire among other wires. The tools are (of course) different for twisted pair or fiber-optic cables, to accommodate the different connections. The tool for testing fiber-optic cables is called an Optical Time Domain Reflectometer (OTDR).

2. C. Internet Message Access Protocol (IMAP) is a secure protocol designed to download email. It has several advantages over the older Post Office Protocol 3 (POP3). First, IMAP4 works in connected and disconnected modes. Second, it lets you store the email on the server, as opposed to POP3, which requires you to download it. Third, IMAP4 enables multiple clients to be simultaneously connected to the same inbox. Simple Mail Transfer Protocol (SMTP) is used for sending mail, and Server Message Block (SMB) is used when sharing files across a network.
3. A. The Domain Name System (DNS) server is responsible for resolving hostnames, such as www.google.com, to IP addresses to enable communication. If it's not working properly or you can't connect to it, you won't be able to browse the Internet using human-friendly website names. Dynamic Host Configuration Protocol (DHCP) is used to assign IP addresses to network clients. The subnet mask might be incorrect, but it wouldn't likely be missing, and a duplicate IP address would provide an error message stating so.
4. B. Secure Shell (SSH) can be used to set up a secure session over port 22 for remote logins, or for remotely executing programs and transferring files. Because it's secure, it was originally designed to be a replacement for the unsecure `telnet` command. SSH and Telnet are both the name of the respective protocols, and the commands used. The Server Message Block (SMB) protocol, File Transfer Protocol (FTP), and FTP Secure (FTPS) protocols are used to share files across a network.
5. B. Quadrature Amplitude Modulation (QAM) is a process that combines two AM channels into one, effectively doubling the bandwidth of modern Wi-Fi protocols. Quality of Service (QoS) is configured to give priority to a user or application. Power over Ethernet (PoE) provides electrical power over Ethernet cables and Ethernet over Power (EoP) enables a user to enlist already established electrical cables to carry Ethernet signals; it requires the use of special adapters that plug into regular power outlets.
6. B. Transmission Control Protocol (TCP) guarantees packet delivery through the use of a virtual circuit and data acknowledgments, whereas User Datagram Protocol (UDP) does not. Because of this, TCP is often referred to as being connection-oriented, whereas UDP is connectionless. Internet Protocol (IP) is used to get packets to their destination across the Internet, and Internet Control Message Protocol (ICMP) is used by connectivity devices to diagnose problems and send messages.
7. D. Remote Desktop Protocol (RDP) is a replacement for the older Terminal Services, which used the Telnet protocol. Terminal services and the Telnet protocol are not secure. (They're depreciated.) RDP, as its name implies, lets users log into a local machine and use a remote machine almost as if they were sitting at it. RDP uses port 3389. File Transfer Protocol (FTP), Secure FTP (SFTP)—also called Secure Shell (SSH) FTP—and Server Message Block (SMB) are all protocols that are used for sharing files across a network.

8. C. 802.11ax (Wi-Fi 6) is considered a replacement for 802.11ac (Wi-Fi 5). 802.11ac operates in the 5 GHz frequency, while 802.11ax can operate between 1 and 7.125 GHz frequencies, encompassing the 2.4 GHz and 5 GHz bands. 802.11ac can send data at over 1 Gbps, while 802.11ax can be several times faster. 802.11a was adopted in 1999. It operates at 54 Mbps in the 5 GHz frequency band. 802.11n was adopted in 2008. It operates at 600 Mbps in both the 2.4 GHz and 5 GHz ranges.
9. A. If Bob is trying to connect to an 802.11g network, his device will not be able to connect because 802.11g operates on the 2.4 GHz frequency only. 802.11n and 802.11ax both operate on 2.4 GHz and 5 GHz. 802.11ac operates only on the 5 GHz frequency.
10. C. Server Message Block (SMB) is a protocol used to provide shared access to files, printers, and other network resources. In a way, it functions a bit like File Transfer Protocol (FTP) with a few more options, such as the ability to connect to printers and ports, and SMB offers more management commands. Secure Shell (SSH) uses encryption to create a secure contact between two computers, and Simple Mail Transfer Protocol (SMTP) is used for sending email.
11. C. Telnet lets users log into another machine and “see” the remote computer in a window on their screen. Although this vision is text only, users can manage files on that remote machine just as if they were logged in locally. Telnet uses port 23. Telnet has been largely replaced by Secure Shell (SSH), and SSH (over port 22) is more secure than Telnet. Port 21 is used by File Transfer Protocol (FTP) and port 25 is used by Simple Mail Transfer Protocol (SMTP).
12. D. A wireless locator, or a Wi-Fi analyzer, can be either a handheld hardware device or specialized software that is installed on a laptop, smartphone, or other mobile device, and whose purpose it is to detect and analyze Wi-Fi signals. It can detect where signals are strong or weak, to determine whether there are potential security issues. A tone generator and probe are used for locating a wire. Protocol analyzers and packet sniffers are tools for capturing and analyzing network traffic.
13. C. Internet traffic is not encrypted by default. Websites that are secure and encrypt their transmissions will start with `HTTPS://` rather than `HTTP://`. These sites can be trusted to encrypt the data, and their identity is verified.
14. B, D. 802.11ac operates in the 5 GHz frequency only. 802.11g is only 2.4 GHz. 802.11n and 802.11ax (Wi-Fi 6) operate in both 2.4 GHz and 5 GHz frequencies; however, the 802.11ax extended (Wi-Fi 6E) is an enhanced version of 802.11ax that operates in the 6 GHz frequency. 802.11be operates in the 2.4, 5, and 6 GHz frequencies. You might find it helpful to create a chart of standards, speeds, and frequencies to study for the exam.
15. C. There are three types of addresses in IPv6: unicast, anycast, and multicast. A unicast address identifies a single node on the network. An anycast address refers to one that has been assigned to multiple nodes, and a packet will be delivered to one of them. A multicast address is one that identifies multiple hosts, and a packet will be sent to all of them.
16. B. A Wide Area Network (WAN) covers large geographical areas and often supports thousands of users. A WAN can connect different locations of a single company, or a WAN may connect several companies together to share information. WAN lines are often leased

from a WAN provider. The Internet is considered a very large WAN. A Local Area Network (LAN) covers a relatively small area such as a home or business. A Personal Area Network (PAN) is typically used by one person and is comprised of their computer and its Bluetooth devices. A Metropolitan Area Network (MAN) is similar to a WAN, but the area covered is much smaller, such as a university or a city.

17. A. Developed by Microsoft, the Remote Desktop Protocol (RDP) enables users to connect to remote computers and run programs on them as if they were sitting at the computer. It uses port 3389. A port is associated with a specific protocol and must be “opened” on a router to enable traffic from the program or protocol to enter the LAN. The combination of an IP address and a port is considered a socket. The IP address gets the data to the right destination, and the port number tells the transmission layer of the Open Systems Interconnection (OSI) model to which application the data is to be sent. Server Message Block (SMB) and Common Internet File System (CIFS) are used to share files across a network. Telnet (port 23) is an unsecure protocol that has been largely replaced with Secure Shell (SSH) protocol. SSH uses port 22.
18. B. Secure Shell (SSH) can be used to set up a secure session for remote logins, or for remotely executing programs and transferring files. SSH uses port 22. SSH has largely replaced the unsecured Telnet, which uses port 23. Port 21 is used by File Transfer Protocol (FTP) and port 25 is used by Simple Mail Transfer Protocol (SMTP.)
19. A. 10.1.1.1 is a private IP address, and therefore not routable on the Internet. Private IP addresses can only be used on the LAN side of a router. The other answer options are all routable. IPv4 network numbers were arranged in classes, and classes A, B, and C each have their own private range. The private IP address range for class A networks is 10.0.0.0/8. The /8 means that the first 8 bits of the subnet mask denote the network number. Expressing a subnet mask this way is known as CIDR (pronounced cider) notation. CIDR stands for classless inter-domain routing. While the term CIDR doesn’t appear on the objectives for this CompTIA A+ exam, you may still run into it while working in IT.
20. D. One of the key features of routers is that they break up broadcast domains. Broadcast traffic from one port of the router will not get passed to the other ports, which greatly reduces network traffic. Bridges, hubs, and switches will all forward broadcast packets.
21. A. Routers are Open Systems Interconnection (OSI) model layer 3 (Network layer) devices. They keep a chart containing the IP address of the device connected to each port, whether that device is a computer or another router’s external address. A Media Access Control (MAC) address is the address of a Network Interface Card (NIC). Memory addresses identify where information is stored, and a loopback address is used to test Transmission Control Protocol/Internet Protocol (TCP/IP) on the local host. The loopback address for IPv4 is 127.0.0.1, and for IPv6 it is::1.
22. C. A loopback plug is for testing the ability of a network adapter to send and receive. The plug gets plugged into the Network Interface Card (NIC), and then a loopback test is performed using troubleshooting software. You can then tell whether the card is working properly. Multimeters are used for testing power supplies and wall outlets, a tone generator and probe help the technician to find a specific wire, and a cable tester checks that an

Ethernet wire was configured correctly, and that it can make an end-to-end connection. If the NIC tests fine, the next step might be testing the cable.

23. A. A Wireless Local Area Network (WLAN) is created when a device, such as a Wireless Access Point (WAP), is installed to connect devices via radio waves instead of cables. A proxy is a device that sits between the user and a remote host (usually the Internet). The proxy can filter traffic and provide load balancing. A Near-Field Communication (NFC) hub isn't an actual term, although NFC capabilities may be part of devices such as a home automation hub.
24. C, D. Simple Mail Transfer Protocol (SMTP, port 25), Post Office Protocol 3 (POP3, port 110), and Internet Message Access Protocol (IMAP, port 143) are all email protocols. SMTP is for sending email. POP3 and IMAP are for downloading (i.e., receiving) email. Port 23 is used by Telnet. Choice B is incorrect because the question specifically asks about downloading (not sending) email, and yes, some of the CompTIA questions are this particular.
25. D. Dynamic IP addressing makes the work of configuring computers on a network much easier. With dynamic IP addressing, the IP addresses are assigned by a Dynamic Host Configuration Protocol (DHCP) server. IP address assignments may change as computers are added to and removed from the network, or even when one hasn't been turned on in some time based on the IP address lease duration. A single IT technician may be responsible for keeping hundreds of PCs working. You should always keep detailed records of any computers that have been assigned static IP addresses and ensure that they are not in the address pool to be assigned.
26. D. Routers operate at the Network layer (Layer 3) of the Open Systems Interconnection (OSI) model. Because of this, they make their decisions on what to do with traffic based on logical addresses, such as an Internet Protocol (IP) address. Switches use Media Access Control (MAC) addresses and are OSI Layer 2 devices. Hubs and Network Interface Cards (NICs) operate primarily at the Physical layer (Layer 1). They are largely unaware of addresses when sending packets.
27. C. A firewall is a hardware or software solution that serves as your network's security guard. Firewalls can protect you in two ways: they protect your network resources from hackers lurking in the dark corners of the Internet, and they can simultaneously prevent computers on your network from accessing undesirable content on the Internet or sending out data that they shouldn't. PoE stands for Power over Ethernet, while EoP stands for Ethernet over Power. Neither has to do with protection. While a router may incorporate a firewall, it is not, by itself, a firewall. Routers are responsible for communications with other networks or broadcast domains. A firewall may be a discrete physical network appliance or software incorporated into another device like a router.
28. D. The default gateway is the address to the network's router on the Local Area Network (LAN) side of the router. The router enables the host to communicate with hosts that are not on the local network. The default gateway is also called the router's internal address. The `ipconfig /all` command can be used to see the default gateway address that the local computer is currently configured to use. The router will also have an external address, which

is used to communicate with networks outside the LAN. Virtually all modern routers use a process called Network Address Translation (NAT), which will substitute the router's external address for a host's IP address when requesting information from a remote network. The router knows which host requested the information and will pass it on to the correct host when it is received. This is one of the ways that the router protects the local hosts from the outside world.

29. A. A patch panel can be found in a telecommunications room (also called a wiring closet), and it is usually mounted in a networking rack. On the back are connections into which a technician will "punch down" wires. On the front is a female port, usually an RJ-45 type. A multiplexer is a device that aggregates several connections into one. A rack U is simply a measurement of the height of a device mounted into a rack (i.e., my patch panel is 4U). Each U is equal to 1.75 inches. The demarcation point is where responsibility for a network changes from the ISP to its customer.
30. C. A Personal Area Network (PAN) is a small-scale network designed around one person within a limited boundary area. The term generally refers to networks that use Bluetooth technology. A Local Area Network (LAN) covers a larger area, such as a house or perhaps one floor of a building, and likely uses the Ethernet protocol. A Metropolitan Area Network (MAN) covers a larger area, such as a city or university campus; and a Wide Area Network (WAN) covers a very large geographic area, such as one connecting distant cities or different countries.
31. A, B. The 169.254.0.0/16 range in IPv4 is the Automatic Private IP Addressing (APIPA) range. APIPA comes into play when the host is unable to locate a Dynamic Host Configuration Protocol (DHCP) server, and the network connection is configured to acquire an IP address dynamically. Because the computer is unable to get a dynamic IP address from the DHCP server, the operating system automatically assigns a random IP address in the APIPA range.
32. C. An IPv6 address in the FE80::/10 range is called a link-local address and is similar to an IPv4 Automatic Private IP Addressing (APIPA) address. (The 169.254.0.0/16 range in IPv4 is the APIPA range, used for automatic configuration if the host can't locate a Dynamic Host Configuration Protocol [DHCP] server.) Link-local addresses are generated by the PC when it boots up. Packets using a link-local address cannot be forwarded by a router.
33. D. Universal Plug and Play (UPnP) is a standard designed to simplify the process of connecting devices to a network and to enable those devices to automatically announce their presence to other devices on the network. In a truly secure environment, UPnP would be disabled, but it is often left enabled on home networks. Although not listed as an objective, it is in the Acronym list for the CompTIA A+ exam. Dynamic Host Configuration Protocol (DHCP) automatically assigns an IP address to a device when it is powered on, attached to a network, and configured to obtain an address dynamically. Network Address Translation (NAT) is a feature of routers used to hide the IP addresses of computers on the local network side of the router from the other networks and computers on the outside of the network. Quality of Service (QoS) can be configured to give desired devices preference over others for using network bandwidth.

34. A, C. Addresses in the FE80::/10 range are link-local unicast addresses. A link-local address is assigned to each IPv6 interface but is not routable on the Internet. If this is the only address the host has, it will not be able to get on the Internet.
35. A. The File Transfer Protocol (FTP) is optimized for downloading files from servers. It uses port 21. Secure Shell (SSH) uses port 22, Telnet uses port 23, and Hypertext Transfer Protocol (HTTP) uses port 80.
36. D. The Lightweight Directory Access Protocol (LDAP) is a directory services protocol based on the X.500 standard. LDAP is designed to access information stored in an information directory typically known as an LDAP directory or LDAP database. This often includes employee phone numbers and email addresses. Simple Network Management Protocol (SNMP) is used in network monitoring, Simple Mail Transfer Protocol (SMTP) is used in sending email, and Common Internet File System (CIFS) is a file system for providing shared access between diverse clients.
37. C. Lightweight Directory Access Protocol (LDAP) is designed to access information stored in an information directory typically known as an LDAP directory or LDAP database. LDAP uses port 389. Port 22 is used by Secure Shell (SSH), 139 is used by NetBIOS, and 3389 is used by Remote Desktop Protocol (RDP).
38. B. The default subnet mask for class B networks is 255.255.0.0, or written in shorthand, /16. The default subnet mask for class A networks is 255.0.0.0, or written in shorthand /8, and for class C it is 255.255.255.0, or written in shorthand /24. 255.255.255.255 is an IPv4 broadcast address. As a subnet mask, it is represented as a /32 (in shorthand) in the Classless Inter-Domain Routing (CIDR) notation.
39. D. If you're working on a larger network installation, you might use a punchdown tool. It's not a testing tool, but one that enables you to connect (i.e., punch down) the exposed ends of a twisted pair wire into wiring harnesses, such as a 110 block or patch panel. A crimper is used to connect wires to an RJ-45 connector, a cable stripper removes the outer cover from wires, and a cable tester is used to verify the integrity of a cable.
40. C. Fiber-optic broadband Internet offers fast speeds (often in the 1–2 Gbps range) but is also the most expensive. Cable may have download speeds up to 1 Gbps (typically 10 to 500 Mbps), but upload speeds are typically only around 5 to 50 Mbps, while fiber-optic upload speeds may be in the 1 Gbps range. Digital Subscriber lines (DSL) use Plain Old Telephone Service (POTS) lines and are slow. Satellite networks can be faster than DSL, but they still only offer speeds up to about 150 Mbps. (Yes, POTS is an actual technical term.)
41. A, B. 69.252.80.71 and 144.160.155.40 are both routable numbers, and therefore, public. IPv4 specifies private (non-routable) IP address ranges for each class as follows: Class A: 10.0.0.0 to 10.255.255.255, Class B: 172.16.0.0 to 172.31.255.255, and Class C: 192.168.0.0 to 192.168.255.255. Other non-routable numbers are 127.0.0.1, which is the loopback address; and 169.254.0.0 to 169.254.255.255, which is the Automatic Private IP Addressing (APIPA) range. Class A addresses have a first octet from 0 to 127. Class B's first octet ranges from 128 to 191. Class C's first octet ranges from 192 to 223. Numbers above Class C are reserved. You might find it helpful to put this information into a chart to study for the CompTIA A+ exam.

- 42.** C. Server Message Block (SMB) is a protocol used to provide shared access to files, printers, and other network resources. It originally ran on NetBIOS over User Datagram Protocol (UDP) using ports 137/138 and over Transmission Control Protocol (TCP) using ports 137 and 139, but it is now part of the Transmission Control Protocol/Internet Protocol (TCP/IP) stack and uses port 445. Running on NetBIOS enabled SMB to facilitate file sharing on a single network, while being part of TCP/IP enables it to facilitate file sharing across the Internet. By itself, SMB is not secure, so it needs other network appliances or software to secure the data being sent over its port(s). File Transfer Protocol (FTP) uses ports 20/21, Secure Shell (SSH) uses port 22, and Simple Network Management Protocol (SNMP) uses port 161/162.
- 43.** A. All the answer choices are communications protocols for sharing resources. The Common Internet File System (CIFS) is Microsoft's version of Server Message Block (SMB). Once upon a time, CIFS was used extensively for file sharing over a network, but it has since fallen out of favor. While CIFS and SMB both facilitate file sharing, SMB does it better and has other features as well. Samba and Network File System (NFS) facilitate sharing files between clients and servers in Linux distributions. Samba allows mixed environments with both Windows and Linux machines to share files. NFS does not.
- 44.** B, D. Each IPv6 interface can, and often does, have multiple addresses assigned to it. IPv6 is backward compatible with IPv4, by using tunneling, dual stack, or translation. IPv6 uses multicast addresses in place of broadcast addresses, and a link-local address is established either automatically when a computer boots up or by manually configuring it, but either way the link-local address must be present.
- 45.** A. The Domain Name System (DNS) uses two types of records to resolve domain names to IP addresses. Type A records resolve the domain name to IPv4 addresses. Type AAAA records resolve domain names to IPv6 addresses. A Media Access Control (MAC) address is the physical address assigned to a Network Interface Card (NIC). An Mail Exchange (MX) address is used to specify multiple mail servers for load-balancing purposes.
- 46.** B. The Domain Name System (DNS) can use an entry in the TXT field to store bits of information for various purposes. A records are used for IPv4 address resolution, and AAAA records are for IPv6 resolution. The canonical name (CNAME) record is used as an alias so that when one domain name is entered, the record points to a different domain. It's often used for subdomains or when a domain name has migrated to a new domain, effectively sending multiple domain names to the same IP address. Mail Exchange (MX) records identify multiple email servers to use for load balancing.
- 47.** B. 127.0.0.1 is the IPv4 loopback address, and it is used to ping the local network interface. The IPv6 equivalent is::1.
- 48.** D. If you need to trace a wire in a wall from one location to another, a tone generator and probe (also called a toner probe) is the right tool to use. It consists of two pieces: a tone generator and a probe. To use it, attach one end to one end of the cable, such as the end at the computer. Then, go to the patch panel with the other end of the probe to locate the cable. These tools are lifesavers when the cables are not properly labeled. A cable tester is used to confirm the integrity of a cable and verify that it is wired correctly. A loopback plug is used

to test a Network Interface Card (NIC), and a punchdown tool is used to terminate wires into a patch panel.

49. B. Dynamic Host Configuration Protocol (DHCP) dynamically assigns IP addresses and other IP configuration information to network clients. The Domain Name System (DNS) translates human-readable names to their associated IP addresses; Remote Desktop Protocol (RDP) enables a user to access a computer remotely as if they were sitting at the target computer; and Lightweight Directory Access Protocol (LDAP) is used for retrieving information from a database.
50. B. Switches provide centralized connectivity for a Local Area Network (LAN). Switches examine the header of incoming packets and forward each only to the port whose associated Media Access Control (MAC) address matches the receiving MAC address in the header. A Wireless Access Point (WAP) is used to connect a wireless network to a wired one. Bridges are used to connect different networks to work as one, and routers are used to forward packets from one network to others.
51. B. Email is pushed from clients to servers using the Simple Mail Transfer Protocol (SMTP). SMTP uses port 25. When trying to remember if SMTP is sending or receiving email, think S for Send. Port 23 is used by Telnet, now considered insecure and obsolete. (Depreciated.) Port 110 is used by Post Office Protocol 3 (POP3), and port 143 is used by Internet Mail Access Protocol (IMAP), both of which are used to retrieve email.
52. C. Of the Wi-Fi standards listed, 802.11n has the longest range by default, at roughly 70 meters indoors and 250 meters outdoors. 802.11ac is newer and faster than 802.11n, but it transmits exclusively in the 5 GHz range, which restricts its functional distance to roughly 35 meters indoors, depending on the devices being used. 802.11a, which is legacy and uses the 5 GHz frequency range, could only send a signal about 30 meters; and 802.11g, which is also legacy but uses the 2.4 GHz frequency range, could only send a signal about 50 meters.
53. C. A cable tester typically uses lights to indicate that the cable is working correctly, and if there is a short, then the indicators for two wires would light up at the same time. Cable testers can range from basic ones, which cost only a few dollars, to very sophisticated ones that cost hundreds of dollars. Some of the better ones can tell you how many feet from you the problem in the cable occurs. A tone generator and probe are used to trace a wire or find a specific wire from a group; a loopback plug is used to test a Network Interface Card (NIC); and a crimper attaches a network wire to its terminator, usually an RJ-45 plug.
54. C. A router will not forward any broadcast packet; therefore, a router is the boundary of an IPv4 broadcast domain. An Ethernet extender is a device that regenerates the signal on an Ethernet cable, enabling the user to extend the network beyond 100 meters. Switches will send broadcast packets out of every port, but otherwise will send packets to a specific port based on the Media Access Control (MAC) address. A modem (modulator/demodulator) converts signals from one type to another, such as from an analog signal to a digital one.
55. A. Domain Keys Identified Mail (DKIM) is a method of authentication that uses public and private keys and the information to verify that the user sending an email did indeed send it from where they claim to have, and that it hasn't been tampered with along the way. It helps

prevent spoofing of an email address. Sender Policy Framework (SPF) is also a technique to prevent email address spoofing. It is done using a TXT entry in a domain's Domain Name System (DNS) service. Domain-based Message Authentication, Reporting, and Conformance (DMARC) uses SPF or DKIM, and in addition requires that the sender's domain is the same as the DNS domain name. Domain administrators can specify to quarantine or reject emails that fail DMARC. To use DMARC, a DMARC record must exist in the DNS. An AAAA entry is used to resolve IPv6 addresses to domain names.

56. C. Although Digital Subscriber Line (DSL) is being dropped by some providers in favor of fiber-optic lines, it is still a viable Internet connectivity solution in rural areas where fiber has not yet reached. DSL utilizes existing phone lines and provides fairly reliable access while carrying voice and data on the same lines. Most DSL subscriptions are asymmetrical, meaning they offer faster download speeds than upload speeds. POTS stands for Plain Old Telephone Service, an acronym from the dial-up days. Cable connectivity is provided by cable TV companies. ISDN is Integrated Services Digital Network, a now obsolete technology that enabled voice and data communication on the same existing telephone lines, similar to DSL.
57. C. When setting up multiple wireless access points, it's good practice to have their *ranges* overlap to ensure that there is no loss of communication when roaming in the network's area. However, to avoid problems, it's best to set up the access points with nonoverlapping *channels*. This way, the overlapping ranges ensure continuous signal coverage, while the nonoverlapping channels avoid interference from one WAP to another in the overlapping areas.
58. D. Internet Mail Access Protocol (IMAP) is used to download mail via port 143. Port 80 is for unsecured web page traffic. Ports 25 and 110 are email ports, but they are associated with Simple Mail Transfer Protocol (SMTP) and Post Office Protocol 3 (POP3), respectively.
59. B. Power over Ethernet (PoE) enables placement of equipment in areas that otherwise would not be able to accept it. Only four of the eight wires in twisted pair wiring (pins 1, 2, 3, and 6) are used for communication. The power is sent over the wires that are not used in communication. If the devices on both ends don't support PoE, then an injector can be used to add power to the line on the way to its destination. Compatibility is important, and there are limits to the amount of power that can be transmitted this way. Ethernet over Power (EoP) is not in the CompTIA A+ objectives, but it uses special devices to send Ethernet communications over existing wiring, such as in a historical building where running new network wires may be impractical or impossible. A Wireless Access Point (WAP) is a device used to connect wireless devices to a wired network or to each other. Some WAPs support PoE. A hub is a very simple network connectivity device.
60. B. The 802.11ac standard has an indoor range of approximately 35 meters. At a minimum, you will need three access points. Depending on coverage and indoor interference, such as thick walls, you might need more, though.
61. C, D. The crimper and cable stripper are both needed to add an RJ-45 connector to the end of a twisted pair cable. Often, both tools are included in one. The cable stripper removes the outer insulation from the group of wires, so they can be individually inserted into the RJ-45 jack. Once properly inserted, the crimping tool is used to force metal teeth into each wire, so an electrical connection can be made.

Punchdown tools are used to connect unshielded twisted pair (UTP) and shielded twisted pair (STP) to a patch panel. A network tap is used to monitor network traffic.

62. C. Domain-based Message Authentication, Reporting, and Conformance (DMARC) uses Sender Policy Framework (SPF) or Domain Keys Identified Mail (DKIM), and in addition requires that the sender's domain is the same as the Domain Name System (DNS) domain name. Domain administrators can specify to quarantine or reject emails that fail DMARC. To use DMARC, a DMARC record must exist in the DNS. DKIM is a method of authentication that uses public and private keys and the information to verify that the user sending an email did indeed send it from where they claim to have, and that it hasn't been tampered with along the way. It helps prevent email address spoofing. SPF is also a technique to prevent email address spoofing. It is done using a TXT entry in a domain's DNS service. An A entry is used to resolve IPv4 addresses to domain names.
63. B. Power over Ethernet (PoE) enables you to power an Ethernet device (such as a switch) through one of the Ethernet ports. For it to work, the access point and the device it plugs into both need to support PoE. Further, the access point and device need to be compatible. Ethernet over Power (EoP), while not on the current A+ objectives, is a technology that enables the user to transmit Ethernet signals over existing power lines. This can be useful in a place where running Ethernet wires is impossible, but more often Wi-Fi is used in those situations instead. A hub can be used to regenerate a signal, but it also needs a power source and is not a Wireless Access Point (WAP). A repeater/extender is essentially the same as a hub. It requires power to regenerate a signal and send it on its way.
64. C. The private IP address ranges are 10.0.0.0 to 10.255.255.254, 172.16.0.0 to 172.16.32.254, and 192.168.0.0 to 192.168.255.254. The address 172.168.38.155 is outside the private IP address range and is a public (routable) address.
65. D. An exclusion prevents the Dynamic Host Configuration Protocol (DHCP) server from assigning IP addresses that are included in the exclusion range. This differs from a reservation, in that a reservation assigns a specific IP address to a specific Media Access Control (MAC) address. A lease is the period of time that an IP address is assigned to a node, and the scope is the range of IP addresses that can be assigned by a DHCP server. Each of these four options is part of preventing duplicate IP addresses on a network.
66. D. To encrypt traffic between a web server and client securely, Hypertext Transfer Protocol Secure (HTTPS) can be used. HTTPS connections are secured using either Secure Sockets Layer (SSL) or Transport Layer Security (TLS). HTTPS uses port 443. Port 21 is used by File Transfer Protocol (FTP), port 80 is used by Hypertext Transfer Protocol (HTTP), and port 143 is used by Internet Mail Access Protocol (IMAP).
67. D. 802.11b/g transmit in the 2.4 GHz frequency, as does 802.11n, so they are compatible. The newer 802.11ac is a 5 GHz standard, and therefore, is not backward compatible with 802.11b/g. 802.11ax transmits in both the 2.4 GHz and 5 GHz frequencies, up to 7 GHz. 802.11be is the newest of these standards and is backward compatible. However, be aware that using the older standards with newer ones may degrade the network speed.
68. D. Networks that are larger than a Local Area Network (LAN) but confined to a relatively small geographical area are Metropolitan Area Networks (MANs). A MAN is generally

defined as a network that spans a city or a large campus. A Personal Area Network (PAN) is the smallest type of network, and a Wide Area Network (WAN) is the largest type of network. A WAN can connect far away cities or even other countries.

- 69.** A. A subnet mask of 255.255.224.0 has eight bits in each of the first two octets set to on, and it has three bits in the third octet on. Therefore, it corresponds to /19 in Classless Inter-Domain Routing (CIDR) shorthand. In the binary number system (base two), each bit has two possible values: 0 or 1. Each bit in an octet, going from right to left, increments by an exponent of two, making the bits of the octets worth the decimal values as follows:
| 128 | 64 | 32 | 16 | 8 | 4 | 2 | 1 |. Bits for the subnet mask are always used from left to right, so one bit is equal to a decimal value of 128. Two bits is equal to a decimal value of 192 (128 + 64). Three bits is equal to a decimal value of 224 (128 + 64 + 32), and so on. When all eight bits of the octet are used for the subnet mask, the equivalent decimal value is 255. For this example, the first two octets (eight bits each) are completely on, and in the third octet, only three bits are on, making a total of 19 bits in the subnet mask turned on to indicate the network number ($8 + 8 + 3 = 19$).
- 70.** B. To communicate on an IPv4 network, a host must be configured with a valid IP address and a subnet mask. A default gateway is needed only if the host is connecting to a remote network. Domain Name System (DNS) server settings are optional but useful, because they resolve hostnames to IP addresses.
- 71.** A, B. No two nodes on any network, whether IPv4 or IPv6, can have the same IP address, because the host portion (or interface ID) of the IP address is what identifies the individual computer on the network. If any of the machines on the network have been manually configured, which is generally done with servers, and the remainder of the computers are configured to use Dynamic Host Configuration Protocol (DHCP), you will need to ensure that the manually configured numbers are outside of the DHCP scope (the numbers the DHCP server will automatically assign) but within the bounds of the network. For example, in an IPv4 network, if the network number is 200.100.1.0, the router, which is also acting as a default gateway, might be assigned 200.100.1.1, and numbers from 200.100.1.2 through 200.100.1.20 could be reserved for static configuration on devices that need an IP address that does not change. The DHCP scope would need to *not* include those numbers. If the network needed an available 180 IP addresses, then 200.100.1.21 to 200.100.1.200 could be safely assigned to the DHCP scope, avoiding any IP address duplication.
- 72.** B, C. Certain devices on a network, such as printers and servers, should have an IP address that doesn't change (static), so the other nodes on the network can always find the device. Answer A is incorrect, because if the Dynamic Host Configuration Protocol (DHCP) lease on the IP address expires, the print server would be assigned a different IP address the next time it logs in. A static IP could be configured on the printer server, or the IP address could be configured as reserved on the DHCP server for that print server. Either choice would work. Static and dynamic IP addresses almost always exist on the same network, because each is needed to have a network that runs smoothly.
- 73.** C. Telnet operates on port 23. Ports 20 and 21 are for File Transfer Protocol (FTP), port 22 is used by Secure Shell (SSH), and port 25 is used by Simple Mail Transfer Protocol (SMTP).

74. A. The Domain Name System (DNS) uses port 53 to communicate. Ports 67/68 are used by Dynamic Host Configuration Protocol (DHCP). Port 110 is used by Post Office Protocol 3 (POP3), and port 137 is used by Network Basic Input/Output System (NetBIOS).
75. B. Clients are unable to reach the Domain Name System (DNS) server, which resolves hostnames (or Uniform Resource Locators [URLs]) to IP addresses. DNS uses port 53. Ports 20 and 21 are used for File Transfer Protocol (FTP). Ports 67 and 68 are used by Dynamic Host Configuration Protocol (DHCP). Port 80 is used for Hypertext Transfer Protocol (HTTP), and port 443 is HTTP Secured (HTTPS).
76. D. Automatic Private IP Addressing (APIPA) is a Transmission Control Protocol/Internet Protocol (TCP/IP) standard used to automatically configure IP-based hosts that are unable to reach a Dynamic Host Configuration Protocol (DHCP) server. APIPA addresses are in the 169.254.0.0/16 range. If you see a computer that has an IP address beginning with 169.254, you know that it has configured itself.
77. C. Unsecured websites are accessed on port 80, which is the port that Hypertext Transfer Protocol (HTTP) uses. Shut it down, and no one will be able to access websites, except secure sites that use HTTPS, which is on port 443.
78. D. The Domain Name System (DNS) is responsible for resolving hostnames to IP addresses. This is used billions of times daily on the Internet; when someone types in a website name, such as www.sybex.com, DNS will resolve that to an IP address to enable communication. Address Resolution Protocol (ARP) maps Internet addresses to hardware addresses. Reverse ARP (RARP) does the opposite, and Dynamic Host Configuration Protocol (DHCP) assigns IP addresses to hosts automatically.
79. D. Satellite Internet is the best solution for this scenario. Instead of a physical connection, it uses a satellite dish to receive data from an orbiting satellite and relay station that is connected to the Internet. Because it requires a clear line of sight between the transmitter and receiver, it can be referred to as “line-of-sight” wireless. Mobile hotspot (cellular) devices are also an option; however, they depend on a strong cellular signal. For an installation far from civilization (and cell towers), satellite may be the only option. Cable, DSL, and fiber rely on lines that would not run as far as a forest ranger lookout tower.
80. C. Wireless Internet Service Providers (WISPs) use fixed wireless technology, which requires antennas to send radio waves between your location and a fixed hub on a tower or other tall structure like a cellular tower, water tower, or tall building. Download speeds can be up to 1 Gbps or more, although they’re often less for residential service. Satellite is an option in very remote areas but it has the latency caused by the signal traveling hundreds to thousands of miles between the client sending a request to the satellite, then the Internet, and back again. Digital Subscriber Line (DSL) uses telephone lines to create an Internet connection; however, many carriers no longer offer DSL. A cellular hotspot can be used in many remote locations but depends on a connection to a cellular tower. Satellite has a much broader availability than cellular service.
81. C. The two host-to-host protocols are Transmission Control Protocol (TCP) and User Datagram Protocol (UDP). TCP guarantees packet delivery through the use of a virtual circuit and data acknowledgments, while UDP does not. Because of this, TCP is often referred

to as connection oriented, whereas UDP is connectionless. Internet Protocol (IP) and Internet Control Message Protocol (ICMP) are not considered host-to-host protocols.

82. A. A Local Area Network (LAN) is often defined as being contained in a single building, office, or home. The types of networks based loosely on geography, from smallest to largest are Personal Area Network (PAN), LAN, Metropolitan Area Network (MAN), and Wide Area Network (WAN).
83. B, D. 802.11a and 802.11g provide throughput that is only 54 Mbps, and 802.11b was a whopping 11 Mbps. 802.11n (Wi-Fi 4), which is better, provides throughput over 100 Mbps (theoretically up to 300 Mbps). However, 802.11ac (Wi-Fi 5) boasts throughputs of over 1 Gbps, while 802.11ax (Wi-Fi 6 and 6E) and 802.11be (Wi-Fi 7) have far surpassed these standards with throughputs of multiple Gbps.
84. B, D. 802.11ac operates in the 5 GHz frequency only. 802.11g is only 2.4 GHz. 802.11ax and 802.11n operate in both frequencies.
85. C. NetBIOS over TCP/IP (NetBT) is for older applications still reliant on Network Basic Input/Output System (NetBIOS), the legacy network protocol intended for very small networks. NetBT lets such applications communicate over Transmission Control Protocol/Internet Protocol (TCP/IP). Trivial File Transfer Protocol (TFTP) is a basic connectionless protocol that enables file transfer functions without user interaction. Hypertext Transfer Protocol Secure (HTTPS) is a secure connection-oriented protocol that runs over port 443. Border Gateway Protocol (BGP) is an Internet Engineering Task Force (IETF) standard that enables routers to share information enabling communication across the Internet.
86. C. An unmanaged switch will simply perform the basic task a switch should do: Direct network traffic out the correct destination port. Prioritizing traffic, configuring Virtual Local Area Networks (VLANs), and mirroring ports are all jobs that are done using managed switches.
87. B, D. In the United States, the Federal Communications Commission (FCC) and the Institute of Electrical and Electronics Engineers (IEEE) are the authorities that approve channel uses. The Occupational Safety and Health Administration (OSHA) sets rules for safe workplaces, and the Internet Assigned Numbers Authority (IANA), as the name implies, is responsible for doling out IP addresses to ISPs and other large organizations.
88. A. DHCP uses ports 67/68. Ports 137–139 are for Network Basic Input/Output System (NetBIOS)/NetBIOS over TCP/IP (NetBT). Port 80 is for Hypertext Transfer Protocol (HTTP), and port 445 is for Server Message Block (SMB).
89. B. The distance for Power over Ethernet (PoE) is limited by the maximum distance set by the Ethernet cabling: 100 meters (328 feet). The power injector, the device that sources the electrical power to certain wires in the cable, can be as much as 100 meters from the powered device. The injector also needs to have sufficient power to match device needs, and devices must be compatible. PoE devices such as powered switches can provide a few watts or well over 100 watts, depending on the device.

90. C. NetBIOS over TCP/IP (NetBT) is an older protocol for applications that still rely on NetBIOS. It uses ports 137 through 139, and it's still on the CompTIA A+ certification objectives. Domain Name System (DNS) uses port 53, Server Message Block (SMB) uses port 445, and Secure Shell (SSH) uses port 22.
91. C, D. The end-user devices on a Small Office Home Office (SOHO) are configured to at least request a Dynamic Host Connection Protocol (DHCP)-assigned IP address from the DHCP server, or they are preconfigured with a static IP, gateway, subnet mask, and Domain Name Server (DNS) information. Switches do not broadcast configuration settings, although a router may also serve as a DHCP server. Address Resolution Protocol (ARP) associates IP addresses with Media Access Control (MAC) addresses to facilitate communications on a Local Area Network (LAN).
92. D. Media Access Control (MAC) address filtering uses the physical address of a Network Internet Card (NIC) to determine whether or not to enable a device to connect to the router. Disabling the Service Set Identifier (SSID) will hide the network from neighbors, but not keep them from connecting if they discover the network. Port forwarding redirects requests for a specific port to a specific device on the network. The Dynamic Host Connection Protocol (DHCP) scope can be configured to only enable five machines to connect, but it may not be the “right” five machines.
93. D. Unless an Internet of Things (IoT) device possesses an end-user accessible management interface, that device will likely connect at least initially using Dynamic Host Configuration Protocol (DHCP) to obtain an IP address. Domain Name System (DNS) resolves names like Wiley.com to an IP address. Active Directory (AD) is a Microsoft client/server security solution, and Single Sign-On (SSO) enables a user to enter their credentials once to access several resources.
94. B. Near-Field Communication (NFC) protocol requires devices to be within about 10 centimeters of each other to transmit data. In this case, the devices are working in card emulation mode, but NFC can also be used to transmit between two like devices such as two cellphones, or to read a smart tag. Radio Frequency Identification (RFID) is another technology that uses radio waves to transfer information. Wi-Fi is 802.11-based wireless networking, and Hardware Assisted Virtualization (HAV) is a technology that enables the Virtual Machine (VM) more direct access to the physical processor's capabilities.
95. A. Radio Frequency Identification (RFID) can be implemented to detect and read a “passive” (no power) tag, which is essentially an antenna as it passes within a few feet in range. RFID tags are often used in industry and retail for inventory tracking. The distance for RFID implementation depends on the size and polarization of the antenna, the frequency, and the power used, among other features. Near-Field Communication (NFC) requires a distance of only a few centimeters. Wi-Fi is 802.11-based wireless networking. Radio Frequency Interference (RFI) is a nuisance that can disrupt network communications.
96. D. A web server consists of hardware and software used to provide information to clients via the Internet (or a company intranet). The main protocols for web servers are Hypertext Transfer Protocol (HTTP) and Hypertext Transfer Protocol Secure (HTTPS); however, they can use other protocols as well. File Transfer Protocol (FTP) servers are used for

downloading files quickly, and while they may have a Graphical User Interface (GUI), they have much less overhead than a web server. Proxy servers are a security measure between an internal user and the web and are used to monitor and filter information going into or out of a network. File servers are often used on a Local Area Network (LAN) to provide access to the same files by multiple users.

97. A. Internet of Things (IoT) devices enable a multitude of personal and industrial devices to connect and communicate over the Internet. Structured Query Language (SQL) is a method of retrieving information from a database. Denial of Service (DoS) is a type of network attack, and Encrypting File System (EFS) enables the user to encrypt individual files, folders, or volumes.
98. C. A fileshare server is a centralized repository for users, typically company employees. File Transfer Protocol (FTP) servers are used for downloading files quickly, and while they may have a Graphical User Interface (GUI), they have much less overhead than a web server. Proxy servers are a security measure between an internal user and the web and are used to filter information going into or out of a network, while web servers may provide information about a company or its products to the general public.
99. B. Proxy servers act as a gateway through which Internet access requests are handled, monitored, and, if need be, filtered. File Transfer Protocol (FTP) servers are used for downloading files quickly, and while they may have a graphical user interface (GUI), they have much less overhead than a web server. File servers are often used on a Local Area Network (LAN) to provide access to the same files by multiple users, while web servers may provide information about a company or its products to the general public.
100. A. As a type of fileshare, the File Transfer Protocol (FTP) server hosts files for easy access, enabling users to browse it and download and upload files. Typically, the bandwidth overhead is less in an FTP server than it would be in a Web server. Proxy servers monitor and filter traffic into and out of a network. File servers are a repository of files accessed by multiple users on a network. A Domain Name System (DNS) server resolves human-readable names such as Wiley.com to an IP address.
101. C. A print server can be either a physical device or software configured on a computer. The print server provides centralized availability of print services to authorized users on the network. It accepts print jobs, and the documents are printed according to the order of receipt or some configured priority. A syslog server gathers and logs event information from devices on a network, creating a central repository for a network administrator to monitor and respond to events. A Domain Name System (DNS) server resolves domain names to IP addresses, and an authentication server verifies identity before enabling access to a network.
102. B. If a user types **www.sybex.com** into a web browser, the Domain Name System (DNS) server will resolve the domain name to an IP address. Similarly, DNS servers will resolve a Fully Qualified Domain Name (FQDN) network directory resource on the network to make locating that resource possible. Syslog servers provide a repository of events on the network to aid in network management. Print servers provide and manage access to one or more printers by multiple users on a network, and an authentication server verifies identity before granting access to resources on a network.

- 103.** D. The Authentication, Authorization, and Accounting (AAA) server facilitates the challenge/response service for validating someone's credentials. Syslog servers provide a repository of events on the network to aid in network management. Domain Name System (DNS) servers resolve Uniform Resource Locators (URLs) to IP addresses, and print servers provide and manage access to one or more printers by multiple users on a network.
- 104.** A. The Syslog server operates with the Syslog protocol, which is used by many different operating systems and devices. These system-generated messages vary from the mundane "System started" to critical alerts. Domain Name System (DNS) servers resolve domain names to IP addresses. Print servers facilitate and manage printing by multiple users to one or more printers on a network, and Authentication, Authorization, and Accounting (AAA) servers verify identity before granting access to a resource.
- 105.** C. Mail servers are used to send, receive, and sometimes store and manage emails. They operate on ports 25, 110, and 143. Often, devices will need to be configured with the name or IP of the server and the proper protocol or port for sending and receiving email. Web servers provide web pages over the Internet. Authentication, Authorization, and Accounting (AAA) servers verify identity before enabling access to resources; and File Transfer Protocol (FTP) servers are used to quickly locate, download, and upload files.
- 106.** C, D. Connection-oriented protocols work over Transmission Control Protocol (TCP), which guarantees delivery of packets. This guarantee requires greater resources than User Datagram Protocol (UDP), which is connectionless, therefore not requiring that a packet be resent if it's not received. Hypertext Transfer Protocol Secure (HTTPS) and Secure Shell (SSH) are connection-oriented protocols while Trivial File Transfer Protocol (TFTP) and Dynamic Host Configuration Protocol (DHCP) are connectionless protocols.
- 107.** B, C. An Intrusion Detection System (IDS) is a component of a Unified Threat Management (UTM) system. The IDS will monitor and alert you of suspect behavior. It can be a network-based device or host-based, meaning it runs as a process in the background. UTM provides multiple security features on a single appliance. Proxy servers are used to control traffic into and out of a network. Asynchronous Transfer Mode (ATM) has to do with transferring different types of traffic (i.e., voice and data) over the same communication lines at the same time.
- 108.** D. The Intrusion Detection System (IDS) will alert on suspect activity but will not react or actively attempt to block the activity. The Intrusion Prevention System (IPS), however, should attempt to block the activity. Both IDS and IPS can be parts of a Unified Threat Management (UTM) system.
- 109.** C. Unified Threat Management (UTM) systems can be hardware networking devices, virtual devices, or an off-premises service. UTM's role is to combine several security features and services into a single device enabling for easier management and compatibility. An Intrusion Detection System (IDS) will only notify an admin if a threat is detected; it doesn't take action against the threat. Intrusion Protection Systems (IPs) will detect and respond to security threats. An Unshielded Twisted Pair (UTP) is a type of network cabling.
- 110.** A. Bluetooth uses the 2.4 GHz frequency. Within that frequency band (2.4–2.48 GHz), it will occupy a 1 MHz-wide channel. It also uses a feature called frequency hopping to

change to a different channel within that band multiple times per second to avoid interference. All the frequencies listed (2.4, 5, 6, and 60 GHz) are used by 802.11 (wireless) networks.

- 111.** B. Cellular is the only type of network connection that enables the type of mobility that this photographer needs. A cellular hotspot device from a mobile provider would work well. Satellite would require repositioning of the dish on a regular basis and may not work well because of obstructions. A Wireless Internet Service Provider (WISP) requires being within a few miles of a tower and line-of-site between the antenna and tower, so that wouldn't work well either. A Digital Subscriber Line (DSL) requires a stationary phone line.
- 112.** C. Cable Internet service requires a cable modem to separate the Internet signal from TV channels, and to convert the signal into one that your computer can use. A switch is used on a Local Area Network (LAN) as a central connection point. A hub for networking is an obsolete device that would send any signal it received out of all its ports. A cable multiplexer connects several signals into one for transmission over a cable, such as input from multiple security cameras.
- 113.** B. This device is for testing network cables that are terminated with an RJ-45 connector. A multiplexer combines several signals into one. A stripper/crimper tool is used to connect RJ-45 connectors to Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP) copper cables, and a Wi-Fi analyzer is used for determining Wi-Fi signal strength. It can be an app on a smartphone or a separate device.
- 114.** D. Bluetooth 5.0 is capable of reaching a distance of 240 meters and has been around since 2016, with incremental changes (5.1, 5.2, etc.) over the years.
- 115.** A. With many new systems added and already booted, it is likely that the Dynamic Host Configuration Protocol (DHCP) scope, which is a valid range of IP addresses available to client-based systems on a particular subnet, is now too small for the number of systems requesting IP addresses. Expand the DHCP scope to solve the problem.
- 116.** B. Virtual Local Area Networks (VLANs) will segment your network into smaller broadcast domains. Multiple VLANs can exist on the same physical switch. Traffic is isolated to only the paths determined by how you configured VLANs on your managed switches. A Virtual Private Network (VPN) uses tunneling protocols to secure a private connection across a public network. Uninterruptable Power Supply (UPS) is a battery backup with other features that is used to maintain power to a device when the grid power goes down, and Structured Query Language (SQL) is used to retrieve information from a database.
- 117.** A. A Virtual Private Network (VPN) uses encryption to secure a transmission across a public network. Software Defined Networking (SDN) is a network architecture designed to make managing a network easier and more flexible. A Virtual LAN (VLAN) separates a Local Area Network (LAN) into separate broadcast domains for security purposes. Static Random Access Memory (SRAM) is often found in processor cache.
- 118.** C. Wireless Local Area Network (WLAN) networks commonly have three types of nodes: a client, router, and gateway. They typically don't include a server and often are fluid in

nature, where devices come and go as needed. They may include a printer. A WLAN can be used to connect wireless users to a wired network via a wireless access point (WAP), which often has a wired connection to the network and provides wireless network capabilities.

- 119.** A, B. A Network Interface Card (NIC) can be configured either with a specific (static) IP address, or to obtain an IP address from an available Dynamic Host Configuration Protocol (DHCP) server. Many routers have the capability to provide DHCP services. When a device with a properly configured NIC attempts to join a network, a request for an IP address will be sent to the DHCP server, and the DHCP server will lease an IP address to that device, if one is available.
- 120.** B. Option 2601::1f:ab:cd:123:4a, and the address in the question, both have a subnet of 1f. IPv6 addresses consist of 128 bits, divided by colons (:) into eight hexets. Therefore, each hexet represents 16 bits. Leading zeros can be omitted, and in one place in each address, consecutive groups of zeros can be omitted, represented by double colons (::). The last 64 bits (four hexets) of an IPv6 address are the Interface ID, identifying the unique computer that the address is assigned to. The first 64 bits are called the prefix. Internet Service Providers (ISPs) and very large organizations are assigned /48 prefixes. The next 16 bits (the fourth hexet) are used to define subnets. 2601::0f:308c:47:4321 has a fourth hexet of 0. fe80:ab:bc:0f:1a:308c:2abc:fee5 is a link-local address, so it isn't routable. 2601:0:0:0x::2acb:ac01 is an invalid number because hex numbers only go to letter f.
- 121.** B. The third octet's subnet mask of 192 means that the first two bits of the octet are used to identify the network number, so the network can be broken down into four subnets using those first two bits of the octet. The subnets would be 00000000, 01000000, 10000000, and 11000000. Internet Protocol (IP) addresses within each range would be 0 to 63, 64 to 127, 128 to 191, and 192 to 255. The first and last IP in each range would not be used, because they would represent the subnet itself and the broadcast numbers, respectively. 130.200.65.5, 130.200.100, and 130.200.125.5 all fall in the second subnet's range. 130.200.130.1 is in the third subnet.
- 122.** A. The Power over Ethernet (PoE) Standards are the Institute of Electrical and Electronics Engineers (IEEE) 802.3af (PoE), 802.3at (PoE+), and 802.3bt (PoE++). A main difference between the standards is how much power per port can be provided. 802.3af can supply up to 15.4 watts per port, 802.3at can provide up to 30 watts per port, and 802.3bt can provide 60 watts (Type 3) or 100 watts (Type 4). The power that actually reaches the devices is less due to voltage loss over distance (attenuation). 802.3b is a legacy broadband Ethernet standard. 802.11 and 802.11ax are Wi-Fi standards.
- 123.** B, C. Power over Ethernet (PoE) devices providing power are backward compatible with older devices, meaning that while 802.3bt is rated at 60W for Type 3 and 100W for Type 4, an 802.3bt device will work with an 802.3at (Type 2) device. 802.3af would not provide enough power for your friend's device. 802.11b is a Wi-Fi standard, not a PoE standard.
- 124.** B, D. An Optical Network Terminal (ONT) is installed by a fiber-optic Internet Service Provider (ISP) and is typically a small box on an outside wall. The terminal is a transducer, converting between copper/electrical signals and fiber-optic/light signals. It does require power, and the terminal may have an indicator light to signal whether it is receiving power.

- 125.** A, B. Each frequency—such as 2.4 GHz, 5.0 GHz, and 6 GHz—is divided into sections. Each section, called a channel, has a range of frequencies associated with it. For example, the frequency range 5.17 to 5.19 GHz has a base frequency of 5.18 and is identified as Channel 36. The different channels enable users to choose a less crowded range to avoid network interference.
- 126.** B. Frequencies for Wireless Internet Service Providers (WISP) can be licensed or unlicensed. (The Federal Communications Commission [FCC] is the licensing body.) Most WISPs use unlicensed frequencies because they are free.
- 127.** C. A Wireless LAN (WLAN) is the best solution for this office. It is a group of devices in the same location that communicate via radio waves instead of cables. WLANs can have multiple Wireless Access Points (WAPs), preferably overlapping so users won't experience signal drop. Wi-Fi is a type of WLAN. A Local Area Network (LAN) is incorrect, because it would require disconnecting and reconnecting cables in each room. A Virtual LAN (VLAN) is established using security protocols to segregate a network. Wide Area Network (WAN) is incorrect, because this is a network in a single office, and a WAN connects geographically distant computers.
- 128.** C. A Storage Area Network (SAN) is a high-speed network whose purpose is to provide fast access by servers to storage. Network Attached Storage (NAS) differs from a SAN in that it is not a separate high-speed network, but a single storage device attached to a Local Area Network (LAN). Serial Attached SCSI (SAS) is a technology for connecting a computer and a storage device. It can be used to create a SAN or NAS. A Wide Area Network (WAN) consists of connected computing devices that are widely geographically dispersed, such as the Internet.
- 129.** A, D. A network Terminal Access Point (TAP) connects to a network in an area of concern and creates a copy of traffic, sending it on to monitoring devices. It can be an integral part of network management. TAPs can be active or passive. Passive TAPs do not require power or management, but active TAPs do. Although it sounds like something a hacker would use, they typically don't. A TAP is a separate hardware device, not part of a router.
- 130.** B. A fileshare server software handles requests from fileshare clients for access to data stored on the server. The fileshare server resides on the same machine as the data. A Client Access License (CAL) is a license enabling one machine to connect to a server, and a Storage Area Network (SAN) is a separate network of storage devices that provides storage for users and servers.
- 131.** B. A Wireless Access Point (WAP) provides Wireless Local Area Network (WLAN) connectivity but may not help with the problems on this network. Your friend needs to determine what wireless channel has the least traffic, and then configure their Wi-Fi to use that channel. For that they need a Wi-Fi analyzer, which can be a separate device or as simple as an app on a smartphone. A toner probe is used to figure out which network cable is connected when they are not labeled, and a cable tester determines if the cable's wires are connected properly.
- 132.** B. Wireless Internet Service Providers (WISPs) that are operating in the 2.4 GHz band are limited to 4 watts of Effective Isotropic Radiated Power (EIRP) for their point-to-multipoint

connections. Their point-to-point connections vary between 4 watts and 158 watts for the 2.4 GHz band. The maximum EIRP for the 5 GHz bands is 125 mw.

133. A. Channels 36 to 48 are set aside for domestic use. All channels above that require a router to have Dynamic Frequency Selection (DFS) and Transmit Power Control (TPC). DFS will automatically switch to a different channel when weather radar and radar system signals are detected. TPC can be used to force clients to transmit using lower power, so they won't interfere with nearby users or access points on the same channel. Channel 165 is set aside for Industrial, Scientific, and Medical (ISM) use. In the United States, the Federal Communications Commission (FCC) and Institute of Electrical and Electronics Engineers (IEEE) are the authorities that approve channel uses.
134. B. The Federal Communications Commission's (FCC's) Over-The-Air-Reception-Devices (OTARD) ruling was expanded to include long-range fixed wireless network hubs and relay antennas, and the customer's right to place antennas of certain sizes on their premises, putting Wireless Internet Service Providers (WISPs) on a more equal footing with satellite and cellular providers. Fios is a Fiber-optic service, and DSL is Digital Subscriber Line, a type of antiquated Internet access that uses Plain Old Telephone Service (POTS) lines.
135. D. When an IP address and subnet mask are converted to the binary numbers that the computer sees and there is a 1 in the subnet mask, it tells the computer that the corresponding bit in the IP address is part of the network number. Wherever there is a 0 in the subnet mask, the corresponding bit in the IP address is part of the host number. The address in the question 192.168.2.200/24 is a class C private address, where, in the subnet mask, the first three octets (24 bits) are all 1s, and numbers in the last octet (8 bits) are all 0s. So, the first three decimal numbers of the IP address, which are expressed in dotted decimal notation, are the network number (192.168.2), and the last octet (.200) is the host (individual computer) address. Network numbers will always go from left to right, with no breaks between.
136. D. Authentication servers provide the Authentication, Authorization, and Accounting (AAA) framework for security. Authentication requires that an entity prove who they are before gaining access. Authorization grants the authenticated user access to resources. Accounting tracks and logs user activity.
137. C. Load balancers do as their name implies. Rather than enable all incoming traffic on a port to go to one server or device, the traffic is distributed among devices. Proxy servers monitor incoming and outgoing packets, filtering them out based on specified criteria. Some proxy servers may include a load balancer, however, the device defined in the question is a load balancer, not a proxy server. Spam gateways don't allow spam in, rather they are used to filter it out. Unified Threat Management (UTM) can employ an appliance or be software-driven, or even be provided by an outside service that monitors and manages malicious activities against a network.
138. A. Supervisory Control and Data Acquisition (SCADA) systems are comprised of both hardware and software to control and monitor industrial machines and processes. Hardware is used to gather information, which is sent to a computer running software that analyzes the data and logs events. SCADA can also initiate alarms when specified conditions exist. Infrared Data Association (IrDA) standards specify network communications that

work via infrared light. Unified Threat Management (UTM) is an appliance, software, or service that combines all malware security in one place. Remote Authentication Dial-In User Service (RADIUS) is a protocol for authentication servers that encrypts transmissions between the client and server.

- 139.** C. A Dynamic Host Configuration Protocol (DHCP) server will “lease” an IP address to a client for a specified period of time. The default is usually 24 hours. In a Small Office, Home Office (SOHO) network where there are seldom new users, the lease time could be longer, but in a restaurant where many people come and go each hour, the DHCP scope might not have enough addresses to accommodate that many users. Setting the lease time to a shorter duration will release the IP address and make it available for a new user. Media Access Control (MAC) address filtering only enables connection from computers with specific MAC addresses and would greatly limit connectivity. Port forwarding sends traffic for a specific port to a specified computer on the network. The Service Set Identifier (SSID) is the wireless network name and can be broadcast so it is easily found or can be hidden.
- 140.** B. The Domain Name System (DNS) uses two types of records to resolve domain names to IP addresses. Type A records resolve the domain name to IPv4 addresses. Type AAAA records resolve domain names to IPv6 addresses. Media Access Control (MAC) and physical addresses are two names for the Network Interface Card (NIC) address.
- 141.** A. Multiple Mail Exchange (MX) records can be set up for a domain to specify different mail servers for load balancing. Direct Connect (DX) is an Amazon Web Services (AWS)-dedicated connection between clients and AWS. AAAA signifies an IPv6 address in a Domain Name System (DNS) record, and TXT DNS records let an administrator specify text in their DNS record. These text records can be used to prevent email spam.
- 142.** B. Sender Policy Framework (SPF) is a technique to prevent email address spoofing. It is done using a TXT entry in a domain’s Domain Name System (DNS) service. DomainKeys Identified Mail (DKIM) performs a similar function but uses a digital signature. Domain-based Message Authentication, Reporting, and Conformance (DMARC) uses Sender Policy Framework (SPF) or DKIM, and in addition requires that the sender’s domain is the same as the DNS domain name. Domain administrators can specify to quarantine or reject emails that fail DMARC. To use DMARC, a DMARC record must exist in the DNS.
- 143.** C. This is an IPv6 address. It is 128 bits long, and the last 64 bits are the interface ID, which identifies the individual computer. Because there are eight groups of hex numbers, it means the rightmost four groups are the interface ID. Any leading zeros in an IPv6 address can be omitted, and the :: can be used once in an address to replace consecutive groups of all zeros, so this number, fully expanded, would be 2001:0000:0000:01a3:0f1a:0308:0833. The interface ID is, therefore, 1a3:f1a:308:833. The leftmost three sections identify the network, and the fourth identifies the subnet. In this example, 2001:0:0 is the site prefix, and 0 is the subnet ID. IPv6 addresses do not need a subnet mask like IPv4 addresses do.
- 144.** A, D. For decades, Wireless Internet Service Providers (WISPs) have been established by groups of individuals or small companies to provide Internet access to areas where it is not profitable for large commercial Internet providers to run, such as very rural areas. They are also called long-range fixed wireless providers. In 1992, the first one was established in the Midwestern United States. Now, there are thousands of them worldwide. In some areas of

the world where there is little or no wired infrastructure, WISPs are the only way that people can get Internet connectivity. A WISP connects to the Internet using either leased lines or microwaves, generally uses point-to-point microwaves between its towers, and point-to-multipoint connections between the final tower and users. Multimode is a type of fiber-optic cable that can carry more than one signal and a demarcation point is the place in a customer premises where the responsibility for the network changes from the Internet Service Provider (ISP) to the customer.

- 145.** A, B. It's true that Channels 1, 6, and 11 are the only ones that don't overlap in a 2.4 GHz network. It's also true that each channel in a 2.4 GHz network is only about 5 MHz wide, while in a 5 GHz network the minimum channel width is 20 MHz, but it can be configured to use 40 MHz or 80 MHz by combining channels. The 2.4 GHz frequency supports older devices; the 5 GHz frequency is newer. While 2.4 GHz channels overlap except for 1, 6, and 11, 5 GHz channels don't overlap. Your friend needs to choose a frequency and channel that are compatible with their devices, but the router may automatically configure the channel if using the 5 GHz frequency.
- 146.** D. A Network Time Protocol (NTP) server uses a source like an atomic clock to provide an accurate time, which is used to update devices and enables devices on a network to synchronize with each other. Structured Query Language (SQL) servers are used with databases. Fileshare servers enable easy sharing of files between users and Dynamic Host Configuration Protocol (DHCP) servers lease IP addresses to devices on a network.
- 147.** A. Structured Query Language (SQL) servers are used to store and provide access to databases. A Network Time Protocol (NTP) server uses a source like an atomic clock to provide an accurate time, which is used to update devices, and enables devices on a network to synchronize with each other. Fileshare servers enable easy sharing of files between users and Dynamic Host Configuration Protocol (DHCP) servers lease IP addresses to devices on a network.
- 148.** B. Unlike a default gateway, spam gateways don't permit spam in, rather they are used to filter it out. Proxy servers monitor incoming and outgoing packets, filtering them out based on specified criteria. Some proxy servers may include other services such as a load balancer. Unified Threat Management (UTM) systems use multiple methods that can employ an appliance or software or even an outside service to monitor and manage malicious activities against a network.

Chapter 3: Hardware

1. A. F-type connectors are threaded and screwed into place. F-type connectors are often found at the end of an ISP's cable connection. BNC connectors were once used in Local Area Network (LAN) wiring but are now found in Radio Frequency (RF) and video applications and test equipment such as oscilloscopes. The Bayonet Neill-Concelman (BNC) connector locks by twisting one-quarter turn. Subscriber Connectors (SC) and Fiber Channel (FC) connectors are for fiber-optic cable.

2. B, D. Both Subscriber Connectors (SC) and Lucent Connectors (LC) are square and can be purchased as single or duplex connectors. SC is square and is a push/pull design. LC connectors are smaller at 1.25 mm and have a latching mechanism to keep them in place, making them good for rack-mount use. Straight Tip (ST) connectors have a bayonet connection. Fiber Channel (FC) connectors have a ferrule core and a threaded coupling. SC, FC, and ST connectors are 2.5 mm. There are other connectors on the market but not on the A+ exam.
3. C. RJ-11 accommodates two pair of wires and is the standard for household- or office-wired telephone connections. RJ-45 is the four-pair connector used for twisted pair Ethernet. Coaxial cable is a type of network cable and has a Bayonet Neill-Concelman (BNC) connector (with a locking mechanism) or an F-type connector. Fiber Channel (FC) connectors are a type of fiber-optic connector.
4. D. A cable with the same T568 standard on both ends is a straight-through network cable. These are used for patch cables and network drops. If you have a T568A on one end and a T568B on the other, that's a crossover cable.
5. A. The color code listed is the T568A standard. In the T568B standard, the orange and green colors are opposite. Lucent Connectors (LC) and Subscriber Connectors (SC) are fiber-optic connectors.
6. D. Double Data Rate 4 (DDR4) Small Outline Dual In-line Memory Modules (SODIMMs) have 260 pins, Double Data Rate 3 (DDR3) SODIMMs have 204 pins, and Double Data Rate 5 (DDR5) SODIMMs have 262 pins.
7. D. The type of Random Access Memory (RAM) modules used by desktop computers are Dual Inline Memory Modules (DIMMs), and laptops most commonly use Small Outline DIMMs (SODIMMs). Another potential laptop memory form factor is the Micro-DIMM, which is used in super-lightweight laptop computers.
8. A. The Video Electronics Standards Association (VESA) introduced DisplayPort technology in 2008. It was designed to be an industry standard and to replace Video Graphics Array (VGA) and Digital Video Interface (DVI) connections. It's also backward compatible with VGA and DVI by using adapters. A DisplayPort connection is intended for video devices only, but like High-Definition Multimedia Interface (HDMI) and Universal Serial Bus (USB), it can transmit audio and video simultaneously.
9. D. The first version of Thunderbolt supported 10 Gbps data rates, which is fast. Thunderbolt 2.0 joins two 10 Gbps channels together for 20 Gbps throughput. But Thunderbolt 3 and Thunderbolt 4 provide 40 Gbps.
10. B. Nano-ITX motherboards are 4.7-inch square, a Mini-ITX motherboard is 6.7-inch square, pico-ITX motherboards are 3.9 × 2.8 inches, and mobile-ITX motherboards are 2.4-inch square.
11. D. The form factor of something defines its size, placement of components and connectors, as well as to what it can be attached. Many devices have form factors, such as Central Processing Unit (CPU) sockets, motherboards, and Random Access Memory (RAM) modules. ATX is a type of form factor. An array is a group of something such as a hard drive array, and orientation refers to the positioning of a connector.

12. B. Single-mode fiber-optic cable can send a reliable signal over a much greater distance (up to hundreds of km, depending on the cable's dispersion rate and attenuation) than Multimode Fiber (MMF), but on the downside, it is more expensive. Cat 7 is a type of shielded twisted pair copper cable that is not sanctioned by the Institute of Electrical and Electronics Engineers (IEEE). RG6 is coaxial cable often used in cable Internet services.
13. A. Category 6 cable will work for the implementation described. It is capable of 10 Gbps but only for a distance of 55 meters. Category 6a can go 100 meters at 10 Gbps. Cat 7 is not an Institute of Electrical and Electronics Engineers (IEEE) standard, nor is it approved by Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA), and it doesn't use a standard RJ-45 connector. Cat 8 is IEEE-approved; it can support 10 Gbps over 100 meters and can support 40 Gbps but only over very short distances, which makes it good for things like a Storage Area Network (SAN).
14. A. Twisted Nematic (TN) Liquid Crystal Displays (LCDs) have the fastest response times. The In-Plane Switching (IPS) display type is quick enough for someone interested in gaming. Vertical Alignment (VA) displays are slower than IPS displays. An Organic Light-Emitting Diode (OLED) is not a type of LCD.
15. D. The Hardware Security Module (HSM) and Trusted Platform Module (TPM) both encrypt data. The TPM, which can be hardware or software, is integrated into a motherboard for protecting a specific device, whereas the HSM is a piece of removable hardware used to hold encryption keys for a system. An HSM would more likely be found in an enterprise setting. The Basic Input/Output System (BIOS), or Unified Extensible Firmware Interface (UEFI), is the program the Central Processing Unit (CPU) uses to start up the system after being powered on. Information Technology Extended (ITX) is a motherboard form factor.
16. C. Transmission Control Protocol (TCP) printing enables clients with different Operating Systems (OSs) to send jobs directly to printers without worrying about intra-OS conflicts. Bonjour is an Apple service and cloud printing is printing over the Internet and doesn't affect the issue being addressed. Virtual printing enables device users to print output to documents like PDF files. Whenever sharing printers for remote printing, be sure to set proper user authentication on the print device.
17. B. A Cat 6a cable is a twisted pair network cable, and you are most likely to find an RJ-45 connector at the end of it. RJ-11 connectors are used in analog phone lines. Bayonet Neill-Concelman (BNC) connectors are network connectors but are used with coaxial cable. Serial Advanced Technology Attachment (SATA) connectors are used with hard drives.
18. A. The connector shown is a Digital Visual Interface (DVI) connector used for digital video. More specifically, it is a Digital Visual Interface-Integrated (DVI-I) Dual Link connector capable of sending both analog and digital signals. The analog signals are ignored, unless a DVI-I to Video Graphics Array (VGA) adapter is used to connect the PC to an older display using VGA. This makes the DVI-I connector more versatile than Digital Visual Interface-Digital (DVI-D) connectors, but they are both considered digital interfaces. High-Definition Multimedia Interface (HDMI) is a popular type of video connection that is also capable of carrying sound. Composite is a legacy type of audio/video cable.

- 19.** B. Thermal printers use a roll of special thermal paper as opposed to individual sheets. Impact printers may also use rolls of paper but with tractor-feed holes on the sides. Impact printers generally use multipart forms, because printing on multiple copies at once is their unique ability. Inkjet and laser printers, as well as fax machines, typically use individual sheets of paper.
- 20.** B. Laser printers need toner cartridges, impact printers need ink ribbons, and inkjet printers use ink cartridges. Thermal printers apply heat to special thermal paper to produce images.
- 21.** A. An imaging drum is a photosensitive drum that can hold a high negative charge if it's not exposed to light. It is dark inside an electrophotographic (EP) printer, except when the laser scanning assembly shines on particular areas of the photosensitive drum, reducing the high negative charge to a much lower negative charge. Toner itself is negatively charged and repelled by the highly negatively charged areas but attracted to the areas with a very low charge. The use of varying negative charges is what facilitates the printing process. When replacing a photosensitive drum, it's best to avoid exposing it to light.
- 22.** C. Information Technology eXtended (ITX) motherboards are available in various sizes. The Mini-ITX standard boards are 6.7-inch square (or more precisely, 6.69-inch square). Advanced Technology eXtended (ATX) motherboards are 12" × 9.6". A micro-ATX motherboard is 9.6-inch square, Pico-ITX motherboards are 3.9" × 2.8", while Nano-ITX motherboards are 12cm × 12cm (about 4.7-inch square).
- 23.** D. Resolution is the number of pixels that a given device is capable of displaying, and is expressed as two numbers, such as 1366 × 768. Refresh rate determines how many times per second the screen can be redrawn. Pixel density is a measure of how many pixels a device can display in a specified space, such as Pixels Per Inch (PPI). A larger display with the same resolution will have a lower pixel density. Aspect ratio defines the relationship between the dimensions (width × height) of a display or image. For example, a screen that has a maximum resolution of 1366 × 768 has an aspect ratio of 16:9. For every 9 pixels in height, there are 16 pixels in width.
- 24.** B. In a Redundant Array of Independent Disk-5 (RAID-5) array, each stripe places data on n–1 disks, and parity computed from the data is placed on the remaining disk. The parity is interleaved across all the drives in the array, so that neighboring stripes have parity on different disks. Said differently, you lose the equivalent of one hard disk worth of storage to hold the parity information.
- 25.** A. The Hardware Security Module (HSM) is a piece of hardware that can be removed and is used to hold encryption keys for a system. It differs from Trusted Platform Module (TPM) implementations in that TPM is a chip (or added card) on the motherboard and not a separate piece of hardware. A TPM can also be software and is used to encrypt hard drives. The Basic Input/Output System (BIOS) or Unified Extensible Firmware Interface (UEFI) is the program the Central Processing Unit (CPU) uses to start up the system after being powered on. Information Technology eXtended (ITX) is a motherboard form factor.
- 26.** D. Many modern Multifunction Devices (MFDs) have the ability to connect to the cloud, then email and/or store scanned documents and images directly from the device without

requiring a connected PC. The documents are made accessible worldwide via services such as Dropbox, Evernote, or Google Drive. Bonjour is an Apple printing technology. Although TCP is used in many applications and processes, TCP printing means specifically locating a printer based on its TCP/IP address by configuring that address into the settings. It's not the same as cloud printing. Virtual printing enables a user to print to a file like a PDF instead of to a physical printer.

27. C. The ability of multifunction devices to email and scan without a PC means that these devices need to be hardened the same way any other device with a network connection needs to be. Secure protocols must be present to protect sensitive corporate information. Duplexing means printing on both sides of a paper.
28. D. Server Message Block (SMB) is the secure protocol used when scanning documents from a multifunction device to a server. Trusted Platform Module (TPM) and Hardware Security Module (HSM) are security encryption devices, not protocols. Simple Network Management Protocol (SNMP) is used to gather information from managed switches and other devices across a network.
29. A. Heat sinks are often made of metal, with many fins on them to increase surface area and dissipate heat faster. Many modern Central Processing Unit (CPU) coolers will have both a fan (which requires power) and a finned metal heat sink. Passive heat sinks do not use power (so no fan), and secondary cooling fans are generally attached to the case.
30. A, B, C, D. While faxing isn't used as much as it once was, it is still a feature available on some Multifunction Devices (MFDs). Email, scanning, and printing are also common features.
31. A, C. Video Graphics Array (VGA) is an analog video connector, and Registered Jack-11 (RJ-11) connectors are used with traditional analog phone lines and modems. Modems receive a digital signal from a computer, then modulate that signal to analog to transmit over analog lines. On the other end, they demodulate the signal into a digital one again, which a computer or other digital device can understand. RJ-45 connectors are used in networking, and High-Definition Multimedia Interface (HDMI) connections carry digital audio and video signals.
32. B. The port shown is a DisplayPort. There is also a mini-DisplayPort, which is simply a smaller version of the DisplayPort. But the port in the image is a full-size DisplayPort. External Serial Advanced Technology Attachment (eSATA) ports provide an external connection for a SATA device. Digital Visual Interface (DVI) connections transmit digital video signals and High-Definition Multimedia Interface (HDMI) connectors provide digital connections for video and audio transmission.
33. A, B. With up-plugging, you can put a smaller Peripheral Component Interconnect Express (PCIe) card into a larger slot, even though it does not fill it up completely. For example, you can insert an x8 card into an x16 slot. The x8 card won't completely fill the slot, but it will work at x8 speeds. It's important to note that a motherboard doesn't necessarily support this feature, so if you plan to use a smaller card in a larger PCIe slot, ensure the motherboard supports up-plugging, or the card will run at 1x speed.

- 34.** C. Redundant Array of Independent Disks-1 (RAID-1) provides disk mirroring—it writes data simultaneously to both drives. If one drive fails, the other drive still has a working copy of the data. RAID-0 is disk striping and does not provide fault tolerance. RAID-5 is striping with parity and provides speed and fault tolerance, but it requires a minimum of three hard disks to function.
- 35.** B. They should choose a Vertical Alignment (VA) Liquid Crystal Display (LCD) monitor. There are three types of LCD technologies listed in the A+ exam objectives: TN, IPS, and VA. Twisted nematic (TN) was developed first and uses less power compared to the other two. The issue with TN LCD screens is that when you begin viewing them at wider angles, the picture quality greatly suffers. In-Plane Switching (IPS) LCD displays provide better color representation as well as wider-angle viewing, but they tend to be a bit more expensive and have somewhat slower response times. Vertical Alignment (VA) LCD displays have slower response times than either IPS or TN; however, they have the best contrast and image depth. Organic Light-Emitting Diode (OLED) displays use organic materials to create light and color. They are not a type of LCD display. There are also micro-LED and mini-LED displays.
- 36.** B. Many newer smartphones boast Organic Light-Emitting Diode (OLED) displays due to their light weight, flexibility, color depth, and wider viewing angle. In-Plane Switching (IPS) is a popular type of LCD that requires backlighting to display the image. Twisted Nematic (TN) was the first Liquid Crystal Display (LCD) technology developed. It uses less power and has a limited viewing angle but supports very fast refresh rates. All modern LCD displays use Light-Emitting Diodes (LEDs) for backlighting, instead of Cold Cathode Fluorescent Lamps (CCFLs). OLED displays don't need a backlight because their carbon-based material can emit light and color.
- 37.** C, D. With most dual-channel motherboards, Random Access Memory (RAM) will work just fine if one module is installed. However, you will get better performance if you fill the entire bank. If there is only one RAM module installed in one channel, then you can't possibly take advantage of the dual-channel architecture.
- 38.** D. There are six major versions of Peripheral Component Internet Express (PCIe) currently specified: 1.x, 2.x, 3.0, 4.0, 5.0, and 6.0. Each version doubles the data transfer rate of the version before. In each version, a single bidirectional lane operates at a data rate of 250 Megabytes per second (MBps), 500 MBps, approximately 1 Gigabyte per second (GBps), roughly 2 GBps, nearly 4 GBps for version 5.0, and nearly 8 GBps in version 6.0. In any version of PCIe, there can be up to 16 lanes, so, in theory, a PCIe 4.0 x16 connector could transfer nearly 32 GB/s (1.969 GB/s per lane, multiplied by 16 lanes). You might find it helpful in your studies to locate or create a chart of the different versions and bandwidth for x1, x4, x8 and x16. You may also see the speed expressed in mega transfers per second (MT/s) or giga transfers per second (GT/s).
- 39.** A, D. When installing or replacing a power supply, always ensure that it has enough wattage to power the computer's components. In addition, it must have enough of the right connectors to connect to all the components that require their own power. Multiple rail and dual voltage are optional features.

- 40.** A, B. Faster hard drives transfer more data than slower hard drives, but there is no specific correlation between hard drive speed and its life span. The downsides to having faster hard drives can be increased battery usage and heat production.
- 41.** C. The slot described is a Peripheral Component Interconnect (PCI) slot. It used a 32-bit or 64-bit bus. The first version was released in 1992, and they remained popular until Peripheral Component Interconnect Express (PCIe) was developed. Some motherboards have PCI and PCIe slots on them. PCI and PCIe are not physically compatible. Serial Advanced Technology Attachment (SATA) is a type of hard drive connection, while External Serial Advanced Technology Attachment (eSATA) is a specific type of connector, with a shape slightly different from SATA, which provides a SATA technology connection on the outside of a case.
- 42.** C. Print servers need to have the appropriate drivers for the printer model and all operating systems that will be clients. It's possible that this print server does not have the macOS driver installed.
- 43.** B. The connector shown is USB Type B. It will plug into the Universal Serial Bus (USB) peripheral device and is commonly used by printers. USB type A typically plugs into a printer port. USB mini-B is a smaller version of the USB B connector, and a Thunderbolt connector looks like a USB-C connector.
- 44.** B, C. Liquid cooling systems are generally quieter than air-based systems that use fans, and they are more efficient at cooling the processor. However, they are more complex to install, and if the liquid were to leak out, it could cause damage to internal components.
- 45.** D. Impact printers most often use tractor-feed mechanisms to load the paper, and they can wear down or get bogged down by paper debris. Printheads are found on both inkjet and impact printers, although they are very different from one device to the other. Ink cartridges provide the color on ink jet printers, and the output trays found on inkjet printers are not needed with impact printers.
- 46.** C. Peripheral Component Interconnect Express (PCIe) uses lanes. Each lane between any two intercommunicating devices consists of a separate pair of wires—one for each direction of traffic—that dramatically increases speed.
- 47.** B. Of the Liquid Crystal Display (LCD) choices given, In-Plane Switching (IPS) has the better viewing angle. Liquid Crystal Displays (LCDs) can be Twisted Nematic (TN), IPS, or Vertical Alignment (VA). VA has a greater contrast ratio, but it has a narrower viewing angle than IPS. Light-Emitting Diode (LED) refers to a type of backlighting, and Organic Light-Emitting Diode (OLED) displays are not a type of LCD.
- 48.** C. All modern Liquid Crystal Displays (LCDs) are illuminated by Light Emitting Diodes (LEDs). Mini-LED displays use very tiny LEDs to provide backlight to LCD displays. Their contrast is close to what Organic Light-Emitting Diode (OLED) displays produce; however, the mini-LED displays are not prone to burn-in, while the OLED displays are. Mini-LED displays generally have a greater lifespan than OLED displays, which produce light by applying electricity to organic material, causing it to glow. OLEDs are not a type of LCD display. Twisted Nematic (TN), Vertical Alignment (VA), and In-Plane Switching (IPS) are methods used to manipulate the liquid crystals in an LCD display.

- 49.** B. The x8 card won't completely fill the x16 slot, but it will work at x8 speeds, if up-plugging is supported by the motherboard. Otherwise, the specification requires up-plugged devices to operate at only the x1 rate.
- 50.** B. Secure Boot is an option enabled in system firmware. Basic Input/Output System (BIOS) is not technically advanced enough to manage Secure Boot, but its successor, Unified Extensible Firmware Interface (UEFI), is. AMI (formerly American Megatrends) is a BIOS manufacturer, and Serial Advanced Technology Attachment (SATA) is a type of hard drive technology.
- 51.** A. Double Data Rate 3 (DDR3) Dual In-Line Memory Modules (DIMMs) have 240 pins. DDR4 and DDR5 DIMMs have 288 pins, but they are not interchangeable and have notches (module keys) in different locations to prevent installing the incorrect modules into a motherboard. Small Outline DIMMs (SODIMMs) are laptop Random Access Memory (RAM), not desktop RAM.
- 52.** A. The module key, also called a notch, on a Double Data Rate 5 (DDR5) Dual In-Line Memory Modules (DIMMs) is at the center of the module, whereas the Double Data Rate 4 (DDR4) DIMM is slightly off center. Both are sold with heat sinks attached and come in multiple colors. Physically, they're the same size.
- 53.** D. Multithreading is a feature of processors that divides physical processor cores into logical cores, and software processes into multiple threads that can run concurrently on those logical cores. As a result, the operating system (OS) can schedule two processes at the same time on each physical core. Intel's implementation of multithreading is called hyperthreading. Multicore means that there are two or more cores on a processor die, each with two logical cores called arithmetic logic units. 32-bit and 64-bit refer to the width of the data bus, and an integrated Graphics Processing Unit (GPU) means that the processor contains the graphics processor so a separate GPU isn't required.
- 54.** A. An impact printer typically requires paper that always feeds at a consistent rate. To achieve this, the paper has holes on the outside edges and is fed into the printer using a tractor-feed mechanism. Thermal printers use special thermal paper that is heated to create images, whereas laser printers use the electrophotographic process. Inkjet printers spray drops of ink onto paper.
- 55.** A. Advanced Technology eXtended (ATX) motherboards are common in desktop computers and measure 12" x 9.6". They are the largest motherboards commonly used in personal computers today.
- 56.** A, D. If the printhead isn't moving, either the mechanism that moves it or debris in its path could be causing the problem. The motor, which makes the printhead carriage move, is also often called the carriage motor or carriage stepper motor. It has a belt attached to it—the carriage belt—that moves the printhead carriage back and forth. Sometimes, these need to be replaced. Debris in the printer could also prevent the printhead from moving and needs to be removed. Note that in some inkjet printers the ink cartridge contains the printhead, while in others it is a separate component. The feeder is the mechanism that pulls paper into and through the printer. The rollers, sometimes called pickup rollers because they literally pick up a sheet of paper, are part of the feeding mechanism.

57. A, C, D. The Central Processing Unit (CPU) must support Virtual Machine (VM) Display Mode Extension; on an Intel processor, it's called Virtualization Technology (Intel VT). The processor must be 64-bit and have Second-Level Address Translation (SLAT). Virtualization also requires the Windows Pro edition or better. Virtualization must be enabled in the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI), which may be found under different names, depending on the motherboard manufacturer.
58. C. The most common analog video connector is a Video Graphics Array (VGA) connector. It is usually blue in color, arranged in a D shape, with 15 pins arranged in three rows. There are also analog Digital Visual Interface (DVI-A) connectors. DVI Integrated (DVI-I) connectors can be used in either digital or analog implementations. DisplayPort is a digital connector. Radio Corporation of America (RCA) provides an analog audio connection, and Bayonet Neill-Concelman (BNC) connectors are used for analog or digital connections, but are generally used for broadband connections, not to connect a display and a computer.
59. A. Thunderbolt v1 and v2 both provide 20 Gigabits per second (Gbps) of data bandwidth. Thunderbolt 3 doubles the data rate to 40 Gbps. Thunderbolt 3 and Thunderbolt 4 can also provide the power the device needs. Universal Serial Bus (USB) 3.0 can only provide about 5 W of power and is much slower, at 5 Gbps. External Serial Advanced Technology Attachment (eSATA) is also slower and doesn't provide power, although Power over eSATA (eSATAp) does. DisplayPort is also slower and provides no power, unless it's DisplayPort over USB.
60. C. A digitizer is a device that can be written or drawn on, and the content will be converted from analog input to digital images on the computer. Digitizers take input from a user's finger or a writing utensil like a stylus. Touchscreen devices and touchpads have a digitizer built into them. An inverter changes Direct Current (DC) to Alternating Current (AC) and is needed for some types of backlighting.
61. B, C. Peripheral Component Interconnect (PCI) slots and adapters are manufactured in 3.3 V and 5 V versions. Adapters are keyed to fit in a slot based on their voltage requirements. Universal adapters are keyed to fit in slots based on either of the two voltages. PCI has largely been replaced by Peripheral Component Interconnect Express (PCIe), but there are still implementations of it, and it is still on the CompTIA A+ exam objectives.
62. A. Trusted Platform Module (TPM) is an international standard for a dedicated security coprocessor, or cryptoprocessor. Coupled with a Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI), it can be configured to boot the system only after authenticating the boot device. LoJack is a feature for locating stolen or missing devices, Secure Boot is designed to prevent malicious software from loading before a PC boots, and BitLocker is a feature of Windows Pro and higher editions that is used to encrypt entire storage drives.
63. B. Touchscreens, touchpads, and digitizer tablets and drawing pads convert your finger or stylus movements on the device to mouse movements on the display. Touchscreens incorporate a digitizer, but a digitizer can also be a separate device which looks like a tablet but is used specifically to interpret hand drawing of images or text. A rectifier is a device that converts Alternating Current (AC) to Direct Current (DC) and can be found in a power supply. An inverter converts DC to AC and can be found in some displays.

- 64.** C. This is an eight-pin Peripheral Component Interconnect Express (PCIe) power connector. They also come in six-pin configurations.
- 65.** D. After installing a new printer, it's good practice to print a test page to ensure functionality.
- 66.** B. Whenever you've just replaced something and an error message pops up, it's a fairly safe assumption that it had something to do with what you just replaced. A toner cartridge that isn't seated properly can cause an error message. Reseat it and the error might go away.
- 67.** C. Redundant Array of Independent Disks-10 (RAID-10, also known as RAID-1+0) provides fault tolerance by adding a mirror (RAID-1) to a striped set (RAID-0). The striped set has a minimum of two drives and the mirror requires two more drives, one to mirror each drive of the striped set, for a total of four drives.
- 68.** C. The image is of a Serial Advanced Technology Attachment (SATA) connector, commonly used for internal hard drives.
- 69.** C, D. To use a second display on a desktop computer, you need to install a second video adapter or have one video adapter with two display interfaces. Laptops often have an external display interface and are capable of providing video to the built-in screen and an external display at the same time.
- 70.** A. Double Data Rate 3 (DDR3) and Double Data Rate 4 (DDR4) memory slots are both keyed, but the keys are in different places. DDR3 has 240 pins, and DDR4 has 288 pins. Therefore, the memory will not fit into the slots on the motherboard.
- 71.** C. The job of the inverter is to store and convert energy from Direct Current (DC) to Alternating Current (AC). Inverters have the potential to discharge that energy and can be dangerous to technicians, so be careful when working with them. A backlight provides light that shines through the Liquid Crystal Display (LCD) to create pictures on the screen. Light Emitting Diode (LED) displays don't need an inverter because they use DC, not AC, and the laptop will already have DC power running through it.
- 72.** A. Duplexing is printing on the front and back. Other common options or settings include orientation (i.e., portrait or landscape), collating (i.e., printing pages in sets such as 1, 2, 3, 1, 2, 3), and print quality (e.g., draft or high resolution).
- 73.** C. A Blu-ray Disc Extra Large (BDXL) can store up to 128 GB of data (Quad BDXL), although most for sale boast only 100 GB of storage (Triple BDXL). Blu-ray is the latest rendition of optical discs, but Digital Versatile Discs (DVDs) are still available and come in Single Layer (SL), Dual Layer (DL), Single Side (SS), and Dual Side (DS) formats. DVD-18 (DS, DL) hold approximately 16 GB of data. DVD-10 (DS, SL) can hold approximately 9 GB, and DVD-9 (SS, DL) can hold approximately 8 GB of storage. DVD-9 and DVD-10 can be Digital Versatile Disc Recordable (DVD+R) or DVD-R formats, but DVD-18 can only be the DVD+R format.
- 74.** A, C. The feeder is the part of the printer that pulls paper through the printer. In an inkjet printer, the paper is usually inserted either in a tray at the top back of the printer, or in a tray on the bottom of the printer. Unfortunately, there are many reasons why the feeder isn't

pulling paper into the printer, including using the wrong paper, having incorrect paper settings in the driver, the tray isn't fully inserted, the pickup rollers are dirty, the paper isn't inserted into the tray correctly, the paper guide is missing, the width guide is too tight, there is too much or too little paper in the tray, and using two different kinds of paper in the same tray or reusing paper that has been printed on or is dirty. A problem with the printhead isn't likely to cause paper not to feed, and a toner cartridge is part of a laser printer, not an inkjet printer.

75. D. The number designation of 3600 in Double Data Rate 4 (DDR4) 3600 indicates the bus speed of 3,600 Megahertz (MHz). To find the throughput, multiply the bus speed by 8. DDR4 3600, therefore, is the same as PC4 28,800, with a peak transfer rate of 28,800 Megabits per second (Mbps). ($3,600,000 \text{ cycles per second} \times 8 = 28,800,000 \text{ bits per second}$. Divide by 1,000 to get Mbps = 28,800.)
76. C. Multiply the 5,200-bus speed by eight to get the bits per second that can be transferred in and out of the RAM module. The PC5 designation means that it is Double Data Rate 5 (DDR5), and the 41,600 means that it can (theoretically) transfer 41,600 Mbps (Megabits per second).
77. B. iPads and iPhones can automatically detect AirPrint-enabled printers on their local network and print to them without requiring the installation of a driver. Bonjour is a service that works with both Macs and Windows devices but requires some configuration. Although Transmission Control Protocol (TCP) is used in many applications and devices, TCP printing is different. In TCP printing, a printer in the Operating System (OS) is configured to use an Internet Protocol (IP) address to connect to a printer. Virtual printing sends the output to something else, such as a PDF file.
78. B. To communicate with other computers on a network, you need a Network Interface Card (NIC). A Wireless Access Point (WAP) is a wireless hub that many wireless devices communicate with, and Wi-Fi Protected Access (WPA) is a wireless security standard. A Keyboard, Video, Mouse (KVM) switch enables you to have multiple systems attached to the same keyboard, video, and mouse. Other types of expansion cards (that could use the same slot as a NIC) include, but are not limited to, video cards, sound cards, storage cards, TV tuner cards, and riser cards.
79. B. The printer driver uses a Page Description Language (PDL), which specifies the printed page layout, to convert the data being printed into a format that the printer can understand. The driver ensures that the printer is ready to print and ensures that the OS sends information in the correct format. The print queue holds print jobs that are waiting to be printed and the print spooler manages the printing process, including locating the right printer driver.
80. C. Windows comes with many drivers for different devices, but if the manufacturer has provided a specific printer driver, it's often best to install that printer driver first, and then connect the device. In this case, the user will be printing mostly graphics, so the PostScript driver will provide better printing for them. PostScript drivers are not dependent on the hardware, so the printed graphic will look the same, regardless of what device it is printed on.

- 81.** B. Printer Control Language (PCL) drivers depend on the printer hardware to create some of the effects, such as filling in areas and making underlines. The PC releases the print job to the printer to finish, making the PC and application available to the user more quickly.
- 82.** D. The power supply fan is used to cool the power supply and the inside of the computer case. This fan draws air from inside the case into vents in the power supply. This action pulls hot air through the power supply, so that it can be blown out of the case, which also causes cooler air to be drawn in through vents in the case.
- 83.** A. A Solid-State Drive (SSD) is the best choice for a hard drive when access speed is the most important characteristic. A conventional magnetic Hard Disk Drive (HDD) is slower. Secure Digital (SD) is a memory card format, not a hard drive type. Blu-ray Disk Recordable (BD-R) is a Blu-ray (optical) disk format.
- 84.** C. Universal Serial Bus (USB) 3.0 supports 5 Gigabits per second (Gbps), USB 1.0 supports 12 Megabits per second (Mbps), USB 2.0 supports 480 Mbps, and USB 3.1 Gen 2 supports 10 Gbps.
- 85.** C. With Redundant Array of Independent Disks 10 (RAID-10), drives are set up as mirrors, then those mirrors are striped. A minimum of two drives are needed to create a mirror, then another two to stripe the data, for a total of four drives. The computer already has one drive in it. That drive would be mirrored, then striped, so three more drives are needed. RAID-10 provides both extra speed and fault tolerance.
- 86.** A. Redundant Array of Independent Disks-0 (RAID-0), also known as disk striping, uses a minimum of two drives to write different bits of data to each drive at the same time to improve speed, but it doesn't offer any fault tolerance. Redundant Array of Independent Disks-1 (RAID-1) is disk mirroring, which provides some fault tolerance but no speed improvement. Redundant Array of Independent Disks-5 (RAID-5) and Redundant Array of Independent Disks-10 (RAID-10) improve both speed and fault tolerance.
- 87.** A. A processor that exhibits a multicore architecture has multiple and completely separate processor dies in the same package. The operating system and applications see multiple processors in the same way that they see multiple processors in separate sockets. 64-bit refers to the width of the data bus. An integrated Graphics Processor Unit (GPU) means that the graphics processor is also on the Central Processing Unit (CPU) package, and multiprocessor refers to more than one physical socket on a motherboard.
- 88.** B. All are Digital Video Disc (DVD) technologies. A Single-Sided, Single-Layer (SS, SL) DVD provides about 4.7 GB of storage. A Dual-Sided (DS) disk will double that capacity to 9.4 GB. Adding a second layer, or Dual-Layer (DL), adds more capacity, but the technology does not double the capacity of a single layer. A Single-Sided, Dual-Layer (SS, DL) disk has capacity of about 8.5 GB. There is no Digital Video Disc Recordable Single-Sided (DVD-R SS), Digital Video Disc Recordable Transport Layer (TL), but a Digital Video Disc Recordable Dual-Sided, Dual Layer (DVD+R DS, DL) holds nearly 17 GB of data. The -R refers to the encoding scheme. There is also a +R format. There are also number designations to identify how many sides and layers a DVD has. DVD-9 is single-side, dual-layer; DVD-10 is dual-side, single-layer; and DVD-18 is dual-side, dual-layer.

89. D. Many power supplies have a two-position slider switch called a dual voltage switch. It can be set for 110–120 V or 220–240 V, depending on the local power specifications. Keep in mind that the computer may be damaged if the power supply isn't set to the correct voltage before the computer is powered on.
90. D. Mobile-Information Technology Extended (Mobile-ITX) motherboards are 2.4-inch square. Micro-Advanced Technology Extended (MicroATX) motherboards are 9.6-inch square, Mini- Information Technology Extended (Mini-ITX) motherboards are 6.7-inch square, and Pico-Information Technology Extended (Pico-ITX) motherboards are 3.9" × 2.8".
91. C. Dot-matrix printers use printheads that strike an ink ribbon, which presses up against the paper to make an image. Therefore, they are impact printers. Laser printers use a photosensitive drum to create the image, inkjet printers use an ink reservoir (cartridge) and spray nozzles to produce an image on paper using dots of ink, and thermal printers use heat to produce an image on special thermal (heat-sensitive) paper.
92. A, C. The Epyc and Ryzen processors are made by Advanced Micro Devices (AMD), while the Core series and Xeon processors are made by Intel.
93. B. A Solid-State Drive (SSD) will provide them with the highest capacity of the four options and give them immediate access. Network Attached Storage (NAS) speaks to its connection and availability, not capacity. If the client required file sharing as well, then using a NAS would be the proper choice. Secure Digital (SD) is a memory card format and does not offer the capacity or immediacy they need. Blu-ray disk (BD-R) has good storage capabilities but not the immediacy for editing.
94. B, C. Digital displays will have a digital interface, such as Digital Video Interface-Digital (DVI-D), High-Definition Multimedia Interface (HDMI), or mini- High-Definition Multimedia Interface (mini-HDMI). Digital Video Interface-Integrated (DVI-A) and Video Graphics Array (VGA) are analog, not digital.
95. A, B, D. The four virtual printing options are print to file, print to Portable Document Format (PDF), print to XML Paper Specification (XPS), and print to image.
96. C. There are six major versions of Peripheral Component Interconnect Express (PCIe) currently specified: 1.x, 2.x, 3.0, 4.0, 5.0, and 6.0. Each version doubles the data transfer rate of the version before. In each version, a single bidirectional lane operates at a data rate of 250 Megabytes per second (MBps), 500 MBps, approximately 1 Gigabyte per second (GBps), roughly 2 GBps, nearly 4 GBps for version 5.0, and nearly 8 GBps for version 6.0.
- Each PCIe slot can have up to 16 lanes, the number of lanes being indicated by x1, x4, x8, and x16. (The “x” is pronounced as *by*.) Therefore, a PCIe 3 x1 slot can support up to 1 GBps of bandwidth.
97. A. Many displays are touchscreens, which convert a user's finger movements to mouse movements on the screen. A touchpad does the same but is not a type of display. (Yes, watch for tricky questions like this on the exam.) An inverter is a part of many displays, and its job

is to store and convert energy from Direct Current (DC) to Alternating Current (AC). Inverters have the potential to discharge that energy and can be dangerous to technicians, so be careful when working with them. A Liquid Crystal Display (LCD) is a type of display but not necessarily a touchscreen.

- 98.** B. Land Grid Array (LGA) sockets support modern Intel processors. The Pin Grid Array (PGA) 132 socket was the first Intel socket. AM and TR socket series are for Advanced Micro Devices (AMD) processors. Tip: You probably can't memorize all the processors and sockets, so ensure that you can identify the families that belong to AMD or Intel.
- 99.** A. When installing dual-channel Random Access Memory (RAM), be sure that the RAM modules have the same parameters. In some cases, you might even need to make sure they come from the same manufacturer. RAM for channeled motherboards is often sold in packs, such as a pack of two RAM modules for dual-channel motherboards, three modules for triple-channel motherboards, and four modules for quad-channel motherboards.
- 100.** B. Pixel density is a measure of how many pixels a device can display in a specified space, such as Pixels Per Inch (PPI). A larger display with the same resolution will have a lower pixel density. Refresh rate determines how many times per second the screen can be redrawn. Aspect ratio defines the relationship between the dimensions (width × height) of a display or image. For example, a screen that has a maximum resolution of 1366 × 768 has an aspect ratio of 16:9. For every 9 pixels in height, there are 16 pixels in width. Density independence refers to the ability of an image or font to be displayed the same, regardless of the display it is shown on. Resolution is the number of pixels that a given device can display, expressed as two numbers such as 1366 × 768.
- 101.** A. Refresh rate determines how many times per second the screen can be redrawn. A slow refresh rate can make video appear blurry or jumpy. Pixel density is a measure of how many pixels a device can display in a specified space, such as Pixels Per Inch (PPI). A larger display with the same resolution will have a lower pixel density. Aspect ratio defines the relationship between the dimensions (width × height) of a display or image. For example, a screen that has a maximum resolution of 1366 × 768 has an aspect ratio of 16:9. For every 9 pixels in height, there are 16 pixels in width. Resolution is the number of pixels that a given device can display, expressed as two numbers such as 1366 × 768.
- 102.** B. The maximum length for a Serial Advanced Technology Attachment (SATA) cable is 1 meter, which is about 39 inches. Your best course of action is to purchase a longer cable, so you can maintain maximum air flow.
- 103.** B. To get this printer off the original user's desk, it probably needs to be its own print server. Installing an integrated (or standalone) print server with a network connection should work well in this situation. Installing a network card wouldn't take care of the sharing aspect of the problem. You need a network connection before you can use Transmission Control Protocol/Internet Protocol (TCP/IP) settings to connect to it. AirPrint is Apple's wireless printing, which would also need to have the printer connected to a wireless network.
- 104.** B. Clean pickup rollers (and other rubber rollers) with mild soap and water and not alcohol. Alcohol will dry out the rollers, making them brittle and ineffective. A dry cloth

will not remove the dirt or debris, and compressed air would just blow the debris into other internal printer components.

105. D. Resolution is the number of pixels that a given device can display, expressed as two numbers such as 1366×768 . The refresh rate determines how many times per second the screen can be redrawn. A slow refresh rate can make video appear blurry or jumpy. Pixel density is a measure of how many pixels a device can display in a specified space, such as Pixels Per Inch (PPI). A larger display with the same resolution will have a lower pixel density. Aspect ratio defines the relationship between the dimensions (width \times height) of a display or image. For example, a screen that has a maximum resolution of 1366×768 has an aspect ratio of 16:9. For every 9 pixels in height, there are 16 pixels in width.
106. C. The primary factor in determining data throughput for a magnetic hard drive is the spindle speed, which is measured in Revolutions Per Minute (RPM). Higher spin rates will result in faster data reads and writes and increase data throughput.
107. D. The white connector is a 20-pin Advanced Technology eXtended (ATX) power connector. You will also see 24-pin versions, which have two rows of 12 pins each. The 24-pin versions are ATX12V. Whether 20- or 24-pin, these are often labeled P1.
108. C. To make information available to the rest of the computer more quickly, hard drive manufacturers increase the speed at which the hard drive platters spin, which is measured in Revolutions Per Minute (RPM). The downside of higher speed is usually more heat generated by the drive, so faster hard drives may require additional cooling in the case.
109. A, B, C. The Advanced Technology eXtended (ATX), Micro Advanced Technology eXtended (MicroATX), and mini-Information Technology eXtended (Mini-ITX) motherboard form factors can all be mounted inside a standard ATX case. The Mini-ITX will have only three of the four mounting holes line up with the case, but the rear interfaces are placed in the same location as those on ATX motherboards.
110. C. If memory supports Error-Correcting Code (ECC), check bits are generated and stored with the data. If one of the eight memory bits is in error, ECC can correct the error. ECC tends to be more expensive than non-ECC memory, so it is more often found in servers than in workstations.
111. A, D. Universal Serial Bus (USB) flash drives and Secure Digital (SD) cards are hot-swappable. (In the case of USB, be sure that the flash drive does not contain key file system files needed for the computer to run!) Hybrid Solid-State Drives (SSDs) might or might not be hot-swappable and are physically larger than USB and SD devices. Serial Advanced Technology Attachment (SATA) is a technology for connecting storage drives to motherboards and other devices.
112. C. This Scalable Link Interface-ready (SLI-ready) motherboard has three PCIe x16 slots (every other slot, starting with the top one), one Peripheral Component Interconnect Express (PCIe) x1 slot (second slot from the top), and two Peripheral Component Interconnect (PCI) slots (first and third slots from the bottom). Notice the latch and tab that secures the x16 adapters in place by their hooks.

- 113.** A, D. Quad-channel motherboards have four banks of Random Access Memory (RAM) slots. They are usually color-coded such that slots of the same color belong to different channels. For best performance, a RAM module needs to be installed into each channel, so four can be accessed at a time. It's always best to refer to the motherboard manual for proper RAM placement. Some motherboards will revert to single-channel mode if, for example, three RAM modules were placed in a dual-channel motherboard with four slots. Channels are typically marked with letters.
- 114.** A. The boot sequence of a computer is changed in the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) settings.
- 115.** C, D. Typical front- or top-panel connectors include Universal Serial Bus (USB), audio, power button, power light, drive activity lights, and the reset button. Serial Advanced Technology Attachment (SATA) and Peripheral Component Interconnect Express (PCIe) connectors are found inside the case, on the motherboard.
- 116.** A. The Universal Serial Bus (USB) 3.0 standard doesn't specify a cable length limitation, but it does recommend a cable length of 3 meters or less. USB 2.0 cables can be up to 5 meters in length. USB4 cables should be only 0.8 meters. The manager will need a USB hub, and to extend the distance the manager could purchase active USB cables, some of which have an external power supply or extra USB A connector for extra power, or a Cat 5/Cat 6 USB extender.
- 117.** C. Firmware upgrades can add new features to your printer, update printer apps with features and security patches, and sometimes fix printing problems. The exact method for installing the firmware upgrade depends on the printer being upgraded.
- 118.** D. An Automatic Document Feeder (ADF) is a device that sits on top of a flatbed scanner. It is used to pull a stack of papers through and scan them one at a time without user intervention. Some Multifunction Devices (MFDs) will scan the front and back of the paper at the same time.
- 119.** D. Peripheral Component Interconnect (PCI) is a shared-bus topology, so mixing 33 MHz and 66 MHz adapters in a 66 MHz system will slow all adapters to 33 MHz. Note: These are quickly becoming legacy expansion slots, but you'll still find them on some motherboards and the CompTIA objectives.
- 120.** A. The color gamut is the range of colors that can be created by a device. Organic Light-Emitting Diode (OLED) displays have the greatest gamut of any display devices. A gamut is more likely represented by a section of a graph showing all possible colors. There's no specific unit of measure. Several standards exist for explaining a device's gamut. Pixel density is how many pixels per inch a device has. Aspect ratio defines the relationship between the dimensions (width × height) of a display or image. Resolution is the maximum number of pixels of color that a device can display, such as 1024 × 768 (width by height).
- 121.** D. Passive cooling systems come in a variety of models, and some are very effective. The defining characteristic is that they do not use a fan or require a power source. Their advantage is that they are the ultimate in cooling-system quiet, because there is no fan or pump running.

- 122.** A, C, D. The Unified Extensible Firmware Interface (UEFI) configures many hardware components and settings, such as system date and time, boot sequence, enabling and disabling devices, clock speeds, virtualization support, fans, and UEFI/Boot security.
- 123.** A. The typical increasing order of capacity and distance from the processor die is L1 cache, L2 cache, L3 cache, Random Access Memory (RAM), and Hard Disk Drive/Solid-State Drive (HDD/SSD). The closest caches are located on the processor die.
- 124.** A. The figure shows a motherboard power connector that can convert between Advanced Technology eXtended (ATX, 20-pin) and ATX12V (24-pin) power connectors, so it can support either type of motherboard. While technically it can provide power to the hard drive, expansion cards, and case fan, the purpose of the 20+4 connectors is for motherboard compatibility.
- 125.** A, D. A Central Processing Unit (CPU) socket is the place on the motherboard where the CPU connects. The Land Grid Array (LGA) socket is used for Intel processors and will include a number that indicates the number of processor pins. LGA places the delicate pins on the motherboard, instead of where they were placed on the CPU like the older Pin Grid Array (PGA) sockets did. TR4 is one of the sockets used by Advanced Micro Devices (AMD) processors. There are many others! A Color Graphics Adapter (CGA) is an ancient type of graphics card. Pentium was the first processor with two arithmetic logic units and is type of Intel processor, not a socket. Tip: Although you might not remember all of the sockets, ensure that you have a good understanding of which groups of sockets are AMD and which are Intel.
- 126.** C. A printer's duplexing assembly is used for two-sided printing. After the first page is printed, it's fed into the duplexing assembly, turned over, and fed back into the paper feed assembly for printing.
- 127.** A, D. The cable is likely a 3.0 cable because of the blue connector. A Universal Serial Bus (USB) 3.0 cable is backward compatible with a USB 2.0 device, so this cable will work with your device. If, however, you had a 3.0 device and a 2.0 cable, the cable would not be able to function at 3.0 speed. The USB 3.0 standard doesn't specify a cable length limitation, but it does recommend a cable length of 3 meters or less. USB 2.0 cables can be up to 5 meters in length.
- 128.** A. The top module is Double Data Rate 3 (DDR3), and the bottom one is Double Data Rate 4 (DDR4). DDR3 has 240 pins, whereas DDR4 has 288 pins. Double Data Rate 5 (DDR5) also has 288 pins, but the DDR5 key position might vary depending on whether it is an Unbuffered Dual In-Line Memory Module (UDIMM) or Registered (buffered) Dual In-Line Memory Module (RDIMM). Buffered Dual In-Line Memory Module (DIMMs) have several advantages over unbuffered ddrms, often including Error-Correcting Code (ECC).
- 129.** D. Never ship a printer anywhere with a toner cartridge installed! The jostling that happens during shipping could cause toner to spill out of the cartridge and all over the inside of the printer, and a toner spill is very difficult to clean up. Remove the toner cartridge first. You can put it in a sealed airtight bag to ship, if needed.

- 130.** A. Most internal video adapters today are Peripheral Component Interconnect Express (PCIe) cards. You might still find Peripheral Component Interconnect (PCI) video cards available. Industry Standard Architecture (ISA) is a legacy expansion slot type not used today. Video Graphics Array (VGA) and Digital Visual Interface (DVI) are types of display connectors, not expansion slot types.
- 131.** A, C. If a drive is encrypted and the Trusted Platform Module (TPM) module is not found, then the drive won't start. First, ensure that TPM is enabled/on in the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI). If that's not possible or it's not there, you might need to refresh/update the TPM's firmware or the motherboard's BIOS/UEFI.
- 132.** A, B. Apple created Bonjour and AirPrint. Bonjour helps many devices find each other on a network, not just printers. While many different processes and products use TCP, TCP printing refers specifically to configuring a printer to be found using its TCP/IP address. Virtual printing doesn't print a hard copy; it prints to a file.
- 133.** D. Before you print to an inkjet printer, you must ensure that the device is calibrated. Calibration is the process by which a device is brought within functional specifications. For example, inkjet printers need their printheads aligned, so that they print evenly and don't print funny-looking letters and unevenly spaced lines. Degaussing is a process for removing static electricity that develops over some electronics and may interfere with proper color display. Drivers are pieces of software that are specific to a device and operating system and enable the operating system to communicate with the device. Each piece of hardware must have drivers installed. Rasterizing, a term more commonly used in visual communications, means converting an image to pixels.
- 134.** C. Thermal printers use a heating element. It heats up spots on special thermal paper (which is waxy and heat-sensitive) to form the image. Laser printers also use heat to bond toner to plain paper. Some inkjet printers use heat to expand bubbles of ink, forcing the ink onto paper. Many types of 3D printers use heat to melt materials that are then extruded onto the paper. While not mentioned under a specific objective, 3D printers are in the hardware and software list recommended by CompTIA.
- 135.** A. When a laser printer requests maintenance, it's because it has reached a certain page count. Apply a proper maintenance kit (one recommended by the manufacturer), and then clear the service message.
- 136.** D. The connectors are a four-pin Registered Jack-11 (RJ-11), typically used for traditional analog telephone installations, and an eight-pin RJ-45 (RJ-45) connector, used on Unshielded Twisted Pair (UTP) and Shielded Twisted Pair (STP) cables for network transmissions.
- 137.** C. The connector shown is a type of Mini Form Factor (MFF) fiber-optic connector called a Lucent Connector (LC). It's especially popular for use with Fiber Channel (FC) adapters, fast Storage Area Networks (SANs), and Gigabit Ethernet adapters. A Subscriber Connector (SC) is square and uses a push/pull design. Straight Tip (ST) connectors have a bayonet connection.

- 138.** A. The correct order for a T568B cable is white/orange, orange, white/green, blue, white/blue, green, white/brown, brown. In the T568A standard, the orange and green cables are swapped. The blue and brown wires don't change position between the two standards.
- 139.** A. Cable television installations typically use Radio Guide-6 (RG-6) but may also use Radio Guide-59 (RG-59) coaxial cable. RG-6 is slightly thicker, can run longer distances, and supports digital signals. RG-59 is suited only for analog TV signals and is used for some security cameras. Unshielded Twisted Pair (UTP) and Shielded Twisted Pair (STP) are used in Ethernet networking.
- 140.** D. Radio Guide-6 (RG-6) and Radio Guide-59 (RG-59) are types of coaxial cable. RG-6 is a better choice for the given situation because it supports digital signals and has a longer range (304 meters, or 1,000 feet). RG-59 can run up to 228 meters (750 feet). Both have impedance of 75 Ohms, and both use Bayonet Neill-Concelman (BNC) connectors or F-type connectors. RG-6 is usually better insulated and will have less signal loss. While the RG-59 might work, if it doesn't, would you want to do the job over?
- 141.** A, D. Multimode Fiber (MMF) and Unshielded Twisted Pair (UTP) Cat 6 and newer support 10 Gigabits per second (Gbps) transmission speeds. Cat 5 supports up to 100 Megabits per second (Mbps), and Cat 5e supports up to 1,000 Mbps.
- 142.** D. Shielded Twisted Pair (STP) cabling has a foil shield surrounding the wire pairs to decrease electrical interference. Some STP cables also shield individual wire pairs. Unshielded Twisted Pair (UTP) does not have the shielding. Both types use Registered Jack-45 (RJ-45) connectors, can follow the T568A and T568B wiring standards, and can be produced as plenum-rated cable that does not produce poisonous gas when burned.
- 143.** D. The connectors shown are Straight Tip (ST) connectors, which are used with fiber-optic cable. ST connectors attach with a Bayonet Neill-Concelman (BNC)-like locking mechanism.
- 144.** B. The connector shown is a Subscriber Connector (SC), also known as a square connector because of its shape. It's a fiber-optic cable connector. Straight Tip (ST) and Lucent Connector (LC) are also types of fiber-optic connectors, and MMF is multimode fiber-optic cable.
- 145.** B. Cat 5e cable can support speeds of 1 Gbps. Cat 5 has a maximum of 100 Megabits per second (Mbps). Cat 6 and newer can support 10 Gigabits per second (Gbps) and Cat 8 cabling can support speeds around 40 Gbps but only for short distances. To run at a given speed, all components of the network must support that speed, including Network Interface Cards (NICs), cable, routers, and switches.
- 146.** A. Category 5 Unshielded Twisted Pair (Cat 5 UTP) can transmit data at speeds up to 100 Megabits per second (Mbps), for a distance of 100 meters. Category 5 Enhanced (Cat 5e) is capable of 1 Gigabit per second (Gbps). Cat 6 and newer can support 10 Gbps. Single mode is a type of fiber-optic cable and is very fast.
- 147.** A. Most network cables are coated with a plastic Polyvinyl Chloride (PVC) coating, which produces toxic gas when burned. Plenum-rated cables are coated with a Teflon-like material that is not poisonous when burned.

- 148.** A. Serial Attached SCSI (SAS) is a point-to-point serial protocol that is used to send data between Small Computer System Interface (SCSI) storage systems and the device they’re attached to. SAS is a storage system designed for enterprise use. Yes, it can run at 12 Gbps or faster, supports up to 64,000 connections, and operates in full duplex. It provides a serial point-to-point connection, provides error correction, and has a wide base of enterprise installations. However, SAS is not cost effective for desktop use.
- 149.** D. On small form-factor devices like tablets, the video-out connector is the small version of High-Definition Multimedia Interface (HDMI): a mini-High-Definition Multimedia Interface (mini-HDMI). It resembles a Universal Serial Bus-C (USB-C) but is still tapered on only one side like the larger HDMI connector. To connect to an HDMI display, you would need a mini-HDMI-to-HDMI adapter.
- 150.** D. Lightning was introduced in Autumn 2012 and still works on the Apple 13, released in 2021. Recommended Standard-232 (RS-232) is a type of serial connection that dates back to 1960. A Mini-High-Definition Multimedia Interface (mini-HDMI) is a smaller version of High-Definition Multimedia Interface (HDMI) for smaller devices and requires a mini-HDMI-to-HDMI adapter to plug in a display. Micro-Universal Serial Bus (MicroUSB) is a type of USB connector that was popular for a time.
- 151.** A. Thunderbolt 3 cables work as Universal Serial Bus-Type C (USB-C) cables and are fully compatible. Thunderbolt 3 are capable of transferring at 40 Gbps, but USB 3.1 (on USB-C) can only reach 10 Gbps. USB4 can reach 40 Gbps.
- 152.** D. Universal Serial Bus-Type C (USB-C) is the only one of these that can be inserted correctly both ways, as you try the first time or flip over and try again. Micro-Universal Serial Bus (MicroUSB) resembles Universal Serial Bus-C (USB-C) but it is not “flippable”—one edge is slightly tapered. A 9-pin D-subminiature connector (DB9) and Recommended Standard-232 (RS-232) are legacy serial connectors.
- 153.** C. DB9 was the “D” format, 9-pin serial connector type that was the standard format for keyboards, mice, and other small peripherals. It was also used for communications between a Personal Computer (PC) and some managed switches. Small Computer Systems Interface (SCSI) is a type of drive connector and technology that would enable up to 15 drives on one daisy chain. The Personal System/2 (PS/2) connector, also called a mini-DIN, is newer than a DB9 connector but older than Universal Serial Bus (USB). It has six pins and was used for connecting mice (color-coded green) and keyboards (color-coded purple). Lightning connectors are used on Apple devices but have been replaced by Universal Serial Bus-C (USB-C) connectors on newer devices.
- 154.** D. Triple channel memory is achieved when three matching memory modules are installed, permitting data to be spread and memory accessed simultaneously. The effect is lower memory latency, triple the access speed (compared to a single channel), and triple the 64-bit communication path.
- 155.** D. M.2 is a Solid-State Drive (SSD) form factor measuring 22 mm wide. Its lengths vary between 30 mm, 42 mm, 60 mm, 80 mm, and 120 mm. Non-Volatile Memory Express (NVMe) is a storage protocol, not a form factor. Many M.2 drives use the Non-Volatile Memory Express (NVMe) protocol. Serial Advanced Technology Attachment (SATA) and

Peripheral Component Interface Express (PCIe) are bus interface standards found on a motherboard.

156. C. Magnetic drives were available in 1.8-, 2.5-, and 3.5-inch formats. Solid-State Drives (SSDs) come in multiple form factors, such as a “stick” called an M.2, resembling a tiny memory module, but with connectors on the end rather than the long edge, or a 2.5-inch box. SSDs also come in a 3.5-inch form factor. M.2 and Mini-Serial Advanced Technology Attachment (mSATA) are form factors for SSDs. Non-Volatile Memory Express (NVMe) is a protocol for storing data that is commonly used with M.2 drives, although M.2 drives can also use the older Advanced Host Controller Interface (AHCI).
157. B. External Serial Advanced Technology Attachment (eSATA) is a type of connector for eSATA drives. Nonvolatile Memory Express (NVMe) is a protocol and communications interface designed to connect small Solid-State Drive (SSD) storage to the Peripheral Component Interface Express (PCIe) bus of a motherboard. The Advanced Host Controller Interface (AHCI) technology preceded Nonvolatile Memory Express (NVMe) and was much slower. M.2 and Mini-Serial Advanced Technology Attachment (mSATA) are form factors for SSDs that connect directly to a motherboard. An mSATA drive looks similar to an M.2 drive, but the connectors are slightly different and mSATA only connects to the slower SATA bus using AHCI technology. M.2 drives can be either NVMe or AHCI, so checking the documentation is important.
158. B. The system Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) settings include password protection to not enable system bootup unless someone enters a password. This would prohibit the Operating System (OS) from loading upon boot.
159. A. Thermal paste is like a grease that ensures that the heat generated from the Central Processing Unit (CPU) is efficiently conducted away and into the heat sink. New coolers (fan/heat sink combinations) often come with thermal pads (paste) preinstalled. Lowering the CPU’s speed might result in less heat generated, but it would obviously also result in degraded performance.
160. B, D. x86 refers to computers that are only capable of supporting 32-bit processors and software. It’s unlikely that you’ll find one of these in the wild, but CompTIA still wants you to know what they are. The bus width on these motherboards limits the number of possible memory addresses to 4 GB, so it won’t recognize more Random Access Memory (RAM) than that. x64 denotes a 64-bit processor, which has a theoretical limit of approximately 16 Exabytes (EB) of addresses.
161. A, D. If the computer is a desktop, you could install a new sound card. Otherwise, the best option is to purchase a Universal Serial Bus-C (USB-C) to 3.5mm adapter. You wouldn’t want to buy a new professional headset because it will still likely have a 3.5mm or 6.35mm jack, and no place to plug it into the computer. As for cutting the jack off, just buy the adapter instead. Other expansion cards include but are not limited to capture cards, Network Interface Cards (NICs), video, and Universal Serial Bus (USB) ports.
162. B, C. The speed of Random Access Memory (RAM) that a computer can use is limited by the speed of the motherboard’s memory bus and the speed of RAM supported by the processor, especially now that the memory controller is part of the processor. Even if faster RAM is purchased, it will run at the slower speed of the memory bus or what the processor supports.

- 163.** D. Although the more fun answer is to purchase a new display, the question asks what would be the least expensive, and that is to purchase a High-Definition Multimedia Interface-to-Video Graphics Array (HDMI-to-VGA) adapter. There are adapters for almost everything on a computer system, so in a case like this, that would be the quickest and least expensive solution.
- 164.** B, D. The 80 Plus efficiency rating standards are widely recognized and are a great way to determine how efficient a power supply is. There are three standards that would meet the requirement to be 90 percent efficient with a 50 percent load on the power supply. Those are 80 Plus Gold, 80 Plus Platinum, and 80 Plus Titanium, with 90, 92, and 94 percent, respectively. Other ratings are simply 80 Plus, 80 Plus Bronze, and 80 Plus Silver. Their ratings with a 50 percent load are 80, 85, and 88 percent, respectively.
- 165.** B, C. A more efficient Power Supply Unit (PSU) will lose less energy as heat, so there will be less heat in the case and less wasted electricity, which results in a lower cost to run. They're also more likely to be able to run at their maximum capacity without having problems. The 80 Plus efficiency rating standards are widely recognized and are a great way to determine efficiency of a power supply.
- 166.** D. Cat 6 and newer can support 10 Gigabits per second (Gbps), but Cat 6 can only go 55 meters at 10 Gbps. To go 100 meters (328 feet), you need Cat 6a. Cat 5e's top speed is 1 Gbps, and Cat 5 is only 100 Megabits per second (Mbps).
- 167.** D. A printer share is a service that enables a user to print from a mobile device to a shared printer. The printer first needs to be installed and shared on a network. A user can then download a printer share app, or connect to a printer share service, and add the shared printer. Sometimes, but not always, the printer driver will need to be installed in the printer share service.
- 168.** B. Direct burial cable is made to go underground without any kind of conduit around it. The coating is made to be waterproof and block moisture vapor as well. A good cable will also protect against degradation from sunlight.
- 169.** A, D. Shielded Twisted Pair (STP) has at least one extra layer of shielding to protect the cable from crosstalk and interference. Some types of STP have shielding around each wire. With all the extra material, STP tends to be less flexible and more expensive than Unshielded Twisted Pair (UTP). Being shielded or unshielded doesn't affect the maximum transmission speed of a cable, and UTP is not suitable for direct burial.
- 170.** D. Only fiber-optic cables use pulses of light to transmit data. The other three listed are types of copper cable that use electrical charges to transmit data signals.
- 171.** D. Category 8 cable is the only acceptable choice. It is capable of 40 Gbps up to 30 meters (100 feet), 10 Gbps over 100 meters (328 feet), and is approved by the Institute of Electrical and Electronics Engineers (IEEE). Category 8 is a popular choice for datacenters and storage area networks (SANs). Category 6 and 6a cable are not fast enough. Category 7 is not a ratified IEEE standard, nor is it approved by the Telecommunications Industry Association/Electronic Industries Alliance (TIA/EIA), and it doesn't use a standard Random Jack-45 (RJ-45) connector.

- 172.** B. External Serial Advanced Technology Attachment (eSATA) connectors provide a way to access the Serial Advanced Technology Attachment (SATA) bus via an external connector. SATA is a type of internal drive connection and bus that replaced the older Parallel Advanced Technology Attachment (PATA). High-Definition Multimedia Interface (HDMI) is an audio/video interface. Serial Advanced Technology Attachment Express (SATAe) is a motherboard bus that supports both SATA and Peripheral Component Interconnect Express (PCIe).
- 173.** D. The orientation of paper refers to whether it is printing wider than long (i.e., landscape) or longer than wide (i.e., portrait). Sometimes, getting a document to print correctly requires changing the print job's orientation. Duplexing is printing on the front and back. Other common options or settings include collating (i.e., printing pages in sets such as 1, 2, 3, 1, 2, 3) and print quality (such as draft or high resolution).
- 174.** D. Typically in a motherboard with multichannel support, the channels will be labeled with a letter (A, B, C, D). To take advantage of the multichannel capabilities, you would install one Random Access Memory (RAM) module in each channel. Lowest numbered slots are usually filled first, so you would use slot 1 (or 0—zero—if numbering starts there) of each channel. You should, of course, always consult the motherboard documentation.
- 175.** C. Print quality settings affect how a print job looks by changing the speed and/or amount of material (in this case, ink) that is used to create the hard copy. Printers will usually enable you to change the amount of ink used to print a document. The Draft setting is lower quality and uses less ink, and often prints faster. High-resolution settings will use more ink and usually print slower, but produce better output. Often, the draft setting is sufficient for a user's needs and can save money on ink. Duplexing is printing on the front and back. Other common options or settings include orientation (i.e., portrait or landscape) and collating (i.e., printing pages in sets such as 1, 2, 3, 1, 2, 3).
- 176.** D. This is a punchdown block. It can be found in a telecommunications closet mounted on a networking rack. Network drops from work areas are terminated (punched down) in the back, and cables with Registered Jack-45 (RJ-45) connectors connect the front to a switch or router.
- 177.** C. Molex connectors have a metal sleeve inside a plastic housing. Technically, they can come in any number of connections, but those used most often in computer systems are 4-pin, 6-pin, 8-pin, and 20/24-pin. They are used to provide power to various devices and the motherboard.
- 178.** C. Audit logs can show you what's happened after the fact, but they won't help prevent a problem. Badging, personal identification numbers (PINs), and biometrics are all methods of authentication when working with secure printing. With badging, the user will need a physical badge to gain access to the printer. A PIN is something known to the user that should not be shared with other users, and biometrics are using part of your body, such as a fingerprint, to authenticate to the printer.
- 179.** The connector on the left is a Mini-Universal Serial Bus (MiniUSB), and the one on the right is a Micro-Universal Serial Bus (MicroUSB).

- 180.** D. Non-Volatile Memory Express (NVMe) storage and Solid-State Drives (SSDs) don't have platters that spin. Blu-ray optical discs spin, but their spin speed is not how they are measured. Only magnetic Hard Disk Drives (HDDs) are measured in rpms, and 15,000 would be a very fast magnetic drive.
- 181.** B. Mini-Serial Advanced Technology Attachment (mSATA) and M.2 storage are Solid-State Drives (SSDs) consisting of a very small circuit board that connects directly to the motherboard via a slot with a screw or connector to hold it in place. Solid-State Drives (SSDs) and Hard-Disk Drives (HDDs) can both be found in the 3.5-inch and 2.5-inch form factors that are used in desktop computers, and they often connect via a Serial Advanced Technology Attachment (SATA) interface. The 2.5-inch drive form factor is used in some laptops; others use M.2 storage.
- 182.** B, D. M.2 drives are keyed with B or M, or B and M keys. A and E keys are for Wi-Fi, Bluetooth, or cellular devices such as networking cards (not M.2s) found in laptops. In computers, a key is a device such as a notch—an indent on a circuit board—that ensures you can't plug the wrong type of device into something. Power connectors are keyed by shape, Random Access Memory (RAM) modules are keyed with notches in different places, Central Processing Units (CPUs) will have keys, Serial Advanced Technology Attachment (SATA) connectors have an L shape for a key, and M.2 drives are keyed as well. In an M.2, a B key is for Peripheral Component Interconnect Express (PCIe) x 2/SATA/USB and so on, and an M key is Peripheral Component Interconnect Express (PCIe) x 4/SATA.
- 183.** C. Serial Advanced Technology Attachment 3 (SATA 3) has a speed of 6 Gigabits per second (Gbps) and a data throughput of 600 Megabytes per second (MBps), but Serial Advanced Technology Attachment 3.2 (SATA 3.2)—also called Serial Advanced Technology Attachment Express (SATAe)—ties compatible drives into the Peripheral Component Interconnect Express (PCIe) bus on the motherboard, decreasing overhead and taking advantage of the PCIe bus speeds, which makes the data throughput multiple times better.
- 184.** A, C. Socket AM4 and Socket TR4 are only compatible with Advanced Micro Devices (AMD) processors. The two Land Grid Array (LGA) sockets listed are for use with Intel processors only.
- 185.** A. This socket is for an M.2 drive. Notice the holes for a screw to hold the different drive lengths. An HDD would usually connect via a SATA connection, RAM uses slots, and TPM connects to the motherboard via a socket.
- 186.** D. This is a multisocket motherboard, meaning that it has sockets for more than one processor. The other three terms describe characteristics of processors. Multicore is more than one core on a die. All new processors are multicore. Multithreaded means each core can perform more than one string of code at a time, and a coprocessor is usually a chip designed to perform a specific function to help a processor be more efficient.
- 187.** A. Servers often perform more work than any other computer on a network, especially in a virtualization environment. A server could be as simple as an ordinary desktop computer, but more often the server will have extra processing power and loads of Random Access Memory (RAM), and be rack-mounted for easy access by technicians in a corporate

environment. Error-Correcting Code (ECC) RAM is most often used only in servers, because it's too expensive for the desktop market.

188. B, C. Intel Xeon and Advanced Micro Devices (AMD) EPYC processors are designed to be high-end server processors. The Atom processor is a small form factor processor, and the Ryzen 3 is a desktop processor.
189. D. Motherboards found in smaller devices, such as laptops and cellphones, tend to be very proprietary, meaning that if you can replace them, you must replace them with a board made by the same manufacturer for that precise device.
190. A, C. ARM Holdings, LTD., is the company that has developed the various iterations of ARM processors. ARM is famous for developing Reduced Instruction Set Computing (RISC), and their intellectual property can be found in everything from embedded systems and smartphones, all the way up to servers. An ARM processor is considered to be a System-on-a-Chip (SoC) rather than a Central Processing Unit (CPU), because processors are built with various features around the ARM processor.
191. A. If you disable the Universal Serial Bus (USB) ports, users won't be able to attach a USB drive to copy files. Removing USB from the boot options will keep them from booting to it, but it won't prohibit someone from using a USB drive. You can also purchase USB drive locks, which are little plugs for the USB ports. Just don't lose your key!
192. B. The connectors shown are for data connections to Serial Advanced Technology Attachment (SATA) drives.
193. C. A Storage Area Network (SAN) is a separate network that has only storage devices on it, but you still need a way to connect to that storage. Connecting can be done through a Host Bus Adapter (HBA) connected through the Peripheral Component Interconnect Express (PCIe) bus on a network server's motherboard. Because Fibre Channel (FC) networks are so fast, they are often used for SANs.
194. D. These pins are called headers. The ones mentioned connect the motherboard to the case front, where you will find Universal Serial Bus (USB) ports, power buttons, Hard Disk Drive (HDD) status lights, and reset switches.
195. A. Laser printers need toner cartridges and will often let you know when it's time to replace them. Inkjet printers use ink cartridges that need replacing when the ink level is low or empty. Impact printers need ink ribbons, and thermal printers need special thermal paper.
196. C. Redundant Array of Independent Disks-5 (RAID-5) and Redundant Array of Independent Disks-6 (RAID-6) both use striping with parity, but RAID-6 has two parity bits per bit of information, so it can lose two drives and still rebuild all its data. A RAID-5 array can only lose one drive and still rebuild its data. This extra security requires a minimum of one more drive than RAID-5.
197. C. A webcam would be very inefficient and a difficult solution at best, and FireWire would not be fast enough for today's systems. While screen-capture software might work, the best solution is to install a capture card either as a discrete (external) unit or in a Peripheral

Component Interconnect Express (PCIe) slot on a motherboard. The capture card can take some of the workload off the processor, making the video less likely to skip, lag, or freeze.

- 198.** A. Adding case fans can draw excess heat out of a case and bring cooler air into the case. Most processors won't shut down until they reach 70 to 100° Celsius (158–212° Fahrenheit), so if a person is working in that room, the ambient temperature won't be that high (although the processor gets very hot). Heat-monitoring software lets you see what's going on but won't help cool the case. Removing the chassis cover subjects the computer to debris and dust that can cause other problems, and a refrigerator is likely to cause condensation, which can short out electrical systems. Adding case fans is the best choice given. Using a liquid CPU-cooling system or adding a bigger heat sink to the processor might also help.
- 199.** B, C. Some power supplies will have a 20-pin+4-pin connector designed to connect to a 24-pin P1 motherboard connector. An ATX12V Power Supply Unit (PSU) is the perfect solution. A 20-pin P1 connector plus a P4 connector is the right number of pins, but the P4 connector is not compatible with the main motherboard power. ATX12VO is a 12-volt only connector that has only ten pins and would not be compatible with this motherboard, unless it had other connections.
- 200.** D. A modular power supply enables you to use only the connectors you need by plugging and unplugging compatible cables into the Power Supply Unit (PSU).
- 201.** B. If you have a system that can't have any downtime, you need to have redundant everything. You will only need a Host Bus Adapter (HBA) if you're connecting external devices. A display doesn't have anything to do with keeping the system running. A dual rail power supply can still fail. For this situation, you would want redundant power supplies that are hot-swappable, and a uninterruptable power supply (UPS) rated high enough for your server to keep running.
- 202.** B, C. Whenever you get new equipment for the first time, the best choice is to check for manufacturer's directions. Lacking those, flipping a printer over and pulling the box off the printer may cause damage before you've even set it up! The best course of action is to slide the contents gently out of the box. Using box cutters could damage the printer or its cables.
- 203.** D. Most modern network-enabled Multifunction Devices (MFDs) will have Bluetooth, Wi-Fi, and Ethernet connections. They are not likely to have Radio Frequency Identification (RFID) as a connection type, although they may have an RFID reader for secure print job authentication.
- 204.** C. The only type of printer that prints on all copies of multipart forms is an impact printer, usually dot-matrix. It's the only type of printer listed that makes a mark by physically striking the paper. These multipart forms are sometimes called No Carbon Required (NCR) or carbonless multipart forms. The back of each page, except the last one, will have a coating of microencapsulated ink or dye that produces an image when it is pressed or written on.
- 205.** D. If you have a printer with multiple trays, normally when you print there will be a setting that enables you to choose a tray from which to print. Letterhead can be in one tray and

plain paper in another. Orientation refers to whether the paper printed in a taller or wider direction. Duplexing refers to printing on both sides, and quality settings enable the user choose either faster or better printing.

206. A, D. Both laser and inkjet printers occasionally need to be calibrated. Exactly when depends on the printer. For inkjet printers, it's often after installing a new ink cartridge, and for laser printers, it's when you need to adjust the colors.
207. A. Secure print jobs are retrieved at the device, based on user authentication, by using a password, a security badge, or biometrics, depending on the printer. Auditing won't prevent attacks, but it will show you when the printer is being accessed and by whom, much like the Windows Event Viewer. Other security features might include removable hard drives with the printer, overwriting documents following Department of Defense (DoD) requirements, and data encryption.
208. A. A punchdown block can be found in a telecommunications closet mounted on a networking rack. Its main purpose is network connectivity, but it also provides a neat way to keep cables organized. Network drops from work areas are terminated (punched down) in the back, and cables with Registered Jack-45 (RJ-45) connectors connect the front to a switch or router. Switches and routers are network connectivity devices. A terminator is another name for a terminating resistor, which is sometimes needed at the end of a length of coaxial cable to avoid a signal echo.
209. A, B. Occasionally, the paper feed assembly on a thermal printer will become clogged with dust or debris. To clean it, use either pressurized air or a clean, lint-free cloth. Using water or a vacuum cleaner isn't recommended. Use isopropyl alcohol if moisture is needed, and only use a vacuum cleaner that is specifically for electronics, because other vacuum cleaners can build up static that will damage sensitive electronic components.
210. A, B, C. Nonvolatile Memory Express (NVMe), Serial Advanced Technology Attachment (SATA), and Peripheral Component Interconnect Express (PCIe) are all communication methods used by Solid-State Drives (SSDs) to connect to the motherboard for transferring data between the drive and Central Processing Unit (CPU). Integrated Drive Electronics (IDE) is a legacy connection technology that was used with the original Advanced Technology Attachment (ATA) drives and Parallel Advanced Technology Attachment (PATA) drives.
211. C. There are six major versions of Peripheral Component Interconnect Express (PCIe) currently specified: 1.x, 2.x, 3.0, 4.0, 5.0 and 6.x. For the six versions, a single bidirectional lane operates at a data rate of 250 Megabytes per second (MBps), 500 MBps, approximately 1 Gigabyte per second (GBps), roughly 2 GBps, nearly 4 GBps, and 8 GBps, respectively. Each PCIe slot can have up to 16 lanes, with the number of lanes being indicated by x1, x4, x8, x16. (The "x" is pronounced as *by*.) Therefore, a PCIe 5.0 x16 slot can support up to 64 GBps of bandwidth ($16 \times 4 = 64$), and a PCIe 6.0 \times 16 boasts a whopping 128 GBps.
212. C, D. Changing the paper on a thermal printer is simple. Lift the cover, remove the existing roll, and replace it with a new roll. Press the paper feed button. However, thermal printers are very specific in the special thermal paper that they use, so be sure you have the correct

paper. There is a right side and wrong side to the paper, so you need to ensure the paper has the correct side facing the printhead, which uses heat from a heating element to make the image.

- 213.** C. Water and electronics simply don't mix. Cleaning cards and papers will clean both the heating element (thermal printhead) and the paper path. A cleaning pen will contain isopropyl alcohol and can clean the printhead, or you can use an isopropyl alcohol lint-free wipe.
- 214.** C. Laser printers need toner cartridges, impact printers need ink ribbons, and inkjet printers use ink cartridges. Thermal printers heat up paper to produce images.
- 215.** A, B. Canned compressed air can be used to gently blow debris out of a laser printer. Some printers may also use a special sticky paper to pull out debris. Water and electronics don't mix. Vacuum cleaners build up static that can damage electronics, so unless they are specifically designed for a computer, vacuum cleaners should not be used.
- 216.** B, C. Inkjet printers sometimes need the paper feeder rollers cleaned with mild soap and water. They also occasionally need the printheads cleaned. Each printer will have a software option to clean them, or you can use a swab with isopropyl alcohol on it if the software routine doesn't solve the problem. Toner cartridges are found in laser printers, and thermal units are found in thermal printers.
- 217.** D. Inkjet printers use ink cartridges that need replacing when the ink level is low or empty. Laser printers need toner cartridges, impact printers need ink ribbons, and thermal printers use heat to produce images on special thermal paper.
- 218.** C. If you have a toner spill, don't use compressed air to blow it away. You should use a specialized toner vacuum to pick it up. Also, never use a damp cloth to try to clean up a toner spill. If a cloth is needed, use a dry one.

Chapter 4: Virtualization and Cloud Computing

1. B. Companies can purchase virtualization software to set up individual clouds within their own network. That type of setup is referred to as a private cloud. Running a private cloud pretty much eliminates many of the features that companies want from the cloud, such as rapid scalability and not needing to purchase and manage computer assets. The big advantage, though, is that it enables the company to control its own security within the cloud. A hybrid model would be the scenario providing benefits of both public and private clouds. The community model is something akin to a shared private cloud, with responsibilities and benefits shared collaboratively.
2. B. Let's say that your company needs extra network capacity, including processing power, storage, and networking services (such as firewalls), but doesn't have the money to buy more

network hardware. Instead, you can purchase Infrastructure as a Service (IaaS), which is a lot like paying for utilities—you pay for what you use. Of the four, IaaS requires the most network management expertise from the client side. In an IaaS setup, the client provides and manages the software. PaaS is Platform as a Service, and SaaS is Software as a Service. FWaaS is sometimes used and means Firewall as a Service but is not widely recognized or on the CompTIA 220-1201 objectives.

3. A. The traditional type of cloud that usually comes to mind is a public cloud, like the ones operated by third-party companies, such as Microsoft, Google, HP, Apple, Netflix, and Amazon, with its Amazon Web Services (AWS). These clouds offer the best in scalability, reliability, flexibility, geographical independence, and cost effectiveness. Whatever the client wants, the client gets. For example, if the client needs more resources, it simply scales up and uses more.
4. C. Platform as a Service (PaaS) adds a layer to Infrastructure as a Service (IaaS) that includes software development tools such as runtime environments. Because of this, it can be helpful to software developers; the vendor manages the various hardware platforms. This frees up the software developers to focus on building their application and scaling it. The best PaaS solutions enable the client to export its developed programs and run them in an environment other than where they were developed. SaaS is Software as a Service. NaaS is Networking as a Service but is not included in the CompTIA A+ exam.
5. D. The highest of the three levels of cloud service is Software as a Service (SaaS), which handles the task of managing software and its deployment. This is the model used by Google Docs, Microsoft Office 365, and even storage solutions such as Dropbox. Platform as a Service (PaaS) provides software development tools in addition to Infrastructure as a Service (IaaS), which provides hardware and connectivity. Firewall as a Service (FWaaS) is not widely used, nor is it on the CompTIA A+ Exam.
6. B. In most cases, clients can get more resources instantly (or at least quickly or on-demand), which is called elasticity. For the client, this is a great feature because they can scale up without needing to purchase, install, and configure new hardware. Ubiquitous access refers to clients being able to access the cloud ubiquitously, or from anywhere, anytime. Resource pooling, particularly when a cloud provider deals with multiple tenants, refers to the provider effectively saving money by not duplicating available capacity. Finally, when the service provided to those tenants is monitored and paid for according to their use, it's metered egress or metered ingress, depending on whether information is traveling out of or into the cloud service.
7. B. A Type 2 hypervisor sits on top of an existing Operating System (OS), called the host OS. This is most commonly used in desktop virtualization, where multiple OSs are managed on the client machine as opposed to on a server. The hypervisor is also called a Virtual Machine Manager (VMM).
8. D. If presented with a scenario for installing multiple Operating Systems (OSs) on a computer running desktop virtualization, just add the minimum hardware requirements (or recommendations) for Random Access Memory (RAM) and storage for each OS together. Treat it as if each OS needs its own minimum (which it does), and they are just sharing the

available physical hardware (which they are). Also, each OS needs its own Virtual Network Interface Card (vNIC) to participate on the network and needs its security to be individually configured based on OS requirements and user needs. Treat it as though it is a separate computer. In reality, you're never going to go with just the absolute minimum because, although the OS will run, it won't run well, and you'll want extra storage based on the software that each OS will be running.

9. C. If each client has been promised 32 GB Random Access Memory (RAM), then the server must have enough RAM to give each client their allotment. In this case, this means 128 GB. The assumption is that the hypervisor will require no RAM on its own. In reality, it probably will require a little, but not much. Resource pooling, when a cloud provider deals with multiple tenants, refers to the provider having additional capacity available but saving money by sharing that availability.
10. C. The major feature of virtualization is breaking down that one-to-one hardware and software barrier. The virtualized version of a computer is appropriately called a Virtual Machine (VM). Thanks to VMs, it is becoming far less common to need dual or multi-boot machines. VMs enable computers to do things like run five instances of an Operating System (OS) or one instance each of several different OSs.
11. C. Metered utilization is synonymous with pay-as-you-use. The resources are available, but payment is calculated according to your actual usage. This is a common model for enterprise environments, especially during the early “migration of services” period. On-demand means services can be added as needed, on-the-fly. A resource pool refers to the resources owned by a cloud provider, such as Random Access Memory (RAM) and storage capacity that are available to the cloud provider's clients. Shared resources refer to the idea that a cloud provider's physical resources may be shared among many different companies.
12. B. The creation of Virtual Machines (VMs) would alleviate the issue of space, power, and most of the hardware costs associated with maintaining bare-metal systems. VMs can provide many of the same services at a fraction of the costs. Control and management of the machines would not change.
13. B. Shared resources describe the cloud infrastructure shared among clients of a cloud provider. For example, a cloud provider may have one physical server that is shared by multiple companies. Shared resources are also those resources made available to multiple employees or users on a local network. Measured resources are synonymous with pay-as-you-go services, where the company only pays for the resources they are using. A private cloud negates many of the advantages of a public cloud such as elasticity, but control remains with the cloud's owner. A community cloud is shared by a small group of users with similar needs, who pool their resources for a more cost-effective solution.
14. A, C. Many companies go to cloud computing and the inevitable shared resources for the advantages of lowering their hardware costs and for the flexibility of adding on-the-fly resources. There are, however, some concerns with cloud computing, such as who has access to the data, the potential for another cloud computing client to introduce malware, and potentially poor application performance if another application is monopolizing the shared resources. Not included in the answer choices is another potential problem—Internet connection downtime.

15. B. Private cloud resources would be under local network control and local security management, perhaps provided to different units within the same organization, while network and security concerns on public-shared resources are controlled and secured by an external cloud provider. The exception would be a company establishing its own security in an Infrastructure as a Service (IaaS) configuration, but even then, some of the security requirements (such as physical security) would fall to the public provider.
16. C. For a company needing additional cloud resources on demand, they should request metered utilization, in which a cloud service will bill much like a utility would, as resources are used. Infrastructure as a Service (IaaS) refers to hardware and networking in the cloud, while resource pooling is used in cloud computing and means that resources are pooled and delivered as needed to many clients. Rapid metering is not an Information Technology (IT) term.
17. C. This configuration would need 2 GB for Windows 10 (the host) plus 3 GB for the client Operating System (OS) and running software at a minimum. In reality, more Random Access Memory (RAM) would be better.
18. D. Synchronization applications work to keep all files consistent, updating from multiple locations as needed. Emulation is when one thing acts like (i.e., emulates) something else. File security is ubiquitous, needed everywhere, but it does not address the need to keep the files consistent whether the users are traveling or on-premises. Virtualization is using a single hardware set as if it were multiple machines to run multiple Operating System (OS) instances or multiple OSs.
19. C. Virtual Desktop Infrastructure (VDI) can be managed/hosted on either a local server (i.e., local cloud) or over the Internet by a third party. When in the cloud and managed by a third party, it is sometimes called Desktop as a Service (DaaS). The advantages of VDI are savings in hardware costs and configuration time. Data sensitivity and security may preclude using VDI in the cloud. Desktop on Demand (DOD) isn't part of the CompTIA A+ terms, Binary Application Desktop (BAD) isn't a real term, and Debt-to-Income ratio (DTI) is an accounting term.
20. B. A Virtual Desktop Infrastructure (VDI) moves the desktop icons, files, and folders to a server instead of the desktop originating from the local machine. When the desktop experience is hosted on a centralized server location, the icons, files, and folders are the same. With this user working from various offices, the best solution for them is VDI in the cloud.
21. C. In a virtual environment, a virtual Network Interface Card (vNIC) connects the guest machine to its local virtual network and any external networks.
22. A. Application virtualization delivers software using a virtual structure, which enables an organization to make a needed application available across multiple devices, without having to install it on each of these devices. This might apply to any platform the organization needs, whether a desktop computer or a mobile device. Wrapping is a programming term meaning one section of code is encapsulated (wrapped) in another. The other two options are not real IT terms.

- 23.** A. Before purchasing hardware of a host system to support a number of virtual systems, it is wise to consider the resource requirements of those virtual systems. The more virtual systems a single hardware system supports, the more resources are needed.
- 24.** D. When wanting to maintain confidentiality, integrity, and availability, security requirements and regulations must first be defined. A company can then consider if an Internet cloud solution or virtualization would be appropriate.
- 25.** A. Network requirements dictate the need for and configuration of Virtual Local Area Networks (VLANs). A VLAN is a network design feature that isolates network traffic by the switch port. Just like a physical machine, a Virtual Machine (VM) must be compatible with the network on which it is intended to run.
- 26.** C. Your best option is to deploy it using a container. Containers are complete software packages, often stored in an image, which include all the code and software dependencies, such as programming libraries and runtime environments, that are needed to run the application. They can make deploying a program for multiple Operating Systems (OSs) much simpler. However, a container made by someone with ill intent can be detrimental to your computer systems and network. Writing three separate programs would be time-consuming and make updating the program more difficult. Running in a Virtual Machine (VM) or on a cloud server won't help because you would still need a separate Mac computer to run macOS in a VM.
- 27.** D. While Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) are widely considered to be the major categories of cloud computing, Anything as a Service (XaaS) is not.
- 28.** C. A private cloud pools a company's on-premises resources for use within the company; there is no Internet component. A public cloud is owned by a third-party provider that delivers resources, including storage, platforms, and software, via the Internet. A hybrid cloud combines the two other forms, where some resources are on-premises and others are available over the Internet. The on-premises resources may provide more control over data, while the Internet resources offer on-demand scalability. Different data types could be kept in different locations, depending on the company's needs.
- 29.** C. Virtual Desktop Infrastructure (VDI) in the cloud, which is sometimes called Desktop as a Service (DaaS), enables a network admin to easily and almost immediately configure desktops for new users, even if they are in a remote location halfway around the world. Infrastructure as a Service (IaaS) provides the physical computing, network, memory, and storage resources enabling the cloud provider's customers to set up virtual servers and networks in the cloud. IaaS can also provide server software and databases, although not all providers do. Think of IaaS as renting the entire network structure. The cloud provider is responsible for the resource provisioning and maintenance needed for the organization's infrastructure. Software as a Service (SaaS) provides applications but not necessarily desktops. VDI on-premises offers similar advantages, but the scalability is limited by local servers.
- 30.** A. A community cloud is the solution for such situations, as it enables a limited group of people or companies to share cloud resources. The group can then benefit from economies of

scale, while keeping their resources separate from other organizations. They could even share in joint projects. Their servers could be located in a datacenter or stored locally by one of the members. The group will have more control than they would over a public cloud and would share the maintenance costs of their cloud. A community cloud is similar to a private cloud but consists of multiple members.

31. B. While all of the items listed are advantages of using cloud-computing, high availability means that data and applications are available around the clock, regardless of the users' location. Shared resources often lead to lower costs and rapid elasticity. File synchronization means that users' files are updated with the newest changes whether they're working at home or in the office.
32. B. Configuring a Virtual Machine (VM) using Virtual Machine Manager (VMM) software whose features include cross-platform virtualization will enable you to configure multiple desktop platforms on one physical machine regardless of the host Operating System (OS). Sharing files isn't really the question being addressed; using different OSs is.

Dual boot systems may not work well together, depending on the OSs being used.

33. C. In general terms, a sandbox is an isolated test environment separate from your network where you can "play" with applications and settings, without worrying about negative effects on your network or computers. Sandbox is also a feature that can be enabled in Windows 10 Pro and higher editions. When launched, it opens a separate instance of Windows running as a Virtual Machine (VM) on your Windows desktop. A file can be opened in that VM to help protect your computer against malicious code. When the sandbox is closed, anything running in it is discarded. Shared files is exactly what it sounds like—when files are shared between people. System Information is a utility with lots of information on the computer's hardware and operating system. The File Manager is a useful utility that, if you're not familiar with it, you need to spend some time on.
34. D. Your friend will need to run both Operating Systems (OSs) to test the software. A Windows 11 sandbox will protect their host OS from any problems the application might cause, but it won't let them test the application on a Linux OS. Dual boot systems are clunky at best and require rebooting between OSs. Running two computers would cost more in terms of utilities and hardware, not to mention precious office space. The best solution for your friend is to install Virtual Machines (VMs) on their office PC. This would enable them to test in either Linux or Windows, without shutting the PC down in between, saving time while making corrections. It would also protect their machine against unintentionally bad code that could otherwise cause damage.
35. B. Developing software for a specific manufacturing function is often costly and time-consuming, so a manufacturer might want to keep that equipment and software running as long as possible. If the equipment is doing the job they need it to do, they will be disinclined to upgrade to something new. Shutting the equipment down when it fails may spell disaster for the company. The best option here is to prepare a Virtual Machine (VM) to run the legacy Operating System (OS) and software, then test the software. Finally, during a planned shutdown, transfer the control of the manufacturing machine over to the new PC with the VM, and, of course, make sure you have an image to rapidly deploy if the new machine or VM fails in the future.

- 36.** A. The advantage of having applications each running in their own Virtual Machine (VM) is that if one application or VM's security is penetrated, the others may still be secure. Scalability would still be limited to the server's resources. The hardware maintenance would be the same, but the security maintenance might be more. However, being able to set up different access for each machine may simplify security configuration. The cost would be more, because a separate license would be needed for each Operating System (OS) running on its own VM.
- 37.** A, C. Regardless of whether a server is physical or virtual, it will need the same security configuration, and a license must exist for every virtual server just as it must for every physical server. While Random Access Memory (RAM) and storage requirements would be the same, one of the advantages of using a Virtual Machine (VM) is being able to put more than one server on a single piece of computer hardware, so overall hardware cost would be less and maintaining that hardware would be less expensive. Virtual servers are much more portable than physical servers, meaning they can easily be moved from one piece of hardware to another.
- 38.** A. While each model has its advantages, if security is the greatest concern, then a private cloud is the best solution. Public, hybrid, and community clouds all involve other entities that may introduce additional potential security problems.
- 39.** D. A Virtual Desktop Infrastructure (VDI) moves the desktop icons, files, and folders to a server, instead of the desktop originating from the local machine. When the desktop experience is hosted on a centralized server location, the icons, files, and folders are the same, regardless of where a user logs in. VDI on-premises hosts the desktop on a local server, whereas VDI in the cloud hosts the desktop on a remote server.
- 40.** C. Cloud computing has many advantages, including reduced capital expenditures, which can help growing companies. It relieves IT personnel of infrastructure management, so they can focus more on other objectives such as customer support. It also boasts rapid elasticity, which means a company can grow its IT infrastructure on a moment's notice as needed. Adding new employees can be easier with cloud computing. There are a few downsides, though. Some are that someone else has control of your data, fees can be surprising when usage is more than expected, and moving from one Infrastructure as a Service (IaaS) provider to another might be difficult. There are more advantages and disadvantages than can reasonably be listed here.
- 41.** A, B. Bare-metal hypervisor is another name for a Type 1 hypervisor and are typically used in enterprise environments. A Type 1 hypervisor has Virtual Machine (VM) software installed directly on the computer, without needing an Operating System (OS) to run it. Type 2 hypervisors need an OS on which to install the VM software. Upgrading the computer hardware would be a great idea, but not if you're in a hurry to get it set up.
- 42.** D. In a situation where security is essential and the customer doesn't want to share hardware/resources with anyone else, they could deploy a cloud solution with dedicated resources. Dedicated resources in the cloud have the benefits of both a private network (security and performance) and the cloud (always accessible).
- 43.** A. Metered egress means that you're being billed for the amount of data that is leaving your cloud server. Ingress refers to something being uploaded onto your server. Shared resources

and dedicated resources describe whether the cloud hardware is being used by others or only your company.

44. A, C. Multitenancy in cloud computing is somewhat like an apartment building. There may be hundreds of people there, but their belongings are kept separate from everyone else's, and they all are able to enjoy the same building amenities. In the case of cloud computing, multitenancy (i.e., sharing resources) lets each company use what they need at the time and provides more efficient management of the hardware and updates, which helps to keep costs down while keeping their data separate. A sandbox is a test environment typically established by creating one or more virtual machines to mimic the actual environment. In a sandbox, technicians are able to make changes and ensure that they will work before making changes to a live computing environment. Dedicated resources means that you're not sharing those resources with any other entity.
45. B. A sandbox is a test environment that can be a feature of an Operating System (OS), but often Virtual Machines (VMs) are used to create sandboxes. Multitenancy, also known as sharing resources, lets each company use what they need from a cloud environment at any given time. Multitenancy is a key concept in cloud computing. Dedicated resources means that you're not sharing system resources like Random Access Memory (RAM), processing power, or storage space with any other entity.

Chapter 5: Hardware and Network Troubleshooting

1. A, D. A Blue Screen of Death (BSOD) is a warning screen indicating a stop error or kernel panic. Linux, Windows, and macOS each have their own (proprietary crash screen) version of BSOD. Regardless of the Operating System (OS), sometimes the solution is as simple as rebooting the system and the problem will resolve. If it doesn't, then the solution depends on any error messages received, and what you find in the troubleshooting process. The Linux BSOD may include a QR code for more information, the Linux penguin logo, and can be various colors depending on the distribution.
2. B. Laptop processors are usually permanently attached to the laptop's motherboard. Furthermore, motherboards are normally proprietary, meaning one from a certain model will not fit into a different case. Therefore, the best course of action is likely a laptop upgrade, although, if they have the ability to add more Random Access Memory (RAM), that might help with speed issues.
3. B, C. Tablets and other computing devices that use touchscreens sometimes have problems with calibration. Symptoms include identifying the wrong spot when touched, "ghost" touches, or no response to touches. Sometimes, cleaning the screen with a microfiber cloth will solve the problem, but if it doesn't, the next step is to look for a calibration option in the device's software. Replacing the digitizer is neither quick nor free, and reinstalling the operating system would be a bit drastic and may not resolve the problem.

4. D. Many laptops use shared video memory, meaning that the system's Random Access Memory (RAM) is divided up for use between the processor and the video card. On these system types, the amount of RAM available for video is configured in the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI).
5. D. Because of the much smaller space available for keys, some laptop keys are consolidated into special multifunction keys. These keys are accessed through the standard keys by using a special function (Fn) key. Nearly every laptop has a video connector on the back or the side to plug in an external display or a projector. You will need to use the video toggle key to get this external port to work. Usually there are three or four states: laptop only, external output only, duplicate, or extend the desktop.
6. B, C. To combat heat, you can either slow the processor down (i.e., run it at a lower speed) or give it less juice (i.e., run it at a lower voltage). Most of the time, this is configured in the system Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI). For example, many Intel processors use SpeedStep technology to slow the processor (i.e., clock speed) down to produce less heat, and they may also have adaptive thermal management. All computer cases are built with optimum air flow in mind, and in addition to not helping the situation, leaving the case open would subject the motherboard and components to dust and dirt that could potentially cause other problems. All computers run on Direct Current (DC) and will have either the transformer (which converts Alternating Current [AC] to DC) in a block on the power cord (as in the case of laptops) or in the power supply, as in most desktop computers.
7. C. If the integrated video card fails, you're looking at a motherboard replacement. Some laptops do have a replaceable video card or may work with an external Graphics Processing Unit (GPU), but this is not common. If a replaceable video card fails or if you choose to upgrade it, the procedure will probably resemble replacing system memory.
8. D. If you are having problems with flickering screens or dimness, it's more likely that the inverter is the problem and not the backlight itself. The inverter converts Direct Current (DC) to Alternating Current (AC) for the display. Modern displays use Light-Emitting Diodes (LEDs), which are DC components, to produce light, so they likely won't have an inverter.
9. C. Thicker paper can cause paper jams, especially in printers with curved paper paths. Paper that is too thin may not get picked up by the printer rollers.
10. B. Most digital displays have a native resolution, which is based on the number of physical pixels the device has. The resolution can be changed, but doing so may result in distorted images, poor image quality, or the image may not display at all.
11. A. The refresh rate defines the vertical scan frequency of a display and determines how many times, in one second, an image can be redrawn on the screen. Many Liquid Crystal Displays (LCDs) have a fixed refresh rate. If the refresh rate is set faster than the video card or software can run, then problems such as a black screen every few seconds may result. The solution is to lower the refresh rate or invest in new hardware. Frame rate is the number of frames that are displayed in a second, expressed as frames per second (FPS). Native resolution is the number of pixels across and down (like 1920×1080) that a monitor is comprised of. Although the monitor will function at other resolutions, the native resolution

often looks best. Aspect ratio expresses the relationship between pixel width and height. For example, the 1920×1080 pixel monitor mentioned in the question has an aspect ratio of 16:9, that is, for each 16 pixels across, there are 9 pixels vertically.

12. B. Tearing in a display looks as it sounds—the image will have an area where parts of the image don't appear to line up, as if a picture were torn. Often when tearing happens, a video game sends frames to the display faster than the display can render them. Setting the refresh rate of the display higher, if it supports this, may solve the problem. If not, consider replacing the display and ensuring that the graphics card and monitor have compatible frame/refresh rates.
13. D. The Power-On Self-Test (POST) is a series of system checks performed by the system Basic Input/Output System (BIOS) when the computer is turned on. Checking the system memory, video, and hard drive availability is part of the POST routine. If POST fails before the video is checked, the system may give errors in the form of beep codes. The BIOS holds information that includes instructions for the POST routine, UEFI is the newer version of BIOS, and RAMCheck is the name of a third-party utility, not part of the computer's boot routine.
14. A, D. Sometimes, it's necessary to charge a battery to 100 percent or to discharge it completely. Overcharging a battery or using a charger that isn't approved for the device may have disastrous results, such as a damaged battery or one that overheats to the point of explosion. Lithium-Ion batteries are particularly prone to catching on fire, and they're used in most mobile devices.
15. D. If the projector worked fine in a different room, then it's something about the new conference room. If the room is brighter, you'll need to turn up the brightness of the projector or turn off lights and close shades. If these don't solve the issue, then you might need a new projector. Lumens is the measure of brightness for a projector. For a well-lit business setting, you probably want a projector rated at 5,000–6,000 lumens. You can't use the projector to change the frame rate, native resolution, or aspect ratio.
16. C. Likely the friend forgot to connect the internal Universal Serial Bus (USB) connector on the motherboard to the case's USB ports.
17. B. The spinning pinwheel, also known as the “Spinning Wheel of Death,” can happen for several reasons. Sometimes, it's a frozen app, but in this case it's happening when different apps are running, so hardware would be suspect. Of the hardware listed, the Random Access Memory (RAM), is the most likely problem. A faulty hard drive could also cause the problem.
18. B. It's rare that a computer will catch on fire, but sometimes frayed wires and excessive dust can result in short circuits, which can cause overheating. Burning electronics have an unmistakable odor. If you ever smell electronics burning, even if you don't see smoke or flame, immediately unplug the device.
19. B, D. Unexpected shutdowns are difficult to troubleshoot, as are all intermittent issues. The first thing to check is to ensure that all socketed chips are seated properly; in fact, reseating them is a good option. If that does not resolve the issue, test the Random Access Memory (RAM) or replace it if possible.

- 20.** C. Most likely, the processor is overheating. Check that the thermal paste/pad between the processor and heat sink have not dried out. If they are fine, then consider adding better or additional fans in the case. This is also a good time to clean any dust out of the case.
- 21.** A. A Blue Screen of Death (BSOD) is a warning screen on a Windows system. It may be blue and have a sad smiley face or an error message on it. Sometimes, the solution is as simple as rebooting the system and the problem will resolve. If it doesn't, then the solution depends on any error messages received and what you find in the troubleshooting process. The macOS equivalent is a spinning pinwheel. As of 2023, Linux also has a BSOD, which may include a QR code for more information and/or the Linux penguin logo. The BSOD in a Linux system isn't always blue. It can be various colors depending on the Linux distribution being used.
- 22.** D. Every computer has a diagnostic program built into its Basic Input/Output System (BIOS) called the Power-On Self-Test (POST). When you turn on the computer, it executes this set of diagnostics. If the computer doesn't perform the POST as it should, one way to determine the source of a problem is to listen for a beep code. This is a series of beeps from the computer's speaker. A successful POST generally produces a single beep. Beep codes vary depending on the manufacturer, so it's always a good idea to consult the motherboard's documentation.
- 23.** D. Failure to boot at all likely means the drive is dead. But first, perform your due diligence and reseat the connections and determine whether the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) recognizes the drive before replacing it. BIOS/UEFI should autodetect the hard drive. If that autodetection fails, it's bad news for the hard drive, unless there's a cable, connection, or jumper issue. If the internal hard drive is indeed dead, you might be able to get by temporarily by plugging in an external drive.
- 24.** B. The system's Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) contains the boot sequence for a system. Most systems probably boot to the first hard drive by default, but they can also be configured to boot from a secondary hard drive, a Universal Serial Bus (USB) drive, an optical drive, or the network. This setting is configured in the BIOS/UEFI. The BIOS/UEFI will attempt to boot from devices based on the priority order that is set in the BIOS/UEFI until it either finds a bootable device or determines that no available device is bootable. A device won't be available if it isn't connected to the system properly, or if that type of device is disabled in the BIOS/UEFI.
- 25.** D. If a laptop does not display any video, it could be the screen or the integrated video. To test it, plug in an external display (that you know works), and use the function keys on the laptop to switch to external video output. If that doesn't work, it's likely that the video card is defective.
- 26.** A. Try cleaning the fan before replacing any parts. The power supply fan has a protective grid covering it, and you won't really be able to get to it with a computer vacuum or a damp cloth. Using compressed air to blow it out is your best option. Be sure to insert something nonconductive, like a plastic knife, between the blades of the fan to keep the fan from spinning to protect the fan's motor. You must, of course, do this with the computer off.
- 27.** C. Most laptops have a battery that can be replaced after removing a panel or the keyboard. Legacy laptops may have an external battery. If the battery won't charge while the laptop is

plugged in, try removing or disconnecting the battery and reinserting/reconnecting it. If it still won't charge, you might try replacing the battery.

28. B, C. When repairing laptops, you should always document and label screw and cable locations, organize parts, refer to manufacturer instructions, and use appropriate hand tools. Power screwdrivers can be used, but if you choose to use them, do so carefully to avoid damaging the laptop. In some cases, but not all, you might need to remove the keyboard to remove the motherboard. Refer to the manufacturer's instructions.
29. D. This computer gives you a beep code during the Power-On Self-Test (POST) routine. You may be able to determine the problem by reading the vendor documentation, but another way to troubleshoot this issue is to use a POST card. A POST card is a circuit board that fits into an expansion slot in the motherboard or connects via a USB port and reports numeric codes as the boot process progresses. Each of these codes corresponds to a particular component being checked. If the POST card stops at a certain number, you can look up that number in the POST card's manual to determine the problem. A power supply tester and multimeter are used to troubleshoot problems with power, and a loopback plug is used to troubleshoot problems with the network card.
30. A. This computer hasn't reached the video part of the Power-On Self-Test (POST) yet, so the only way it has to communicate error codes with the user is through a series of beeps. The pattern of beeps has a specific meaning. Often, continuous short beeps indicate a Random Access Memory (RAM) problem, while one short beep and three long beeps indicate a video problem, but you would need to consult the motherboard documentation to be sure. A power supply tester and multimeter are both used to troubleshoot problems with power, and a loopback plug is used to troubleshoot problems with the network card.
31. A. First of all, troubleshooting this on a Hard Disk Drive (HDD) is different than a Solid-State Drive (SSD). You should never defragment an SSD. When files are written to an HDD, they're not always written contiguously (i.e., with all of the data in a single location). As a result, file data is spread out over the disk, and the time it takes to retrieve files from the disk increases. Defragmenting a disk involves analyzing the disk, and then consolidating fragmented files and folders so that they occupy a contiguous space, thus increasing performance during file retrieval. Luckily for us the defragment utility makes the task easy. SSDs use flash memory, so they don't experience the latency that an HDD does when retrieving data. Running the check disk utility (`chkdsk`) will find some problems with file allocation units and physical sectors but won't fix a fragmented drive. The other two options are drastic measures and not usually needed to fix this issue.
32. A. A rhythmic clicking sound can be made only by components with mechanical parts, such as a conventional Hard Disk Drive (HDD). A power supply fan failure usually results in a whining sound or no sound at all because the fan doesn't work, but it may not cause a system boot failure. Solid-State Drives (SSDs) and Random Access Memory (RAM) don't make any sound when they fail.
33. D. Vertical white lines running down the page are likely due to the toner being clumped together and not transferring properly to the drum. It's a common problem when the ambient

air's humidity is too high. To fix this issue, first remove and try gently shaking the toner cartridge to loosen the toner. If that doesn't work, you may have to replace the toner cartridge with a new one.

34. A, C, D. Printer jams and creased paper happen when something prevents the paper from advancing through the printer evenly. There are several reasons this could be happening. If the rollers that pull the paper along are damaged, they won't pick paper up properly. If the paper is too humid, it can crease, jam, or tear easily. Paper that is too thick or debris in the paper path can also cause paper to crease or jam.
35. C. This is most likely a problem with the power supply. Test it with a power supply tester or a multimeter. Even though the fan is spinning, the power supply might still not be providing the correct power to run the computer. Not having any indicator lights would indicate a problem with the power supply. If it were Random Access Memory (RAM), Central Processing Unit (CPU), or Hard Disk Drive (HDD) issue, there would at least be some lights (like the power light) illuminated.
36. A. If you hear a grinding noise, consider yourself fortunate to have a warning that your hard drive is failing. If you don't have a good backup and a way to reinstall the Operating System (OS), you'll want to take care of that immediately, then invest in a new hard drive. Solid-State Drives (SSDs) and Random Access Memory (RAM) don't make any noise when they fail. A failing processor fan would result in an overheating Central Processing Unit (CPU), which would shut the system down.
37. B. If your printer fails to pick up paper, it could indicate that the pickup rollers are too worn. They press up against small rubber or cork patches known as separation pads. These pads help to keep the rest of the paper in the tray, so that only one sheet gets picked up at a time. A pickup stepper motor turns the pickup rollers.
38. C. Most likely, the ink ribbon has reached its maximum number of prints or has dried out. Because the bottom copies are printing fine, the printhead is working. Replace the worn-out ribbon, and it should work fine again.
39. C. The users are connecting; it's just slower than it should be. This is likely due to too many people accessing the Wireless Access Point (WAP) at once. The more devices there are connected, the more likely that their signals will interfere with each other, even if the WAP hasn't reached the theoretical maximum that the manufacturer says it can support. To solve this problem, install a second WAP.
40. B. Resistive touchscreens respond to pressure, and they are highly accurate in detecting the touch position. These types of touchscreens require the use of a stylus or other hard object, such as a fingernail. Capacitive screens work by detecting interruptions in an electric field. You can use your finger with them, but they can't tell how hard you are pressing. Tempered is a type of glass that is very strong, and object-oriented is a type of programming/software.
41. A. The most common reason that users on wireless networks experience intermittent connectivity issues is distance. The farther away from the Wireless Access Point (WAP) the user gets, the weaker the signal becomes. When the signal weakens, the transfer rates drop

dramatically. Ways to fix a low Radio Frequency (RF) signal include using a more powerful transmitter, using a larger antenna, focusing the signal toward where it is needed, or moving the users closer. The maximum distance for an 802.11ax signal is 230 feet, so in theory, an 802.11ax WAP in the center of a building could transmit 230 feet in any direction. Transmission distance is also affected by obstacles in its path, such as walls and stairwells. The most important feature of 802.11ax is its ability to support a greater number of simultaneous users than previous standards.

42. C. Unless you replace all the network connectivity devices with faster 10 Gbps devices, the network will run at the slower device's speed. The customer needs to replace the switch with a 10 Gbps switch.
43. A, D. Try reseating the printer's data and power cable. The printer may need to be reset, which can sometimes be done by unplugging it for 30 seconds, then plugging the power back in. If the print jobs are still garbled, replace the printer driver.
44. B. An overheating, swelling battery has the potential to explode and should be handled carefully. If the phone is plugged in, immediately unplug it. Turn the phone off and discontinue using it. While you might be able to replace the battery, most often the phone will need to be replaced.
45. C. Most laptops have a power jack, which is soldered onto the motherboard. They have been known to be knocked loose with rough handling, or when a laptop is dropped or bumped while the power cord is plugged in. If the power jack isn't damaged, you might be able to rectify the problem by simply soldering the power jack back into place. However, if the power jack is damaged, you'll need to find a replacement jack.
46. B. When a charger wiggles in a port, it's usually a sign that the port has been damaged by pressure against the cord plugged in, causing the port to bend out of shape. Of course, you should check the port and the cable first, but most likely you'll need to replace the port. Soldering it back into place won't help.
47. A. Phones that are stuffed in back pockets or purses often end up with lint and other debris in their charging port. Using canned air to remove debris from a port isn't recommended. Try holding the phone with the port facing downward, and gently tap the phone to remove the debris. Don't blow into the port as this can introduce moisture into the phone. You might be able to remove the debris with a small sewing needle, but this could also damage the port if you're not careful. If debris isn't the problem, you'll need to try some other solutions, such as a different block and cord or replacing the battery or the port. You would never spray cleaning solution or any liquid into the phone. If the phone is compatible with wireless charging, you could try charging the battery wirelessly to determine if the battery is the problem.
48. C. Corrosion can limit or totally prevent a tablet's charger port and cable from making a connection, but you don't necessarily need to replace the port or tablet. Tread carefully when cleaning corrosion. Isopropyl alcohol is used to clean because it will dry very quickly. Ensure that the tablet is powered off, and then remove the battery if it is one that is intended to be removed. Use as little liquid as possible on a lint-free cleaning swab and be gentle. Never use a toothbrush to clean the tablet's power port.

- 49.** A. The fusing assembly heats up the toner, and the toner melts into the paper. If the fuser isn't heating properly, images can smudge or smear.
- 50.** B, D. Installing another Wireless Access Point (WAP) closer to where the users are will extend the overall wireless network range and give them a better signal. A wireless range extender might also do the trick. You wouldn't install wired connections for the users because not all visitors will have a Registered Jack 45 (RJ-45) connection on their device or carry a cable with them. Buying a faster WAP won't help if the network doesn't support it, and it doesn't solve the issue of the signal being weak in the lobby.
- 51.** A, D. If the network card doesn't have any lights, it doesn't have a connection. It could be that the cable is bad or that it's not plugged in on the other side, or it could also be a problem with the Network Interface Card (NIC) or the connectivity device on the other side. If nobody else in the same area is having the same problem, it points to an issue with this computer or cable as the *most likely* problem.
- 52.** D. When troubleshooting connectivity issues, the first thing to determine is how widespread the problem is, because that determines where you'll look first. If the user has no network connectivity, they won't be able to reach the Internet. Testing the Network Interface Card (NIC) and the cable might be part of the process, but not the first action to take.
- 53.** A. For network-enabled laser printers, no connectivity can be a sign of improperly configured Internet Protocol (IP) settings such as the IP address. While each printer is somewhat different, you can manually configure most laser printers' IP settings through the Liquid Crystal Display (LCD) control panel.
- 54.** D. On a wired network, if you run into slow speeds or intermittent connectivity, it's likely a load issue. There's too much traffic for the network to handle, and the network is bogging down. Solutions include adding a switch, replacing any old hubs with switches, and even creating Virtual Local Area Networks (VLANs) by using managed switches. Even without creating VLANs, each port of a switch is its own collision domain, so adding a switch reduces network traffic and will result in less latency. The switches will be connected to a router (or a higher level switch in a network hierarchy) that manages network traffic between the switches. If you want to upgrade the cabling or connectivity infrastructure to combat a speed issue, you should do all of it and not just cables or a router. Hopefully your network doesn't have any hubs! They are legacy devices.
- 55.** A. This is known as port flapping, also known as link flapping. It can be caused by a faulty or nonstandard network cable, non-Energy Efficient Ethernet (EEE) devices, or Small Form-factor Pluggable (SFP) devices that are not working or synchronizing properly.
- 56.** C. You would need to disable Energy Efficient Ethernet (EEE) on the switch. The port is flapping because the device connected to it is not EEE-compliant. Link flap prevention settings would disable the port when port flapping is detected and require the network administrator to enable the port each time it is disabled. Eventually you might want to replace the offending device, but until that is done, disabling EEE on the switch is the best option.

- 57.** B. Without knowing the printer's problem, it would be most helpful if the user could tell you the error code seen on the printer's display. The error code might signify a paper jam or no connectivity, but knowing the error code will save you guesswork and possibly avoid creating more problems. While it's true that often turning a printer off and on will clear a problem, it may result in a print job being deleted, especially on older printers. It's best to see what the printer error code is first.
- 58.** B. You can immediately rule out client-side hardware issues, because the user can connect to some resources. You need to figure out why they can't connect to others. This is most likely caused by one of two things: a configuration issue or a connectivity device (such as a router) problem. Because it's affecting multiple people, it's probably a problem with the router (i.e., default gateway).
- 59.** A, C, D. The answer will depend on the specific printer, but common causes are that the stapler is empty, a different printer driver is needed, or the staple unit isn't enabled on the printer. It's usually almost physically impossible to put the staples in backward.
- 60.** B, C, D. Depending on the copier/printer, you might still be able to print to it, even though the stapler is jammed. Trying to staple too many pages or unsupported paper can certainly cause staple jams as well as installing the wrong staples. Because the procedure for removing jammed staples varies by company, you'll want to consult the specific printer manufacturer's documentation to resolve the problem.
- 61.** C. The phone has overheated due to the car's heater blowing hot air on it while in an unventilated area. It must cool down before you try to use it again. The phone wouldn't be too cold, because you had the car's heat on. It's probably not necessary to buy a new phone. Most modern phones will shut down before damage occurs, and most modern phones don't have batteries that can be removed.
- 62.** A, C. Multifunction Devices (MFDs) are printers that can do a host of other tasks like scanning, emailing, copying, and so on. There are so many conditions that can result in an MFD's tray not being recognized that it is nearly impossible to list them all here. The one I've seen most often is that the tray isn't fully inserted. Remove and reinsert the tray fully to resolve this problem. The second most common issue is that paper is jammed at the back of the tray where it is picked up and pulled into the printer. Remove the tray, remove the paper or debris, and then reinsert the tray. Beyond that, the problem could be that the tray isn't installed in the software, is improperly configured in the software, it isn't compatible with the Operating System (OS), or the wrong driver is installed. Sometimes, it's just a glitch, and you'll need to restart the printer. It could also be a problem with the paper itself—perhaps it's curling, too thin, or contains too much humidity.
- 63.** B. Dead pixels are spots on the screen that never light up. You can check for these by setting the background to white and seeing if any spots don't light up. If the display is under warranty, you might want to return it, as there isn't much you can do to fix a dead pixel.
- 64.** B. Oversized images and icons are related to screen resolution; it usually means that your resolution is set too low for the display or projector you are using. Set the resolution to the native setting (or higher than it was), and the problem should disappear.

- 65.** A. Nearly every hard drive is built with Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) software installed on it, which monitors hard drive reliability and can theoretically warn you in the event of an imminent failure.
- 66.** B. Before you do anything else, you need to back up the system’s drive. Self-monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) errors indicate that a hard drive failure will likely happen. Drive failure may be averted, if the error is because of excessive heat, and there is a way to correct it. Otherwise, expect the drive to fail sooner rather than later. The best course of action is to ensure that the system is backed up regularly until a new drive can be installed.
- 67.** C. Almost every circuit board will have a capacitor or several on it. Capacitors store electricity between two dielectric plates and discharge that energy rapidly, as needed. When they fail, they can swell or burst, and electrolyte (i.e., acid) will seep out of its top vent. If you see a swollen or weeping capacitor on a motherboard, the best option is to replace the motherboard immediately.
- 68.** B. Cursor drift is the mouse cursor slowly drifting in one direction even though you are not trying to make it move. If the laptop has a track point, this issue is generally related to the track point not centering properly after it’s been used. If you have cursor drift, try using the track point and moving it back and forth a few times to get it to recenter itself. You can also try rebooting. If the problem persists, disable the track point and replace it with a mouse, or purchase a new laptop.
- 69.** A. When the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) fails to retain your computer’s settings, such as time, date, and hard drive configuration, it indicates one specific problem: a depleted CMOS battery. The BIOS/UEFI uses a small battery (often a CR2032 lithium battery, much like a watch battery) on the motherboard to help it retain settings when the system’s power is off. If this battery fails, the BIOS/UEFI won’t retain its settings. Simply replace the battery to solve the problem.

CMOS stands for Complementary Metal-Oxide Semiconductor and is a type of computer chip. There are many CMOS chips on motherboards, and they contain embedded information or instructions. The user-configurable interface is called “the CMOS chip” (as opposed to the other, non-configurable CMOS chips). If there is no power going to the CMOS chip, it will lose its settings. The CMOS battery provides a trickle of electricity to keep those settings even when the computer is turned off. That is why, when settings like date, time, and boot order are lost repeatedly, the CMOS battery likely needs replacing.

Although there are many CMOS chips on any given circuit board, including a motherboard, the specific CMOS chip on a motherboard that contains the user-configurable portion of the system’s Basic Input/Output System is often called the “CMOS setup,” or simply CMOS, or “the CMOS chip.” Even if a computer uses the newer UEFI interface instead of the older BIOS interface, the chip the UEFI resides on is still called the CMOS chip. BIOS and UEFI provide the same function; they are an interface that enables the user to change configuration settings on the motherboard, using the CMOS chip. (In ancient times, configuration changes were made by moving physical jumpers on the board to change circuit connections.) UEFI refers only to the interface and software on the CMOS chip, but BIOS is more than the user

interface. Think about the words for the acronym—Basic Input/Output System. This system consists of software, embedded on chips on the motherboard, that tells the processor what to do to bring the system to a working state and load simple drivers for basic input and output devices like keyboards, and displays—the bare bones that are needed to allow the user to interact with a computer system. Virtually all circuit boards, even those on diverse devices like hard drives, furnaces, dishwashers, and IoT devices, have their own BIOS, even if that BIOS doesn't have a user interface. Whether you're using BIOS or UEFI to change settings, the changes you're making affect the computer's Basic Input/Output System (BIOS).

70. B. If Set Automatically in an iPhone's Date and Time settings is turned off, the date and time will be based on what the user set it at initially, which might not be correct. The setting in an Android phone can also be found in Settings, Data, and Time, but the setting is Use Network Data and Time or similar, depending on the Operating System (OS). Automatic settings will change the time for daylight savings time and receive the correct time from cell towers. They can also use the Global Positioning System (GPS) features of the phone to determine date and time.
71. A. If you're using Redundant Array of Independent Disks version 5 (RAID-5), which provides disk striping with parity, a single drive failure usually means that your data will be fine, provided you replace the failed drive. If you lose multiple drives at the same time, you will need to restore from backup. Incidentally, the minimum number of disks for a RAID-5 array is only three, but the additional disk to stripe across will increase speed.
72. C. Of the possible issues, the least likely is the contrast setting. Having an incorrect contrast may make the image difficult to see, but it shouldn't make it blurry. Adjusting the focus and cleaning the lens are easy fixes. The most likely issue, if they're using their own laptop, is that the laptop's resolution is too high for the projector. In that case, change the PC's resolution to match the native resolution of the projector, if possible. Depending on the projector, you might need to adjust the sharpness setting or turn on automatic keystone adjustment. The projector's position shouldn't matter if it's in a room where it's mounted to the ceiling and doesn't get moved; otherwise, having it too far away could also be a problem.
73. C. With display burn-in, no matter what you have on your screen, you can still see the outlines of a different image. That image has been “burned” into the display and isn't going away. The only solution is to replace the display. Burn-in is also called image persistence or ghosting. Organic Light-Emitting Diode (OLED) displays are more susceptible to burn-in than other display types.
74. D. When users are typing, their palm might inadvertently touch the touchpad, causing erratic pointer behavior. This is referred to as a ghost cursor because it seems like the cursor just randomly jumps all over the screen. The touchpad can be turned off through Control Panel in Windows. Depending on the Operating System (OS), you can disable the touchpad under Settings. You might also be able to adjust the touchpad's sensitivity. On a laptop, there may be a function button to turn the touchpad on and off easily.
75. A, C. A corrupt driver can make any device behave in a nonstandard way. Check the driver's name in Device Manager, then locate and rename the driver file with a different extension such as .old. Again, in Device Manager, remove the old driver and then install a new one.

The driver file being renamed keeps Windows from reusing it, and leaving it there means you'll still have the file to revert to if needed. There could also be a problem with connectivity to the mouse port. Try using a different port to see if the problem disappears.

- 76.** C. Most smartphones use capacitive touchscreens. Calibrating the screen is not an option. You can check to see if something is pressing on the phone where it shouldn't be, but otherwise fixing this problem is likely going to require replacing the digitizer. Capacitive touchscreens detect the minute changes in an electrical field when an object such as a finger comes into contact with the screen. Resistive screens require a much heavier touch and react to pressure on a touchscreen.
- 77.** C, D. The answer will depend on the manufacturer of your Redundant Array of Independent Disks (RAID) controller, but generally speaking, a beeping controller isn't a good thing. At the very least, this will mean that there is a problem with a RAID array. If you don't know the codes for your array by heart, you'll want to have the list of beep codes handy for reference. It could mean a driver failure, or it could mean you're in the process of a hot (i.e., power on) repair replacing a failed drive. In any case, you've got a problem and need to look at the manufacturer documentation to figure out what exactly that problem is.
- 78.** B. If the touchscreen on a Microsoft Surface Pro isn't working properly, search for calibrate and select Calibrate the Screen for Pen or Touch. Then follow the onscreen instructions.
- 79.** D. While modern smartphones are water resistant, the water-resistant feature fades over time and doesn't protect the phone against water under pressure (like a shower) or extreme temperatures. If your phone gets wet, immediately turn it off. Tap it gently with the power port facing downward to remove excess water, and then leave it off in a well-ventilated area to allow it to dry out for several hours. A fan gently blowing cool air into the power connector may also help. Wipe any visible water off the phone with a clean, soft cloth, but don't stick anything into the phone's ports. Water, especially salt water, is conductive and can cause a short in the phone, which could damage or destroy it or cause the battery to swell or explode. The danger of placing the phone in a bag of rice is that a rice particle might go into the phone's port and cause more problems.
- 80.** A, D. Water and electronics don't mix. A darkened screen, inability to charge, and distorted pictures and sound are all symptoms of water damage. Water inside a phone can cause a short circuit and damage the phone or battery. Some problems might not show up until much later, when components have had time to corrode and lose their connectivity. Most phones will have some type of visible indicator, like a red line, to show when the phone has been exposed to excessive moisture.
- 81.** A, B, C. Exactly what to do will depend on the printer and software being used, but most likely it's a default setting somewhere either on the printer or in the software. It could also be caused by the paper guide being inadvertently moved when paper was placed in the tray or choosing the wrong tray in a multi-tray printer. Changing the paper orientation won't fix this problem, as a paper mismatch or wrong paper size error means exactly that. There is a disconnect between the paper they're telling the software to print on, and the paper size that the printer believes is in the tray.

- 82.** B, C. What the users are experiencing is called jitter. There can be many causes for jitter but setting up a Virtual Local Area Network (VLAN) for the phones to segment traffic may help, as well as configuring Quality of Service (QoS) to prioritize the phone traffic. Wake-on-LAN (WoL) is a feature to remotely turn on a computer. Most Voice over Internet Protocol (VoIP) phones don't have user-upgradable Random Access Memory (RAM).
- 83.** A, B. Always look for the simple fixes first. Is the printer turned on? Does it have the right paper in the selected tray? Restarting the print server service will delete all the jobs in the queue, which would result in some very upset accountants, and so would deleting and reinstalling the printer in the Operating System (OS). If one particular job is causing problems, you might be able to stop or cancel that print job and print the others, then you can try to resolve the problem with that one print job.
- 84.** D. An audible pop sound and darkness is most likely the projector bulb burning out. It's time to replace the bulb. Most projectors have an indicator light or display a message telling you that the bulb is near its end-of-life (EOL) so ideally you will have already purchased one and have it on hand. Projectors should not be unplugged without allowing the fan to cool the lamp down. Resetting the lamp timer is something that either you manually do or that automatically occurs when the bulb is replaced, so that it can keep track of the remaining bulb life for you.
- 85.** A. Latency is the time it takes for a packet to get from point A to point B. High latency means that your network is running too slowly. There are actions you can take that can improve this, such as segmenting network traffic with switches to cut down on collisions, adding a Content Delivery Network (CDN), and ensuring that your network is free of malware. If the Service Set Identifier (SSID) broadcast is enabled, it will increase network traffic, so disabling it will reduce traffic (and latency).
- 86.** C. There are many reasons why there could be an authentication error on a network. It could be a problem with a server that checks user credentials, too many devices on a network, or outdated firmware and old encryption protocols. There could also be heat damage to a router or damage to any other network connectivity device that would keep a user from connecting. Sometimes, changing to a different channel on a Wi-Fi network where there is less traffic will solve the problem, or you might need to update Network Interface Card (NIC) drivers. Disabling the Service Set Identifier (SSID) broadcast has no effect on authentication, but having the wrong SSID entered in your Wi-Fi settings could certainly cause an authentication error.
- 87.** D. Hard drives, Network Attached Storage (NAS), Redundant Array of Independent Disks (RAID) arrays, Network Interface Cards (NICs), and other devices—even motherboards—use Light-Emitting Diode (LED) codes to let you know what's going on with them. Knowing the LED codes for your particular system is important. In the device used for this question (a Seagate NAS array), alternating red and white means the RAID is synchronizing or software is updating. Blinking white happens when the drive is starting up, shutting down, or has activity. When the LED is solid white, the system is ready, but even an experienced tech wouldn't know that, without checking the manufacturer's documentation or having familiarity with the specific product.

- 88.** D. While this error can be caused by a faulty hard drive, it's more likely that someone left a Universal Serial Bus (USB) drive in the computer, and it's set to boot to USB before the hard drive. It's unlikely that the Operating System (OS) was deleted, unless there was an electrical event or someone sneaking in and deleting it. If the Power-On Self-Test (POST) detected a problem with the system, you would not have gotten this far. To remedy the situation, enter the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) and change the boot order so that USB ports are not included, or at the very least, so that it looks for the hard drive first.
- 89.** B, C. Hole punching and stapling are considered finishing options on printers. Both of these options can occasionally cause print jobs to stall. Incorrect paper size can also cause printers to stall but is not a finishing option. Paper orientation will usually cause undesirable effects on the output, or an error message, and might stall a print job, but again this is not a printer finishing option.
- 90.** C. Packet loss occurs when a chunk of data doesn't make it to its destination, and words cutting out is one symptom. Increasing bandwidth, setting up a Virtual Local Area Network (VLAN) for the phones, or updating hardware may fix it. Jitter manifests as garbled or stuttered speech. High bandwidth and low latency are always desirable features.
- 91.** B, D. If hole punching isn't enabled, the printer/copier won't hole punch the documents. User error could also be a problem. Ensure that users are trained in selecting finishing options. If the hole punch waste tray is full, but everything else is in order, most printers will pause the print job until the tray is emptied. A document in the Automatic Document Feeder (ADF) should have no effect on the current print job. If the document were left on the scanning tray, it might pause printing, depending on the printer.
- 92.** D. Typically, a fan should run a while to cool the bulb down when you've finished using a projector. A single loud pop sound, dim or flickering image, and muddy colors are all symptoms of a projector lamp that is has or is about to burn out.
- 93.** B. Most Redundant Array of Independent Disks (RAID) arrays have indicator lights to tell you the drive's status. These may vary by manufacturer, but anything other than a green light is usually a cause for concern. Other statuses that the lights may tell you are when the drive is rebuilding, a rebuild is aborted, or the drive is predicted to fail.
- 94.** A. Putting Universal Serial Bus (USB) locks on all the USB ports would certainly prevent the Personal Computer (PC) from booting to them, but it would also prohibit you from using those ports when you need them. If the Operating System (OS) was installed on a bootable USB, you could likely boot from it, but that's not what you want either. You want it to boot to the hard drive. Whether it's Windows or Linux isn't the issue, either. You need to change the Basic Input/Output System/Unified Extensible Firmware Interface (BIOS/UEFI) boot order settings or disable booting to USB.
- 95.** C, D. The best answer will depend on the exact situation. Lowering the bandwidth, for example, from 80MHz to 40MHz, might decrease interference but will also lower throughput. Changing the channel might help decrease interference. You would want to run a network analyzer and choose the channel with the least traffic, or optionally, if the Wireless

Access Point (WAP) allows, let it choose the best channel for you. If your WAP is experiencing interference from other WAPs or networks, you might want to lower, rather than raise, the signal strength. Installing an antenna with a lower gain might also work. Changing the SSID won't have any effect on interference.

96. C. You can't format or install an Operating System (OS) on the hard drive until the system can see that it's there. Occasionally, you'll find a drive that is Dead on Arrival (DOA), but it's more likely that you forgot to plug in either the data cable or power cable for the drive. You would certainly check those before installing a different drive.
97. A. While the Central Processing Unit (CPU) may be the component that generated the error, the most common cause of this particular error is Random Access Memory (RAM). This is considered a fatal error in your Operating System (OS), producing the infamous Blue Screen of Death (BSOD) in Windows and Linux, or the rotating/spinning pinwheel in macOS.
98. C. If the Central Processing Unit (CPU) is overheating, it may be that the heat sink is not functioning properly or is not connected properly to the CPU. After the system cools down, try using new thermal paste and reseating the heat sink. Overclocking will only make the processor run hotter. If reseating the heat sink doesn't work, you might need to replace the processor, install a better cooler, or add case fans.
99. D. As batteries age, they are not able to hold as much of a charge, and in some cases, they are not able to hold a charge at all. It might be time for a new tablet, unless the tablet battery is removable and replaceable.
100. C. Check the easy fixes first. It might seem silly but be sure that the display is plugged into a power outlet and turned on. Check to see if its power light is on.
101. B, C. Many laptop power adapters have a light on them indicating that they're plugged in. If there's no light, check to ensure that the outlet is working or switch outlets. Also, most laptops have a power-ready indicator light when plugged into a wall outlet. Check to see whether it's lit. If the outlet is fine, try another power adapter. They do fail on occasion.
102. B. Setting a Wireless Access Point (WAP) to transmit at the maximum power may cause the Wi-Fi to extend into areas you would rather it didn't. It can also cause problems like more interference resulting in poor performance and stability because it's picking up signals from nearby Wi-Fi networks. Enabling or disabling the Service Set Identifier (SSID) broadcast will have no effect on the signal strength. It may take a bit of playing with settings, antennas, and placement to get the Wi-Fi transmission exactly how you need it to be, but in this case, lowering the WAP's power setting is a good start.
103. A. Most macOS machines will make a chime sound on a successful bootup, so you can be relatively certain the problem is not the motherboard itself. Before going that route, try another display or try the current display on another computer. That will narrow the problem down quickly. Remember, if it's not the display, it's probably the video card.
104. B. If you try to power on the system but get no lights or fan, first check the obvious things. Is it plugged in? Does the cord work? Is the wall receptacle working properly? If those all check out, then it's probably the Power Supply Unit (PSU).

- 105.** B. A display can present incorrect colors if the pins on the connector are damaged, or if the connector isn't plugged all the way in. Depending on the exact pins that were damaged, you may have other issues like a distorted image or the monitor not working at all, but likely the colors will be incorrect.
- 106.** A. One beep every five seconds indicates that the Mac isn't detecting any Random Access Memory (RAM). Sometimes, RAM will creep out of place because of heating and cooling of the metal contacts. This might also happen if you just installed new RAM. Newer Mac computers have RAM soldered onto the motherboard, therefore they won't experience chip creep, and you won't be able to upgrade them either. (So, buy a Mac with as much memory as you can afford at the time.) If it's updating firmware, the Mac will beep three long, three short, and three long beeps. After a time, the Mac should start up normally. If it produces three beeps, a five-second pause, and three more beeps, then the RAM didn't pass its integrity check and needs to be reinstalled or replaced.
- 107.** B, C. Depending on the printer and settings, either choosing a different tray or changing the printer settings may do the trick. The printer may be overriding the software settings. Most printers don't have a single automatic tray that lets you turn the paper 90 degrees (it's done using multiple trays), although some manual-feed trays will.
- 108.** A, B. Depending on your printer, there may be several reasons it's making a grinding sound, and the fixes vary by printer, but the two solutions here are fairly universal. If a cable moves along with the printhead, make sure that it is not caught on something or obstructed in some way. Check for any blockages or debris that may be preventing moving parts from moving. If those two things don't resolve the issue, refer to the manufacturer's documentation or online resources, as there are many different kinds and manufacturers of printers. Inkjet printers don't have ink ribbons, and you wouldn't replace the printhead without further troubleshooting first.
- 109.** B, D. Sometimes, using off-brand ink and toner works just fine, and other times it doesn't. It may be close enough for most of us but not for an artist's eye. Try using ink or toner made specifically for that make and model of printer. Another quick fix is to ensure that the printer is defaulting to better quality, not faster speed. The exact steps to do that depend on the specific printer being used. Paper orientation has nothing to do with color, and you might need to reinstall a corrupted printer driver, but it's unlikely that you'll need to delete and reinstall the printer to correct a color problem.
- 110.** B, D. Two things that can cause echoes are a broken cleaning blade and bad erasure lamps. A broken cleaning blade causes old toner to build up on the EP drum and consequently present itself in the next printed image. If the erasure lamps are bad, then the previous electrostatic discharges aren't completely wiped away. When the photosensitive drum rotates toward the developing roller, some toner sticks to the slightly discharged areas. A third cause can be printing many copies of a document without allowing the printer to cool off between. In that case, the toner can stick onto the fusing roller.
- 111.** B, C. The Input/Output (I/O) switch will not enable the Power Supply Unit (PSU) to power on if it is in the Off position; equally, the wrong voltage being selected may prevent the computer from starting, and if it does start, using the wrong voltage would have disastrous consequences. Note that not all PSUs support dual-input voltages, and some detect the

voltage automatically. Most often the voltage options are 110 or 220. The other two choices are irrelevant to the problem at hand.

112. D. Improperly adjusted antennas can make a significant difference in wireless connectivity. In this case, take a few minutes and use a Wi-Fi analyzer to check the signal strength and adjust the antenna until it is just where you want it. You would not need to adjust the Wireless Access Point (WAP) signal strength because you're right under it, looking up at it. Even on the lowest power setting, you should still see more bars. The Service Set Identifier (SSID) being broadcast or not is irrelevant to the question being asked.
113. D. If you smell an odd odor or see smoke coming from a computer, shut it down immediately. Open the case and start looking for visible signs of damage. Things to look for include melted plastic components and burn marks on circuit boards. If components appear to be damaged, it's best to replace them before returning the computer to service.
114. C. Modern printers (called Multifunction Devices [MFDs]) are practically computers on their own. As such, like computers, restarting them will sometimes clear existing problems. If that fails, you could try the other three options, but refer to the individual printer manufacturer's troubleshooting procedures.
115. C. When the fusing assembly of a laser printer doesn't have a chance to cool off, toner can melt onto the overheated fusing roller, causing ghost images (also called double or echo images) to appear on the printed page. The roller will need to be cleaned or replaced. Replacing the photosensitive drum, corona wire, or High-Voltage Power Supply (HVPS) will not fix this problem.
116. B. If jobs aren't printing and you're unable to perform any actions in the print queue, it could be that the print spooler service has stalled. To fix the problem, you need to stop and restart the print spooler service. This is done through your operating system. The downside is that the print jobs in the queue will be deleted, and users will need to reprint them. Unfortunately, if the print queue isn't responding, you must restart the print spooler service before you can do anything else.
117. A, B. Sometimes, when you print a color document, the colors might not be the same colors that you expected based on what you saw on the screen. A few different issues could cause this problem. First, ink could be bleeding from adjacent picture areas, causing the color to be off. A leaking cartridge can cause this, as can using the wrong type of paper for your printer. Paper that is designed for an ink-jet printer has different characteristics than paper designed for a laser printer. You should always use the right paper for your type of printer to avoid problems like incorrect colors or ink bleeding into unintended areas. Second, it could be a dirty printhead. Try running the self-cleaning routine. If that doesn't work, consider replacing the ink cartridges with ink cartridges made by the printer's manufacturer.
118. C. If the pickup roller or separation pads get dirty or damaged, the result can be multiple pages picked up instead of just one at a time. To remedy the situation, either clean them or replace them. Pickup rollers and separation pads can be found on both laser and inkjet printers. The fusing assembly is part of a laser printer that has to do with melting toner on the paper, and a printhead can be found in both inkjet and impact printers but doesn't affect how many sheets of paper are picked up. It's unlikely that a paper tray would need replacing, and you've already verified that it is properly adjusted.

- 119.** B, C. The spots (speckling) are likely caused by dirt or debris in the printer, on the scanning tray, or in the Automatic Document Feeder (ADF). Replacing the High-Voltage Power Supply (HVPS) is not going to fix this problem, and you would never use compressed air to blow debris out of a printer. It may cause dust and debris to go even deeper into the device or contain an explosive material that shouldn't be used with electronics. Instead, follow the manufacturer's instructions for thoroughly cleaning all parts of the machine.
- 120.** C. There's probably a simple explanation for this one. The device may be in silent or vibrate mode. Most mobile devices will have a switch on the side that sets them to silent or vibrate mode, which will mute the device, preventing it from making a noise when it receives a call or a message. If that doesn't resolve the problem, it might also be a good idea to check their volume settings.
- 121.** B, D. A significant change in usage patterns can affect the Input/Output Operations Per Second (IOPS) on the system based on the type/size of files being transferred and the software used to do it. If a drive in the array has failed, it will also affect the maximum IOPS the system is capable of, as there is one less drive to do the work.
- 122.** A. A dim or flickering screen can be a sign that the display assembly needs to be replaced. But before you go that route, it's best to check the brightness or auto-brightness features. Location settings and battery are irrelevant in this situation. The battery is still working because they can see something.
- 123.** C. Faded prints generally mean the printer is running out of ink. Replace the ink cartridge, and the problem should disappear.
- 124.** C, D. A failing motherboard or Central Processing Unit (CPU) often causes continuous reboots. A hard drive failure might give an error such as "No operating system found." If the power supply failed, the computer would not be booting at all.
- 125.** D. If the problem affects multiple users, chances are that it's an issue with the central connectivity device. Suspect an issue with the switch that the computers are plugged into, or a router port.
- 126.** C. Given that the user recently cleaned their desk, it is likely cables were moved. The first thing to check would be the network cable. You know that they have logged into their computer because they are working locally. If the servers were offline or the problem was caused by a reconfigured Group Policy, you would receive other complaints.
- 127.** A. Opening the projector's log to review relevant information is a good step to take. From the description, it doesn't sound like the culprit is loose cables, lighting, or overheating.
- 128.** C. The most likely explanation is that the wireless router is overheating. If it randomly shuts down in the afternoon, being in the sun may contribute to overheating. Also note that the sun provides electromagnetic energy, which can cause problems with some devices. For these reasons, it's best not to place electronic equipment in direct sunlight.
- 129.** B, C. Reconfiguring the array to RAID-5 instead of RAID-6 would increase performance and available storage space but would provide less fault tolerance. RAID-6 is slower than

RAID-5 due to the extra parity stripe, and it requires a minimum of four drives instead of RAID-5's three drives. By changing to RAID-5 you're only able to lose one drive and still rebuild the array, whereas with RAID-6 you can lose two drives and still rebuild the array without having to recover from a backup. The question doesn't address fault tolerance, so changing from RAID-6 to RAID-5 would meet the requirements of better performance without losing storage space. Hard Disk Drives (HDDs) have a natural speed disadvantage compared to Solid-State Drives (SSDs) because of their moving parts, so replacing the HDDs with SSDs would maintain the capacity and increase performance. As hard drive storage gets bigger, the performance lag is exaggerated, so using a single large drive is a very bad idea. In addition to the higher performance lag, the fault tolerance would no longer exist. Again, the option to replace the existing HDDs with fewer and larger HDDs would make performance worse, not better. SSDs have no moving parts, so their latency is much lower. Either replacing the existing HDDs with a greater number of smaller drives or the same size of SSDs would increase the performance, but also the cost of the drives. Input/Output Operations Per Second (IOPS) is the best measure to use when comparing drive performance.

130. B. Wi-Fi signals can be blocked by thick walls, and concrete walls are very thick indeed. While the office might be a safe place for the billing clerk to work, the walls are blocking their Wi-Fi signal.
131. C. Although your spouse may want a better laptop, if it was working fine before and the only thing that has changed is router placement, that's most likely the problem. Large motors and microwaves, among other things, can cause Electromagnetic Interference (EMI), which can wreak havoc on Wi-Fi signals. To solve the problem, move the router and work area to another location.
132. A. Wi-Fi signals are radio waves and part of the electromagnetic spectrum. The metal staircase would act like an antenna, absorbing the energy of the signal. Sofas are thick and most have metal in them that will also absorb the signal. The sunny windowsill is out in the open, but sunlight (which is also on the electromagnetic spectrum) can interfere with radio signals too, and too much heat might damage the router. The best option here is on a stand in the corner of the dining room, which is in the center of the home. While you have chairs and a table there, there would likely not be as much furniture to block the signal as behind the sofa. Placement would, of course, depend on the exact situation.
133. B, D. Newer iPads, like smartphones, have the display, digitizer, and glass front neatly bonded together, so if you must replace one, you must replace them all. If a backup has not been recently made and the device is still working, make one immediately. A bit of package sealing tape over the crack may keep it together until it can be repaired and keep your friend from cutting their finger again.
134. B. Most wireless headsets use a Bluetooth connection. The first thing to check is that Bluetooth is enabled, which also means double-checking that Airplane mode is not turned on. In this case, Bluetooth is off. AirPlay is specific to Apple devices, and it shares output with other Apple devices and compatible TVs, not headsets.

- 135.** B. Input/Output Operations Per Second (IOPS) is the only way to truly compare the speed when some drives are solid-state and others are mechanical. Mechanical drives often use Revolutions per Minute (RPM), which is also known as spindle speed, as an indication of how fast they can access data. Solid-State Drives (SSDs) have no moving parts, so there is no spindle speed. Regardless of the drive type, IOPS is a better way to compare drive performance, and the only way when they are not the same type of drive. Other factors to consider are how long the drive is expected to last and drive latency.
- 136.** B. It's easy to accidentally bump the Airplane mode button on some smartphones. Airplane mode turns off cellular and Wi-Fi service on your device, so that it won't interfere with a plane's controls during takeoff and landing. Fortunately, turning off Airplane mode is equally easy.
- 137.** B. Multiple walls and floors between you and the outside world, not to mention all the electronic equipment found inside an office building, may be interfering with your signal. Move toward an outside wall or window away from the interfering walls and equipment to see if the connection improves.
- 138.** C. If you are using Redundant Array of Independent Disks, version 0 (RAID-0), which provides disk striping, you have increased performance but not fault tolerance. RAID-0 has more points of failure than a single drive would, meaning that you're at a greater risk of failure versus using just one hard drive. One drive failure will cause the entire set to fail. To recover it, your only option is to replace the failed disk and restore it from backup. You cannot rebuild the array as you can with RAID-1, RAID-5, RAID-6, or RAID-10.
- 139.** C. If the laptop won't output a screen image to an external display or projector, it means one of two things (assuming you know that the display or projector works): Either the external video port is malfunctioning, or the function keys aren't working. In either case, you likely need to replace the motherboard if you want the display to appear on an external device. It wouldn't be the laptop's video card or display because the laptop's display is working. An inverter is part of a Liquid Crystal Display (LCD) that doesn't use Light-Emitting Diodes (LEDs) for backlighting.
- 140.** C. If print jobs are processed very slowly or if you are continually seeing "Low Memory" error messages, it might be a good time to upgrade the memory in the printer.
- 141.** C. If you are using Redundant Array of Independent Disks, version 0 (RAID-0), which provides disk striping, you have more points of failure than a single device, meaning that you're at a greater risk of failure versus using just one hard drive. One drive failure will cause the entire set to fail. If a single drive fails with RAID-1, RAID-5, RAID-6, or RAID-10, the system will not crash, and you can rebuild the failed drive from the information on the other drives. If the drives are hot-swappable, you may be able to do it without incurring any downtime.
- 142.** A. If this happens, don't panic. Wait several minutes to see if it stops. Most likely the screen is flashing on and off several times because the Operating System (OS) is updating. Flashing could indicate a display that is failing; however, it was working fine before you restarted it, so it's more likely to be an update.

- 143.** D. A groove or scratch in the EP drum can cause the problem of vertical black lines running down all or part of the page. Because a scratch is lower than the surface, it doesn't receive as much (if any) of a charge as the other areas. The result is that toner sticks to it as though it were discharged. The groove may go around the circumference of the drum, so the line may go all the way down the page.
- 144.** A. A loose video cable may be fine while you're stationary but wiggle enough to lose connection between the motherboard and display when the laptop is moved. Luckily, this is an easy fix. The video cable in a laptop is a very thin and delicate ribbon cable. Disassemble the laptop following manufacturer's instructions to the point where you can reseat the video cable, then carefully reseat it.
- 145.** B. High-Definition Multimedia Interface (HDMI) cables carry both video and audio signals. These cables can wear out over time from excessive use, plugging and unplugging, or excessive heat.
- 146.** B. While an overheated projector will shut down, and a burned-out lamp will not project an image, the most likely cause in this scenario is that the projector simply went to sleep after a time of inactivity. Usually, touching the power button will wake it up again.
- 147.** A. Every computer has a diagnostic program built into its Basic Input/Output System (BIOS) called the Power-On Self-Test (POST). When you turn on the computer, it executes this set of diagnostics. If the computer doesn't perform the POST as it should, one way to determine the source of a problem is to listen for a beep code. This is a series of beeps from the computer's speaker. A successful POST generally produces a single beep. If there's more than one beep, the number, duration, and pattern of the beeps can sometimes tell you which component is causing the problem. Check the motherboard manufacturer's documentation to determine the specific issue.
- 148.** C. Repeated crashes and soaring data usage can both indicate malware on a phone. Typically, Android's Operating System (OS) security updates end three years after the OS release, and without security updates, an older device is more at risk of contracting malware. The best thing to do is go to the Google Play store and download anti-malware software to check the device. It might also be time to consider an upgrade.
- 149.** D. A loose power cable can cause intermittent shutdown. Try reseating the cables. If the unit is overheating, it will shut down and not turn back on until it cools. Check to see if there is excessive dust on the cooling fan, and if so, clean it. Projectors also have a filter that may need periodic cleaning to avoid overheating. A loose HDMI cable would have other symptoms, such as a flickering image or distorted sound.
- 150.** B. The hard drive cache will hold information that is being used repeatedly, so it can be accessed more quickly, much like the cache on a processor. It also acts as a buffer between writing data and the hard drive, improving system performance. However, if the power goes out unexpectedly, data stored in the hard drive's cache will be lost.
- 151.** D. Replacing the mechanical drives with Solid-State Drives (SSDs) will improve the performance, but not the fault tolerance of the system. Redundant Array of Independent Disks, version 0 (RAID-0), which provides disk striping, does the same. RAID-1

(mirroring) will provide fault tolerance but does nothing to help performance. RAID-5 provides disk striping and parity. Striping improves system read/write speed. The parity means that if one drive crashes, the system can continue working until the drive is replaced. RAID-6 enables the system to recover from the failure of two drives, so although its performance is slightly less than RAID-5 because of the extra parity, it vastly increases fault tolerance and it's still faster than a single drive. RAID-5 isn't one of the options.

- 152.** D. The power supply is the only component listed with moving parts, and therefore is the most likely component to cause a whining sound. It's more than likely a fan. Either it needs to be cleaned (desperately) or replaced. Power supplies that are failing can also sound louder and quieter intermittently, because a fan will run at alternating speeds. If a power supply's functioning is questionable, it should be replaced because its failure or intermittent failure can cause problems with other devices.
- 153.** A, D. Every computer has a diagnostic program built into its Basic Input/Output System (BIOS) called the Power-On Self-Test (POST). When you turn on the computer, it executes this set of diagnostics. The steps include checking the Central Processing Unit (CPU), checking the Random Access Memory (RAM), checking for the presence of a video card, and verifying basic hardware functionality. An error in the BIOS or in one of the checked components can cause a beep code.
- 154.** A. If the laptop is locked up, the only way to reboot it is with a hard boot. Although removing all the power sources would work, it's not necessary to do so. Simply hold down the power button for about five seconds, and the laptop will power off. If that does not work, you might need to remove the power sources.
- 155.** B. If a mobile device is overheating, turn it off to let it cool down. (Most phones will automatically shut down if they're overheating.) Overheating could be from overuse, or perhaps the device was left in a hot environment or did not have proper ventilation. If it continues to overheat or does so for no reason, expect a problem with the battery, and if possible, replace the battery. If the battery can't be replaced, replace the phone.
- 156.** C. Nearly all Peripheral Component Interconnect Express (PCIe) Redundant Array of Independent Disks (RAID) controllers will have their own Basic Input/Output System (BIOS) for setup, configuration, and troubleshooting. Some will have utilities available for use within an Operating System (OS) as well. If a motherboard has an onboard RAID controller, you will likely need to go to the BIOS or Unified Extensible Firmware Interface (UEFI) to configure it. Note that the question says the array isn't detected. It doesn't say the controller isn't detected.
- 157.** D. One potential cause of intermittent device failures is chip creep, which happens when components such as expansion cards start to creep out of their socket. This can be caused by heating and cooling that happens when the equipment is running then shut down. Remove and reinstall (reseat) the card (and screw it into the case!) and see whether that resolves the issue. If not, you might need to replace the sound card.

- 158.** D. In a networked environment, users need the proper permissions both to install and to print to the printer. Not having permission will result in access being denied.
- 159.** A, C. Printer jams (also known as “The printer crinkled my paper!”) happen when something prevents the paper from advancing through the printer evenly. There are generally four causes of printer jams: an obstructed paper path, stripped drive gears, using the wrong paper, and excess humidity, which can make the paper swell and become less rigid.
- 160.** B, C. Small devices sometimes suffer from an extremely short battery life. If it’s a laptop, you might be able to perform battery calibration. For all mobile devices, you can try to drain the battery completely, and then charge it fully before turning the device back on. If these options don’t work, then it’s likely that the battery needs to be replaced.
- 161.** C. If your printer isn’t spitting out print jobs, it may be a good idea to print a test page and see whether that works. The test page information is stored in the printer’s memory, so there’s no formatting or translating of jobs required. It’s simply a test to make sure that your printer hears your computer. If the test page works but other print jobs don’t print, there could be a problem with the application or the driver.
- 162.** B. Modern Liquid Crystal Displays (LCDs) use Light-Emitting Diodes (LEDs) to provide backlighting. Dimness or flickering is most commonly caused by a problem with the power supply or failed LED strips. In those cases, if you have electronics and soldering knowledge, you could replace the LED strips, but the easiest course of action is to replace the display.
- 163.** A. If your printer isn’t spitting out print jobs, it may be a good idea to print a test page and see whether that works. The test page information is stored in the printer’s memory, so there’s no formatting or translating of jobs required. If the test page works, then the problem is not communication between your PC and printer. If nothing happens, double-check your connections and stop and restart the print spooler service. If garbage prints, there is likely a problem with the printer or the print driver.
- 164.** C. If a laptop keyboard is not responding, you can always plug in an external keyboard and use that. It might not be an ideal long-term solution, but it will generally get the user back up and running, and it’s faster than troubleshooting the keyboard.
- 165.** A, B. The most likely components are the processor and the memory. Try reseating the chips or testing them. If the problems persist, you may need to replace those components. It could also be the motherboard.
- 166.** D. Toner cartridges are often shipped with a strip of sealing tape across the cartridge to keep the toner from getting shaken out during shipment. If the user forgets to remove the tape, the printer will only print blank pages. The solution to this problem is fortunately quite easy. Remove the toner cartridge from the printer, remove the sealing tape, and reinstall the cartridge.
- 167.** B. Fortunately with today’s large capacity storage devices, this problem doesn’t happen often. However, if a device’s storage is too full and has less than ten percent free space, it can slow down dramatically. The first solution to try is to remove files and uninstall unused apps to free up space.

- 168.** C. A failure to open files means that the computer can't properly read those files. In most cases, this indicates an issue with the Hard Disk Drive (HDD) or Solid-State Drive (SSD). Problems with drives can also cause slow read/write or application speeds.
- 169.** D. Suspect that the Wireless Access Point (WAP) has failed. A low Radio Frequency (RF) signal would show fewer bars but should still be able to connect to the WAP, especially if they did the day before. An oversaturated WAP would show sluggish performance and dropped packets. The Service Set Identifier (SSID) broadcast shouldn't be the issue because they've connected to this network before and likely have saved the network to their device. Because there is more than one user, the problem probably isn't the individual user. It is, most likely, that the WAP has failed.
- 170.** C. The correct printer driver needs to be installed for the printer and operating system. For example, if you have an HP LaserJet Pro M15w and a Windows 11 computer, you need to install an HP LaserJet Pro M15w driver made for Windows 11. If this is not done, you will likely get garbled characters out of the printer. Often, the Windows Operating System (OS) will have adequate drivers for your printer, but the manufacturer's driver downloads often come with other software that provides additional features for you to use with your printer, and if the output is garbled, then you certainly want to use the manufacturer's printer drivers, not those provided with Windows.
- 171.** C. If a laptop does not display any video, it could be the screen or the video card/integrated video. To test it, plug in an external display (that you know works) and use the function keys on the laptop to switch to external video output. If that doesn't work, it's likely that the video card is defective. If the external display works, you know it's a problem with the display on the laptop. The backlight (or inverter) could be dead, or it could be that the screen has become disconnected.
- 172.** B. If the phone is extremely slow but isn't completely locked up, isolate the issue. Is it one app or overall performance? It could be that apps are running in the background and need to be closed. Shutting down those apps or powering the device off and then back on is a good step. You can also check to see how much memory is available. If it's one app giving you problems instead of the entire device, look for updates to the app or delete and reinstall the app. The symptom could also indicate malware. Use a malware removal tool. Finally, if none of these steps works, perform a restore to factory settings. If the problems persist, it's time for a new device.
- 173.** A, B. If the system had been operating normally but now tells you that the Redundant Array of Independent Disks (RAID) array is not found, it's likely something is wrong with one of the drives or the RAID controller. The RAID array was working fine yesterday, so it's not likely to be the Basic Input/Output Settings (BIOS), although that's a possibility. It's also not likely to be a drive controller on the motherboard, although that's also possible if the motherboard has been damaged. A drive failure or RAID controller failure is most likely. (My bet would be the controller.) Double-check to ensure that the RAID controller BIOS is configured properly, and that everything is connected as it should be.

Chapter 6: Operating Systems

1. B. The `net use` command enables you to connect to a shared resource. Depending on the version of Windows you are using, `net` can be one of the most powerful commands at your disposal. While all Windows versions include a `net` command, its capabilities differ based on whether it is used on a server or workstation and the version of the operating system. Commonly, `net share` is used to create shared folders, and `net use` is used to connect to shared resources. The `net user` command allows administrators to create and manage user accounts. `netstat` shows what sockets (IP address plus port) are being used and by which protocols. `Net Share` is a valid command for managing shared resources, but `netshare` and `netdom` are not valid commands.
2. B. It's possible that the hard drive has some bad sectors, so run `chkdsk /f` to scan the drive and attempt to repair them. If that doesn't work, formatting is the second option, and replacing the drive is the third. If your drive is getting read/write errors, having an extra hard drive on hand would be wise.
3. C. The `diskpart` utility lets the user see and manage partitions on the computer's hard drives. Because of the enormous power it holds, the user must have administrator status to run `diskpart`. Once a partition is created, the `format` command will set up the file system on the new volume. The `chkdsk` command verifies the disk integrity and `gpupdate` forces group policy changes to take effect immediately.
4. B. Resilient File System (ReFS) is a feature available on Windows Pro for Workstations and Windows Enterprise editions. ReFS will detect when data on a mirrored drive has been corrupted and will use a healthy copy of the data on other drives to attempt to correct corrupted data and protect data. New Technology File System (NTFS) has been available on Windows operating systems (OSs) since 1993 and provides file encryption and the ability to use NTFS permissions for security. The fourth extended filesystem (ext4) is a Linux filesystem, and File Allocation Table 32 (FAT32) is a legacy filesystem sometimes used for compatibility between different OSs, and used on external storage devices like memory cards, Universal Serial Bus (USB) drives, and hard drives.
5. A. Windows 10 Home edition does not offer BitLocker as an option. BitLocker is available in the Pro, Pro for Workstations, and Enterprise editions.
6. C, D. Resilient File System (ReFS) is a feature available on Windows Pro for Workstations and Windows Enterprise editions. ReFS will detect when data on a mirrored drive has been corrupted and will use a healthy copy of the data on other drives to attempt to correct corrupted data and protect data. As of the fall 2023 update, ReFS use on Pro editions of Windows became limited. To use the full-featured ReFS, you need Pro for Workstations or Enterprise editions.
7. C. Windows Pro for Workstations is designed so that users can take advantage of the capabilities of high-end workstations. Windows Home edition can support up to two physical Central Processing Units (CPUs), while Windows Pro for Workstations can support up to four physical processors. Remember that each physical processor has multiple cores.

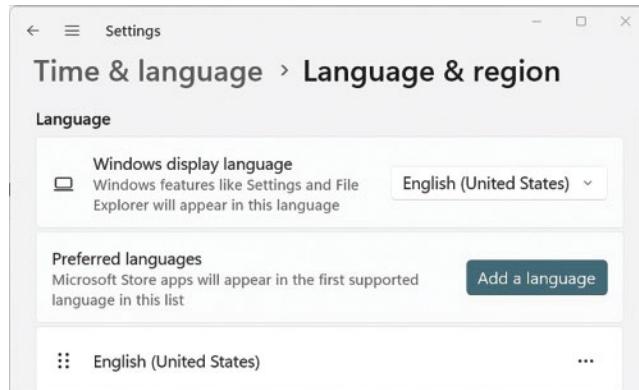
8. B. Windows Home does not have the capability of joining a domain, so the employee will not be able to use their personal device. Windows Pro, Pro for Workstations, and Enterprise editions are all able to log in to a domain. The number of processors and amount of RAM are irrelevant to the ability to log in to a domain.
9. A, D. Task Manager is a powerful tool that works in all versions of Windows, although it has different capabilities in different versions. In Windows 10 and 11, it allows you to shut down nonresponsive applications and view the performance of the Central Processing Unit (CPU), memory, disks, Wi-Fi, and Graphics Processing Units (GPUs); as well as to show application usage history, services, and programs launched at startup, users attached to the system, and other useful information.
10. C. The Internet Options utility in the Windows Control Panel has six tabs that allow you to configure how your browser interacts with the Internet. The six tabs are General, Security, Privacy, Content, Connections, Programs, and Advanced. (Note, not all versions of Windows have the Content tab.) The General tab allows you to change the Home page, while the Privacy tab has a Turn on Pop-up Blocker option.
11. A. A quick look at Device Manager (`devmgmt.msc`) is often all you need to troubleshoot a problem with an onboard device. In Device Manager, if the device drivers aren't installed for the device, you'll see a yellow exclamation point next to the device name in the list, which signifies that the device is not working properly. Programs and Features enables the user to add, remove, or troubleshoot installed programs (the options will change by program) and add Windows features that are not yet installed. The File Explorer Options utility changes how File Explorer works, such as showing hidden files or extensions and other view options. Ease of Access provides alternative ways to interact with the computer for differently-abled users.
12. D. To always show the time and date correctly for the salesperson's location, you would need to enable both Set time zone automatically and Set time automatically, as shown in the graphic. Sync now, which synchronizes your clock, would work in the moment but will not automatically change the time and time zone as the salesperson travels.
13. C. The Voice activation window of Privacy settings in Windows Settings will allow the user to turn on microphone access and choose which apps are allowed to use voice activation, even when the device is locked. The choices are slightly different in Windows 11. In Windows Settings, choose Privacy & security, then Speech. The setting is on by default. The Default Programs app of the Control Panel allows you to manage default applications for opening types of files, such as photos or mail by opening those settings in Windows Settings. By choosing Privacy, then Notifications in the Windows Setting, you can allow or deny applications to access your notifications. The Control Panel's Indexing Options look at words in and metadata of files to provide faster file searches.
14. A, C. In a workgroup (peer-to-peer) network, you would first need to ensure that each person who will be using the shared resource has a username and password on the manager's computer. The resource would then be shared on the manager's PC, and on each employee's computer, go into File Explorer, click on This PC, then Map Network Drive and follow the onscreen prompts to map drive X:\ to that shared resource.

15. B. To have a domain, you would need a Domain Controller (DC), for which the company would need Windows Server software installed on a network-connected computer. They only have Windows 10 workstations. Homegroups were a networking scheme that shared a computer's libraries with other people on the same Homegroup, but Homegroups are no longer an option. Crossover cables are not a practical way to share anything among 10 computers. By default, the computers would belong to the workgroup named workgroup. Each computer that is sharing a resource would need to have the user they are sharing with listed on that computer, then the person sharing information could right-click a folder and choose Give access to, then Specific people, and choose with whom they want to share that particular resource. Workgroups are great for small groups of people, but if there are more than 20 or 30 people in the group, you'll likely want to move up to a Domain Controller and centralized security.
16. D. One of Task Manager's many capabilities is allowing you to see what resources (e.g., memory, Central Processing Unit [CPU], Graphics Processing Unit [GPU], network, and disk) are being used by application, and it allows you to end the process or the entire process tree to free up those resources. Performance Monitor will show resources used but not by application. Computer Management gives access to several other resources but not Task Manager, while Windows Memory Diagnostics is used to test the health of Random Access Memory (RAM) modules.
17. A. In Windows 11 Settings, choosing Privacy & security, then Microphone opens a window that provides granular settings for microphone use, including which apps can use the microphone. Device Manager could be used to disable the microphone, but it would be for all purposes. Computer Management provides access to several tools, but not granular microphone settings. In Windows Settings, Personalization options allow the user to change settings, such as background, colors, and lock screen. In Windows 10, the only difference is that you would choose Privacy, not Privacy & security.
18. B. The best way to understand IPv4 addressing is to convert the IP address and subnet mask to binary numbers. This is essentially what the operating system is looking at when determining the network and host portion of an IP address. What we see as dotted decimal notation is seen by the computer as four sets of eight binary bits (either a 1 or a 0). In the subnet mask, a binary 1 indicates that the position of that bit is part of the network number, and a 0 indicates that it is part of the host number. Network numbers always go consecutively from left to right with no breaks between. Eight binary bits that are all ones (11111111) equates to 255 in decimal, so the maximum value of a subnet mask's octet is 255. Choices A and D are invalid subnet masks because for a number to exist in the second octet from the left, the first octet would need to be all ones, or 255. Choice C is an invalid subnet mask because the ones indicating the network number would be in the first octets reading from left to right, not the last. If you compare the IP address of 200.100.1.10 to the subnet mask in choice B, 255.255.0.0, you can see that the first two octets are network number and the last two are host numbers, making the network number 200.100.0.0 for that IP address and subnet mask combination. The host computer is then 0.0.1.10.
19. C. The default setting for obtaining an IP address is automatic, which means that the computer will look for a Dynamic Host Configuration Protocol (DHCP) server to assign it

an IP address and subnet mask automatically. No manual configuration is required, but in Windows 11 if you open Windows Settings and click on Network & Internet, then click on Properties of the network connection you want to change, and then click Edit next to IP assignment, you can change the default settings to manual. The process is the same for IPv6, except that you would choose IPv6 instead of IPv4 once you're on the Edit screen. This can also be done through the Control Panel, by clicking on Network and Sharing Center instead of Network & Internet, then clicking on Change adapter settings and right-clicking on the network connection you want to change. Choose properties, then click on IPv4 and click on configure. Your screen should be similar to the following figure.

20. C. An IP address on a device can either be dynamic or static. In a static IP address, the minimum amount of information that needs to be configured is the IP address, subnet mask, and, if the computer will access the Internet or other networks, a default gateway. A proxy server is an added security measure between a device and the Internet. It is used to translate between protocols and filter out certain types of traffic, such as keeping inappropriate websites out and confidential data in the network.
21. B. Often on a network, especially a smaller one, the router will serve multiple purposes. In this scenario, it is the default gateway, the Dynamic Host Configuration Protocol (DHCP) server, and the Domain Name System (DNS) server. 192.168.1.1 is the address of the router, gateway, DHCP server, and DNS server. 192.168.1.242 is the local computer's IP address. CC-15-2A-CC-3B-31 is the Media Access Control (MAC) address, which is embedded in the computer's network interface card (NIC). 255.255.255.0 is the subnet mask.
22. C. Rapid Security Response (RSR) is a feature of new iOS, iPad OS, and macOS systems. It automatically sends targeted fixes for security issues between software updates. For example, if there's a security update to Safari, it is loaded before the operating system (OS) on startup, or it may be deployed when the system is on, and sometimes will ask the user to restart Safari (but not always). Each RSR will update the OS number with a letter after, such as 16.4.1 (b). RSR is on by default but can be turned off in System Settings, General, Software updates, and Automatic updates (although that's not advisable!). Sandbox and File Quarantine are part of macOS's built-in antivirus protection that only requires you keep the system updated, which it will do automatically.
23. A. In IPv4 networking, a computer system will compare the subnet mask to the IP address to identify the network and host number of the IP address. IPv6 addresses don't use a subnet mask. IPv6 addresses consist of eight segments. The first three are a site prefix, the fourth is the subnet ID, and the last four segments are the interface ID, which is essentially the host address. The subnet mask doesn't hide anything.
24. A, B. A network with that many computers (typically more than 10) needs a domain for security management. The Windows 11 Home edition PCs can't log in to a domain, so they would need to be upgraded to at least the Pro edition. It's not necessary to downgrade the Windows 11 Enterprise workstations to Windows 11 Pro or upgrade the workstations to Windows 11 Enterprise.

25. C. It is possible to view apps and websites in many languages and dialects. In Windows Settings, choose Time & language, then Language & region (see the following graphic). Click Add a language to choose the appropriate language to install if it isn't already installed, then click Next and install to install it and select the desired language as the preferred language. The language may require downloading a language pack. Icons beside the installed language are used to indicate what is available in that language.
26. B. The Processes tab of Task Manager (`taskmgr`) will allow you to terminate the non-responsive application. Event Viewer (`eventvwr.msc`) keeps a log of security, application, and system events. Computer Management (`compmgmt.msc`) gives access to several other resources, but not one that lets you end wayward applications. The `msconfig.exe` application launches System Configuration, which gives you access to boot configuration settings, running services, and links to other Windows tools.
27. A. In the Control Panel, choose Internet Options and select the Connections tab, then LAN. LAN settings will take you to a window that enables configuration of a proxy server. Proxy server settings can also be configured through Windows Settings, by choosing Network & Internet, then Proxy. The File Explorer Options utility is used to configure how files and folders are viewed and how searches are conducted. Device Manager is a great utility to use when troubleshooting hardware issues, and the Security and Maintenance utility provides a quick way to see if security is configured on the PC and any recent messages.
28. A, D. The computer is configured to obtain the address dynamically because the graphic says "Yes" next to Dynamic Host Control Protocol (DHCP) enabled. If it was set to obtain an address dynamically but not able to reach the DHCP server, the operating system would have obtained an address using Automatic Private IP Addressing (APIPA) and would have been in the range that begins with 169.254.0.0, so this PC is not being assigned an APIPA address. You don't know for sure that it is getting its address from the DHCP server because someone could have manually configured it to the IP address shown. Addresses in the 192.168.x.x range are non-routable addresses, meaning that they can only be used internally. To reach the Internet, they would go through a gateway (router) that has Network Address Translation (NAT) enabled. (Essentially all modern routers use NAT.) You know the network number is 192.168.1.0 and the host address is 0.0.0.242 by comparing the IP address to the subnet mask.



- 29.** B, D. IPv4 addresses are 32-bits long and consist of four octets, which is a group of eight bits each, separated by a period (.). They are normally presented in dotted decimal notation meaning each group of eight bits is shown as a decimal number less than 256, with a period (.) between each number such as 192.168.1.1. IPv6 addresses are a 128-bit IP address presented as eight segments of four hexadecimal numbers each, separated by a colon (:). Where the hexadecimal number is 0 in any segment, it can be omitted and replaced simply by double colons (::). If consecutive segments are 0, they can all be replaced by a single set of double colons, but only one set of double colons can exist in any given address, otherwise you wouldn't be able to tell how many sets of 0 are in each part of the IP address. In the example fe80::308c:fee2:dabc:8337, the expanded address would be fe80:0:0:0:308c:fee2:dabc:8337. The first three segments (48 bits) are the site prefix, and the fourth segment (16 bits) is the subnet ID, also known as private topology or site topology. The site prefix and subnet number together constitute the subnet prefix. The last four segments (64 bits) are the interface ID, also sometimes called a token. The subnet ID in this case would be 0. IPv6 addresses do not have a subnet mask. The value of the first octet, fe80, tells you that this number is a link-local address, an internal number only, not routable.
- 30.** B, C. The IP address in question must be IPv6 because IPv4 addresses are only 32-bits long. The / indicates that the number behind it is the number of bits for the network address in IPv4 or the prefix length in IPv6, both of which identify the network number of an IP address. In IPv4, this is called Classless Inter-domain Routing (CIDR) notation.
- 31.** A. Global unicast addresses are routable, like IPv4 public addresses. Meaning that a global unicast address can be reached by any other PC on the Internet, unless you put security measures in place like a firewall. You would likely want a global unicast address on a web server but not on your workstation. Link-local addresses can only be used to communicate with devices that are on the same local link. They will start with fe80 and are assigned in a manner similar to IPv4 APIPA addresses. The IPv6 loopback address is ::1 and is used for testing just like the loopback address in IPv4 (127.0.0.1). A unique local address is akin to an IPv4 private address. Unique local addresses are non-routable, so a computer with only a unique local address and a link-local address (but no global unicast address) would need a router with IPv6 NAT to access the Internet.
- 32.** A. The Task Manager's Users tab provides information about any users connected to the local machine. The Users tab shows the user's identification and the resources they are using. Right-click and choose Expand to see what they are using on your computer. You can also disconnect them from here, but it might be nicer to message them first.
- 33.** C. With a 64-bit processor, you can install either a 32-bit or 64-bit operating system (OS). A 32-bit system will not be able to take advantage of the full processing power of the 64-bit processor though. Windows 11 requires a 64-bit processor.
- 34.** B. Windows 11 minimum requirements are a 1 GHz or faster 64-bit processor that is on the approved list and has at least two cores, and 4 GB of RAM. Available storage must be at least 64 GB. Firmware must be the newer Unified Extensible Firmware Interface (UEFI) not the older Basic Input/Output System (BIOS) interface, and it must be Secure Boot capable. The system must support Trusted Platform Module 2.0. Graphics compatible with Direct X 12,

WDDM 2.0 driver and 720p display, and a Home version requires Internet access and a Microsoft account for setup. These are the minimums, and in reality, it won't run well unless there is a faster processor and much more Random Access Memory (RAM).

35. C. Pro Artist is not a valid Windows edition. Windows is available in many different editions. The editions on the CompTIA A+ exam are Home, Pro, Pro for Workstations, and Enterprise. Other Windows editions (not on the CompTIA A+ exam) include Education, Windows in S mode, and Windows for IoT.
36. D. Windows N editions do not include media related technologies, like Windows media player. You can add them by downloading a media feature pack from the Microsoft website.
37. D. The `net stat` command-line utility presents statistics related to the installed network interfaces. By default, on a Windows machine, running the command will display a list of connections and the associated protocol, the source and target address, and the current state of the connection. `ping` is used to test connectivity between two computers, `nbtstat` is used for troubleshooting Network Basic Input/Output System (NetBIOS) over Transmission Control Protocol/Internet Protocol (TCP/IP), and `nslookup` is used to query a Domain Name System (DNS) server.
38. D. The `/? [command name]` syntax simply does not work. The CompTIA A+ objectives list `[command name] /?`, but there are other ways to get help in the Command Prompt. Typing simply `help` and pressing Enter at a command prompt will provide a list of commands that `help` can help you with. Armed with that information, you can type `help [command name]`, for example, `help xcopy`, and you will see the syntax, switches, and explanations for how the command works. Some commands, for example, `sfc`, will not work with that `help` syntax. To find help with `sfc`, you would type `sfc /?`, `sfc /help`, or `sfc help`, but none of those options work with all commands. For example, `gpresult /? works`, but `gpresult /help` will tell you that `/help` is an invalid option. Remember that the option CompTIA wants you to know is `[command name] /?`. There are upwards of 200 commands supported by Windows 10 and Windows 11. CompTIA's A+ objectives list just a few, so focus on those.
39. C. Event Viewer (`eventvwr.msc`) is a Windows tool available in most versions, and it allows you to view application error logs, security audit records, and system errors. System Information (`msinfo32.exe`) shows a plethora of information about the hardware and software of a system, but it doesn't keep a log of changes. It provides static information available at the time you launch the program. Windows Defender is a Windows 10 Control Panel utility that provides a software firewall for the local computer. Disk Management (`diskmgmt.msc`) is a graphic utility for creating and formatting volumes on any physical drives attached to the system. Worth noting is that Disk Management shows you the physical disks attached to the system and their volumes, while opening File Explorer and choosing This PC shows only the logical volumes.
40. A. The screen shown is System Information. It quickly provides a snapshot of the system's hardware and software including the operating system (OS) version, Random Access Memory (RAM), processor, motherboard and much more. The program to launch it is `msinfo32.exe`. Resource Monitor's program name is `resmon.exe`. Unlike System

Monitor, Resource Monitor is changing every moment, alerting you to resources that are overused or experiencing difficulty. System Configuration (msconfig.exe) has been appearing in Windows OSs for many years, but its features have changed over time. In Windows 10 and Windows 11, this utility is used to control how Windows boots up and to provide quick access to other Windows tools. Finally, devmgmt.msc is Device Manager, which should be your go-to app when resolving hardware issues. From there, you can update or install drivers, see what isn't working, and disable hardware if need be.

41. C. The CompTIA A+ objectives don't specifically list the power modes in Windows 11 settings. They do, however, mention power plans, which have default power settings, just like power modes. If a user needs a custom power plan, they can be created in the Power Options utility of the Control Panel. Different options, such as Hibernate or Standby, can be configured for when the laptop is on battery power versus when it's plugged in.
42. A. A power plan needs to be created with the user's desired settings. This is done in the Power Options utility of the Control Panel. Different options, such as Hibernate or Standby, can be configured for when the laptop is on battery power versus when it's plugged in. There are also power settings in Windows Settings, but they are not listed in the CompTIA A+ objectives.
43. B. The way to change to a different drive is to type the drive letter and a colon, such as D:, and then press Enter. cd stands for change directory. Using cd can take you to a different directory, or change the working directory on a different drive, but it cannot take you to a different drive. root is not a Windows command.
44. C, D. Windows Pro for Workstations and Enterprise editions support up to four physical Central Processing Unit (CPU) sockets and 6 TB of Random Access Memory (RAM). The Home edition supports one CPU socket and 128 GB of RAM, while the Pro edition supports a maximum of two CPU sockets and 2 TB of RAM.
45. A. A 32-bit processor doesn't have the capability to run a 64-bit operating system (OS) in any mode. It also won't be able to run a 64-bit program. It simply doesn't have a wide enough data path.
46. C. The minimum Windows 10 storage is 20 GB. Windows 11 has a minimum storage requirement of 64GB. Windows 10 questions are included to meet the CompTIA objectives. The two options measured in GHz are incorrect because GHz is a measure of speed, not storage. Windows 10's minimum requirements are a 1 GHz or faster processor or System on a Chip (SoC), DirectX 9 or later with Windows Display Driver Model (WDDM) 1.0 driver, and a minimum 800 × 600 display. For storage, the 32-bit version requires 16 GB, and the 64-bit version requires 20 GB available for the operating system (OS). Random Access Memory (RAM) requirements are 1 GB for the 32-bit OS, and 2 GB for the 64-bit OS. Keep in mind that these are the absolute minimum requirements, and that the OS will run but not as well as you have come to expect. In reality, a faster processor, more RAM, and more storage would be expected.
47. C. The cd, md, and rd commands are used to change, make, and remove directories, respectively. They're shorthand versions of the chdir, mkdir, and rmdir commands.

The `rd` or `rmdir` command will only delete empty directories by default. With that command, the `/s` switch will remove all subdirectories and files. The `/q` switch is quiet mode, and when used with the `/s` switch, it will not ask if it's okay to remove all the files and subdirectories; it will remove them without warning. The `del` command is for deleting files.

48. B. Performance Monitor (`perfmon.msc`) offers a graphic display of a wide range of counters to track how well hardware, such as Random Access Memory (RAM), drives and Central Processing Units (CPUs), are performing over time. Those reports can be printed and filed as a baseline to compare to future performance and used to identify bottlenecks in a system. Event Viewer (`eventvwr.msc`) keeps logs of system, application, and security events that can be used for activities such as detecting attempted unauthorized access to resources. System Information provides a snapshot of the system's hardware and software, including the operating system (OS) version, RAM, processor, motherboard, and much more. The program to launch it is `msinfo32.exe`. System Configuration (`msconfig.exe`) has been appearing in Windows OSs for many versions now, but its features have changed over time. In Windows 10 and Windows 11, this utility is used to control how Windows boots up and to provide quick access to other Windows tools.
49. A. The `ipconfig` command is used to display information about the computer's current network configurations. The `/all` switch will show more detailed information than `ipconfig` alone will, such as whether Dynamic Host Configuration Protocol (DHCP) is enabled and what the Domain Name System (DNS) settings are. Typing `ipconfig /renew` will request a new Internet Protocol (IP) address from a DHCP server, if one is available to the host PC. The macOS/Linux equivalent of `ipconfig` is `ip` (replacing the old `ifconfig` command) and `tracert` shows the path a packet takes to get from one computer to another.
50. D. In Windows 11 Settings, Contrast themes is found under Accessibility. In Windows 10, the High contrast settings option makes the colors more distinct and easier for visually impaired users to distinguish between them. It might make it easier for the user to read the words on the screen. The setting is also available in Windows Settings, Personalization, Colors, then scroll down and choose Contrast Themes. In Windows 10, these were under Settings, Personalization, Themes and Settings, and Ease of Access.
51. B. `cd\` will take you to the root of whatever drive you are on. You could also type `cd` and press Enter to go back one directory at a time. For example, to go from `C:\windows\system32` to `C:\`, you would need to type `cd.. [enter], cd.. [enter]`. The other options will not get you to the root of the C drive.
52. B. Sleep stores everything that's open in Random Access Memory (RAM) and enters a low power state. The display and drives aren't using power, but power is needed to continually refresh memory so it can retain the information. It uses very little power, but "wakes up" very quickly with everything open as it was. Sleep in some computer systems and other electronic devices may be called Standby or Suspend. Shutting the computer down would cause the laptop to use no power but starting up would take longer. Hibernate stores open programs and data to the hard drive and once hibernated would use no power, but it will not resume its state as quickly as Sleep would. There is no resting power state.

- 53.** B. Linux is free and open-source, so a user can modify the operating system's source code to behave and appear however they choose. The downside is that there might not be as much support if something goes wrong, as there would be with a commercial package. Windows and macOS are closed-source commercial operating systems (OSs), meaning that you pay for them and can use their utilities to configure the OS, but you don't have access to the OS's source code. Chrome OS is a commercial, proprietary OS found only on Chromebooks, but there is an open-source version called Chromium OS.
- 54.** A. Remembering the passwords for various websites is easily managed in macOS with Keychain. It does not provide the other three options.
- 55.** A, B. Windows 11 minimum requirements are:
- 1 GHz processor
 - 4 GB Random Access Memory (RAM)
 - 64 GB or larger storage
 - Unified Extensible Firmware Interface (UEFI), not the older Basic Input/Output (BIOS) interface
 - Trusted Platform Module (TPM) version 2.0
 - Graphics card compatible with DirectX 12 or later with WDDM 2.0 driver
 - 720p high-definition display at least 9 inches diagonally
- Other specialized editions and advanced features may have additional requirements.
- 56.** B. Windows Pro editions (64-bit, Windows 10 or Windows 11) support up to 2 TB of Random Access Memory (RAM) and a maximum of two Central Processing Unit (CPU) sockets. The Home editions support only 128 GB of RAM and one CPU. Windows Pro for Workstations and Enterprise editions support up to four physical CPU sockets and 6 TB of RAM. Windows 10 has a 32-bit edition. Any operating system (OS) or CPU that is 32-bit only supports a maximum of 4 GB of RAM.
- 57.** B. The Local Group Policy Editor (`gpedit.msc`) is not available in the Home editions of Windows. It is available in the Pro, Pro for Workstation, and Pro for Enterprise editions. You don't need have Active Directory (AD) installed on a server to use the Local Group Policy Editor, although it is available there as well. Going to Administrative tools won't help because the Group Policy Editor is not available anywhere on Windows Home editions.
- 58.** C. The `cd`, `md`, and `rd` commands are used to change, make, and remove directories, respectively. They're shorthand versions of the `chdir`, `mkdir`, and `rmdir` commands. The syntax of the command is `md [drive:]path`, so the directory would appear after the drive letter when typing the command. The drive letter must be included because it is not the drive that you are on.
- 59.** B. There are three tools that quickly show you Central Processing Unit (CPU) and memory usage in Windows. They are Resource Monitor, Performance Monitor, and Task Manager. The only one that lets you set up logs is Performance Monitor. It will collect counter information and then send that information to a console or event log. Event Viewer logs system, application, and security events but not performance.

60. C. From the Personalization menu of Windows Settings, you can change the desktop theme and background colors. Accounts enables the user to manage what accounts have access to this computer and at what level. The Apps settings deal with application-specific parameters and not operating system (OS) settings. Finally, the System settings in Windows Settings has a multitude of settings that relate to the system but not the image that appears on the desktop.
61. D. The Google Chrome OS was developed by Google. It comes preinstalled on laptops and tablets called Chromebooks. A freeware version, Chromium OS, can be installed on tablets, smartphones, laptops, and desktops. Ubuntu is based on the open-source Linux OS kernel. iOS is Apple's proprietary operating system (OS) and Windows 11 Pro was developed by Microsoft.
62. D. Finder in the macOS is very similar to File Explorer in Windows. Both allow you to browse through folders and find files, disks, and applications. Both can be used to change the view so entries can be seen as images, a list, a column, and so on. Spotlight is the tool for searching within macOS, and iCloud is similar to Microsoft's OneDrive for storage.
63. A. The ping (i.e., packet Internet groper) command sends a series of four packets to a remote computer and waits for a reply. If the reply is received, you know that the local computer is able to reach the remote host. It also displays how long the transaction took. ping can be used with domain names like [Wiley.com](#), or the IP address (if known). When ping localhost or ping 127.0.0.1 or ping ::1 is run, the command verifies that Transmission Control Protocol/Internet Protocol (TCP/IP) is working on the local computer. tracert shows the routers that a packet traverses to reach its destination. ipconfig is used to view network configuration, and pathping is a combination of the abilities of ping and tracert.
64. B. All of the answer choices are Linux commands. The pwd (print working directory) command writes the full path to the current (working) directory from the root on whatever the default output device is (usually the display). The path might be, for example, /home/audrey/documents. The ls command provides a list of all the files and folders found in the current directory, while the cp command is used to copy files and directories, and yum (Yellowdog Updater Modified) is used to install, update, remove, and search for software packages.
65. D. If a user finds their desktop getting out of hand, they can create multiple desktops, which macOS calls Spaces, to organize their desktop objects, or simply to make more space. Multiple desktops are created using Mission Control. Once multiple desktops are created, apps can be moved from one desktop to another by dragging, similar to using a smartphone. Finder is used to drill down through the file structure to find what you're looking for, and Time Machine is used to make backups.
66. B. The macOS Dock provides quick access to the programs you'll likely use most often. Taskbar provides a similar function in the Windows operating system (OS). File Explorer and Finder are both used to drill down through the filesystem to find what you're looking for, with File Explorer being the Windows utility, and Finder being the macOS utility.
67. D. Event Viewer, Disk Management, and Certificate Manager are all Microsoft Management Console (MMC) snap-ins. An MMC provides an interface where a user can

configure and easily access their own tool list that they use most often. These tools are called snap-ins, and many of them are available. A console contains shortcuts to the tools, and when the console is saved, it can be identified by a toolbox icon. Services are programs that run in the background on a Windows system, such as Print Spooler and Wireless Local Area (WLAN) AutoConfig. Processes are parts of a program that are running, usually consisting of multiple threads. Threads are the section of code being worked on by the processor. Policies are rules for granting access, such as the ability to log on locally or settings for passwords requiring complexity. Policies are configured through the Group Policy Editor (`gpedit.msc`) and are not available in Windows Home editions. There are literally hundreds of policies that can be set in a Windows system. The Group Policy Editor is also an MMC snap-in.

68. C. The Hibernate power setting, once it has saved everything from Random Access Memory (RAM) to a system file (`hiberfil.sys`) on the hard drive, will turn the system off and use no power. Hibernate takes considerably longer to get back to a running state than Sleep does, but Hibernate won't use any power after it has stored the data. When the system is resumed, the contents of the system file are copied back into RAM and the user can continue where they left off. Sleep needs a small amount of power to keep the data in RAM refreshed. Always On will obviously use power continuously, and Hyper-V is Microsoft's virtualization product, not a power setting.
69. B, C. Because you are already on the C drive, you would not need to specify the drive letter to change to a directory on that drive. If you did specify the drive, it's not a problem, because if you were going to a directory on a different drive, you would need to specify the drive letter. You could go to that directory with two commands, changing one directory at a time, by typing `cd windows [enter]` and then `cd system32 [enter]`, but that would be inefficient and is not one of the options given. You can also type `cd.. [enter]` to go back one directory.
70. D. The `resmon.exe` program launches the Resource Monitor, which is shown in the graphic. Resource Monitor is a powerful performance monitoring tool. It provides more granular information than Task Manager or Performance Monitor but doesn't have the ability to save a log of performance. The Event Viewer can be launched with `eventvwr.msc`. The Local Users and Groups application can be launched with `lusrmgr.msc`, and the Performance Monitor can be launched with `perfmon.msc`.
71. B. Any 32-bit operating system has a limit of 4 GB of Random Access Memory (RAM). The limitation is caused by the bus width. There simply aren't enough numbers available to identify memory locations above 4 GB.
72. A. Remote Desktop can only be enabled on a Windows Pro or better operating system (OS). Windows Home edition does not have this capability. However, using a PC with Windows Pro, Pro for Workstations, or Enterprise edition is not the only way to access the manager's computer. The Remote Desktop Mobile app (called the Microsoft Remote Desktop) is available for iOS and Android devices.
73. D. The `gpupdate` tool is used to update Group Policy settings immediately. It refreshes, or changes, both local and Active Directory (AD)-based policies. The `gpedit` command allows

the user to edit group policies, while the `gpresult` command will show the Resultant Set of Policy (RSOP) for a user or computer. RSOP is the culmination of all policies that affect the target user or computer. It is particularly helpful in troubleshooting conflicting policies. `gprefresh` is not a valid command.

74. B. The `pathping` command works like `ping` and `tracert` combined. It shows the path a packet takes from point A to point B, then will show the time at each hop. (A hop is the number of routers a packet passes through to get to its destination after it leaves the initial router.) `grep` and `mv` are Linux Terminal commands, which are used to search for text from a file, and move files and folders, respectively. The `tracert` command shows the path a packet takes to its destination.
75. A. To turn off all notifications, or to choose how to manage if and how individual notification senders can interact with you, In Windows 11 Settings, choose System, then Notifications and choose Notifications again. From here, you can turn off all notifications or some and choose whether or not a sound is played when they arrive. The Gaming option enables configuring the system to be optimized for gameplay and recording. The Update & Security option is only available in Windows 10, and doesn't address notifications. The Apps option lets you manage where apps can be installed from, default apps for opening files, and other application configuration settings.
76. B, C. In October of 2022, the Ventura release of the macOS changed System Preferences to System Settings, to make the desktop operating system (OS) more in line with iOS and iPadOS. Preferences for each app can still be found within the app. At that time, they renamed some apps and moved them around, so troubleshooting will depend on whether the macOS involved is newer or older than Ventura.
77. C. The macOS Disk Utility can be used to find and fix errors in the directory structure of a Mac disk. If the Mac won't boot into the operating system (OS), the utility can be accessed through macOS Recovery. Depending on the hardware your Mac is using, you would either hold the power button until startup options appear or press and hold Command+R while the computer is starting to bring up macOS Recovery. From there, choose Utilities and Disk Utility. FileVault provides encryption; Terminal is the macOS and Linux command-line user interface, as well as the new Windows 11 command-line interface; and Force Quit can be used when a single app is causing problems and refuses to close. In Windows, Terminal opens the PowerShell interface, but the Command Prompt is still available. The Windows Terminal enables the user to run multiple shells at the same time, including the Command Prompt, Linux bash, and PowerShell.
78. A. Task Scheduler is a Microsoft Management Console (MMC) snap-in, and as its name implies, a tool for running programs and performing tasks based on a trigger, such as date or time or events such as logon, idle, or locking the workstation. Event Viewer keeps logs of system, security, and application events. Device Manager is a tool for working with hardware, such as updating drivers and scanning for newly attached devices. Local Users and Groups is a MMC snap-in for creating and managing users and groups.
79. C. When an operating system (OS), smartphone, PC, or any electronic device is at end-of-life (EOL) or end-of-support, it generally is no longer sold or supported, meaning

that replacement parts and product and security updates are no longer available. While you might be able to scavenge parts, not getting security updates should be a great concern. At an electronics end-of-support, the best course of action is to recycle the device and procure a newer one. The other options are generally not true.

80. A. The `dir` command will show you a list of all the files and folders that are in the directory you are working in, along with the date created. Using the switches that work with `dir`, you can view much more information. The `ls` Linux command lists information about files in the working directory. The `pwd` Linux command prints the complete path to the working directory, and the `grep` Linux command searches for files with a pattern that you specify.
81. A. Disk Management is a Windows tool that has been available for many Windows versions. With it, you can reassign or change a drive letter, create and format volumes, shrink or expand volumes, change basic drives to dynamic drives, import foreign drives, and even establish software Redundant Array of Independent Disks (RAID). In Windows 10, it can be launched through the Control Panel by choosing Administrative Tools, then Computer Management or by typing `diskmgmt.msc` in the Search box. In Windows 11, Administrative tools has been replaced with Windows Tools, which is not as robust and doesn't provide a link to Disk Management; however, the easiest way to access Disk Management in Windows 10 or 11 is to press the Windows Key plus the X key to bring up the Quick Link menu, which is a list of commonly used tools, then simply click Disk Management on the list.
82. C. FileVault is the macOS utility for encrypting data. Finder is the macOS utility for drilling down through folders to find objects. Time Machine is used to create and restore backups of data on a Mac, and BitLocker is the Windows drive encryption utility.
83. B. Time Machine is the macOS backup utility. It can be accessed through System Preferences, and once it's set up, it will run on schedule much like any other backup software. Image Recovery and iBackup are not macOS tools. Accessibility options can be found in System Preferences and are used to adjust settings for different vision, hearing, and mobility needs.
84. A. Updates to macOS can be found under Software updates in Settings. Individual applications can be updated through the App Store. Open it and click Updates in the toolbar to see which updates are available.
85. A. If you need to know the Windows version of the PC you're working on, press Windows+R to bring up the Run dialog box and type `winver`, then click the OK box or press Enter. This command works in both Windows 10 and Windows 11. You'll see a screen similar to the one shown in the graphic. The other options are not valid commands.
86. B. The `gpresult` command will show the Resultant Set of Policy (RSOP) for a user or computer. RSOP is the culmination of all policies that affect the target user or computer. It is particularly helpful in troubleshooting conflicting policies. The screen shown used the `/r` switch, which shows the RSOP summary for the currently logged-in user on the local computer. The `gpedit` command allows the user to edit Group Policy settings. The `gpupdate` tool is used to update Group Policy settings. It refreshes, or changes, both

local and Active Directory (AD)-based policies. `gprefresh` is not an existing command.

87. B. All the commands listed are Linux commands. The `cp` command is used to copy files. There are three syntax for the `cp` command, as follows:

1. `cp [option] source destination`
2. `cp [option] source directory`
3. `cp [option] source-1 source-2 source-n directory`

For example, if the copy command has two filenames, it will create a copy of the first filename and save it as the second. The command would be `cp file1 file2`. The `mv` command is used to move files, and the `find` command is used to find files and directories and perform operations on them. The `cat` command is a powerful tool that can be used to view contents of a file, create new files, and concatenate (i.e., put together) files.

88. A, B. Operating systems (OSs) and electronics have a lifecycle just as all living things do. They are introduced, grow, reach maturity (receive mainstream support), decline (receive extended support), and reach their end-of-life (EOL, receive no support). The end of mainstream support means that there are no updates other than security. The end of extended support means there is no support, including security updates and patches. Essentially, if (when) a vulnerability is discovered by a hacker, the user of an EOL OS is at risk for being attacked. Applications may continue to work just fine, but updates might not work with the OS. The OS will not magically stop working, but if a problem occurs there will be no official support available.
89. D. The Chromebook, which has the Chrome OS preinstalled, is the best option for this user. Its main user interface is the Google Chrome browser, and it can run apps designed for Android smartphones. Chromebooks are also known for being less expensive laptop options. Windows Home and macOS would be fine for accessing the Internet, but they would not support the applications that the user is accustomed to using, and the user would experience a learning curve. Linux might be able to run their Android apps using third-party software, but again the user would have a learning curve.
90. C. Certificates are a way of proving who someone or a website is by means of a digital signature. A user's certificates hold the private key of a key pair for encryption. If certificates are outdated or otherwise no longer valid, then encryption doesn't happen and the transmission can be intercepted by someone with malicious intent. Normally you wouldn't need to worry about certificates, but if a problem occurs, the certificate may need to be deleted and a new one requested. Certificate Manager (`certmgr.msc`) allows you to view and manage certificates by user or computer. Device Manager is a hardware management tool. Local Users and Groups allows for organizing users by access need and assigning permissions and access to the group rather than the user, simplifying access management. Group Policy Editor allows administrators to further control what users and computers are allowed to do on the network.
91. C. macOS is Apple's proprietary desktop operating system (OS). Apache is a popular web server OS, not a desktop OS. Red Hat Linux is a distribution of the open-source Linux OS, and FreeBSD is a freeware, open-source OS based on UNIX.

- 92.** B. The Domain Name System (DNS) has one function on the network, and that is to resolve hostnames to Internet Protocol (IP) addresses. For a computer or phone to open a website, it needs to know the IP address of that website. Each DNS server has a database called a zone file, which maintains records of hostname to IP address mappings. If the network settings for a DNS server on a client computer are improperly configured and the client can't reach the DNS server, then human-friendly names are not resolved to IP addresses, causing the problem this user is having. Authentication servers are used to verify whether a user has the proper credentials to gain access to resources on a network. A Domain Controller (DC) is created when Microsoft's Active Directory (AD) is installed on a server. A DC is a type of authentication server. A Dynamic Host Configuration Protocol (DHCP) server is used to automatically provide an IP address to a client based on a list (scope) of IP addresses made available on the DHCP server. A proxy server sits between the client and the outside world and is used to filter incoming or outgoing content.
- 93.** A. The `su` command (switch user, substitute user, or super user) is used to start another shell on a Linux computer. Without specifying the username, it's assumed you are trying to start a shell with a super user (or `root`) authority. This can be dangerous because as the `root`, the user can do anything on the system, including delete parts of the operating system (OS), and there is no undo or warning message. You must know the `root` password to run `su`. It's far safer to run the `sudo` command. The `sudo` command stands for superuser do, or substitute user do, and it will run a single command as the alternate user. The `apt-get` command is used to download or remove software packages, and it has largely been replaced by the `apt` command, which is newer and more user friendly. The `ps` command lists the processes that are currently running along with their Process IDs (PIDs).
- 94.** D. The Displays pane in System Preferences is used to set resolution and brightness (turn Night Shift on and off), and possibly other settings depending on whether there is a display connected. The Printers & Scanners pane is where you would add or manage a printer and its print jobs. Accessibility preferences include settings for hearing, mobility, and vision. The Desktop & Screen Saver options allow you to configure the desktop and screen saver.
- 95.** A, B, C. For some services like Microsoft 365, you'll need a license and pay a fee monthly or annually (or your employer will) to have access to collaboration tools. For Google collaboration tools, you need to create a Google account. Most smartphones come with some collaboration tools preinstalled and ready to use. It is unlikely that you would need to purchase each separately and install them on your device, as they often are packaged together.
- 96.** B. The System File Checker (SFC) is a command-line utility that checks and verifies the versions of system files on your computer. If system files are corrupted, the SFC will replace the corrupted files with correct versions. The `/scannow` option will scan and repair files, whereas `/scanfile` will just check one specified file. The `/verifyonly` option will scan the integrity of protected system files but not attempt to repair them. The `/verifyfile` option will verify the integrity of a specific file.
- 97.** C. The `robocopy` utility (Robust File Copy for Windows) has the big advantage of being able to accept a plethora of specifications and keep New Technology File System (NTFS) permissions intact in its operations. For example, the `/mir` switch can be used to mirror a

complete directory tree. Both `copy` and `xcopy` are valid commands but have nowhere near the power that `robocopy` does. `copyall` is not a valid command.

- 98.** B. When files are written to a hard disk drive (HDD), they're not always written contiguously, that is, with all the data in a single location. Defragmenting a disk involves analyzing the disk and then consolidating fragmented files and folders so that they occupy a contiguous space (i.e., consecutive blocks), thus increasing performance during file retrieval. The executable for Disk Defragment is `dfrgui.exe`, which brings up the Optimize Drives window. By default, drives are automatically scheduled to be optimized, but it can be done here on command, or the schedule settings can be changed. The Disk Management (`diskmgmt.msc`) utility is used to create and format volumes and other tasks related to managing drives. Performance Monitor (`perfmon.msc`) shows real-time or logged performance indicators and Device Manager (`devmgmt.msc`) is useful in examining and troubleshooting issues with hardware.
- 99.** D. Because the majority of business users are still using Microsoft products and there may be compatibility concerns with data from older systems, a Windows operating system (OS) would be the correct choice. Chrome OS is most appropriate where users would be working in the cloud. Linux and macOS may have compatibility issues with data from other sources. Microsoft 365 does come in a version for macOS; however, the company specific software must also be considered.
- 100.** A. System Preferences is where settings can be viewed and modified. System Preferences are divided into various panes, including Displays, Networks, Printers & Scanners, Privacy, Accessibility, Time Machine, Power, and many other selections for changing settings. Windows Settings is a part of the Microsoft Windows operating system (OS). App Store is where you would go on a macOS to find new applications to download and update the OS.
- 101.** C. The Update & Security category of the Settings app in Windows 10 contains more than the name would suggest. In Update & Security, there is, of course, Windows Update and Windows Security, but users can also find Backup, Troubleshoot, Recovery, Activation, Find my device, For developers, and Windows Insider Program selections. To perform a backup using File History, an additional drive is needed (you can't back up to the drive Windows is installed on), and under More options, you'll find settings for how often to automatically back up your computer and be able to choose which folders to back up. (In Windows 11, use File History to backup files. File History can be found in the Settings app or in the Control Panel. Backup and Restore, from Windows 7, can be found in the Control Panel.) The Systems category contains Display, Sound, Power, and other system-related settings. The Apps category is where you can uninstall apps, set default apps, and change what apps load upon startup. The Network & Internet category has Wi-Fi settings and a network troubleshooter, among other common network-related settings.
- 102.** B, C. Typically, on a network, static Internet Protocol (IP) addresses, rather than dynamic ones, would be assigned to shared resources such as file servers and printers/Multifunction Devices (MFDs) to avoid problems connecting to those resources that might occur if their IP addresses were acquired dynamically. A user's workstation normally does not need a static IP address and allowing it to obtain one automatically makes workstation configuration easier and avoids accidental duplication of IP addresses. A local printer,

by definition, is attached to a local computer and not directly to the network, so it wouldn't have its own IP address.

- 103.** C. When the application is running, the operating system will also be running, so you need to add their respective Random Access Memory (RAM) requirements together to determine the minimum total amount of system RAM needed. The minimum amount of RAM for a Windows 11 installation is 4 GB, and because the application's RAM requirement is 4 GB, you'll need a total of at least 8 GB. Because you only have 4 GB, an additional 4 GB will need to be installed. While that will run the program on this system, having only 4 GB for the operating system (OS) will not allow it to run as fast as the user is accustomed to, so in reality you'll likely want to add more.
- 104.** C. Although the Extended Filesystem (XFS) and Fourth Extended File System (ext4) are both filesystems used with Linux, the XFS file system, which uses parallel execution, is more robust and designed to handle the large file sizes of database servers. File Allocation Table 32 (FAT32) is the filesystem that was used when only 32-bit processors were available and can still be used for compatibility issues with legacy devices or compatibility between different platforms, such as Windows, Linux, and macOS. However, Windows 10 installations default to New Technology File System (NTFS) as the filesystem used for installation, and Windows 11 requires it. FAT32 only supports 4GB of RAM due to the word size limitation of a 32-bit data path, and Windows 11 supports terabytes (TB) of RAM. NTFS has been available for decades and offers security features that FAT32 doesn't have.
- 105.** C. An installation can be started many ways—with a USB drive, a DVD, and so on—and an image and setup files can also be located on and installed from a network. Often called a PXE-initiated boot (for Pre-boot Execution Environment), it allows the workstation involved in the installation to retrieve the files from the network as needed and then configure variables accordingly. Netboot refers to booting a computer from a network drive, not installing an operating system (OS). Unattended installation is an installation type that uses an answer file and little or no interaction from a human. While it's possible to install Windows from a USB, if you're using a USB to boot and install an image from a server, the bare metal machine still needs PXE support.
- 106.** D. Because the workstations don't have DVD drives, you can't use optical media to install Windows 10, and because there are no USB ports, it's unlikely that you will be able to use an external drive. Internet-based installation requires that you can boot and get to the Internet, so you would need an operating system (OS) already installed, and the question states that these are bare metal machines. You're left with a network installation using the Pre-boot Execution Environment (PXE) boot as the only option.
- 107.** B. The `sudo` command stands for superuser do, or substitute user do, and will run a single command as the alternate user. The user can authenticate with their own password instead of the `root` password, which is a security feature. Another command, `visudo`, is used to configure exactly what each user can do when they run `sudo`. The `visudo` command is not on the CompTIA A+ objectives, but it answers the question of how you would control the access of users who are not `root`. The `su` command (i.e., switch user, substitute user, or super user) is used to start another shell on a Linux computer. Without specifying the

username, it's assumed you are trying to start a shell with super user (or `root`) authority, and you need the root password to run it. Note the difference between `su` and `sudo`, starting a whole new shell vs. running a command. The `apt` command, which has largely replaced `apt-get`, is used to download or remove software packages, and the `ps` command will list the processes that are currently running along with their Process IDs (PIDs).

108. C, D. The `hostname` command returns the name of the computer that it is entered on and, while not its primary purpose, `ping localhost` will also return the computer's name. `Nslookup` will show the default DNS server and its IP address. `clientname` is not a valid command.
109. D. The `tracert` command will show the routers that a packet went through and how long each hop took, which can narrow down your search for the problem by showing how far it got. The Linux equivalent to `tracert` is `traceroute`. Typing `ipconfig /all` will show the current Transmission Control Protocol/Internet Protocol (TCP/IP) configuration of the local machine, such as its IP address, Media Access Control (MAC) address, and default gateway. The macOS/Linux equivalent of `ipconfig` is `ip`. The `ping` command will only show that the packet is not making the trip there and back by timing out.
110. C. Ease of Access Center has settings to help users who have limited sight, mobility, or hearing. Devices and Printers is for managing and troubleshooting printers, print jobs, and other devices like connected smartphones or keypads. Programs and Features lets you uninstall or change installed programs, and Sound is used to configure recording and playback devices or choose a sound scheme.
111. D. The `ps` command (i.e., process status command) will list the currently running processes along with their Process IDs (PIDs), the controlling terminal for the process, the time the Central Processing Unit (CPU) has been used by the process and the name of the command that started the process. The `su` command (i.e., switch user, substitute user, or super user command) is used to start another shell on a Linux computer. The `sudo` command stands for superuser do or substitute user do and will run a single command as the alternate user. The `apt` command, which has largely replaced the older `apt-get` command, is used to download or remove software packages.
112. B. Extended File System, version 4 (Ext4) is not compatible with macOS and Windows. Neither is ext3. For compatibility between Linux, macOS, and Windows, format an external drive with Extensible File Allocation Table (exFAT) or File Allocation Table 32 (FAT32), so it can be read by any of the three. ext3 only supports file sizes up to 2 TB and volumes up to 16 TB, while ext4 supports files up to 16 TB and volumes up to 1 EB. ext3 is limited to about 32,000 subdirectories, while ext4 has no limit. ext4 also provides superior resistance to fragmentation and faster filesystem checking.
113. B, C. Going to the Control Panel and choosing the Sound utility will enable you to change the default playback device for sound, so will opening the Windows Settings app and clicking on System, then Sound. Opening Windows Settings, then System and Sound will as well, but that is not one of the answer choices. The Security and Maintenance utility in the Control Panel has settings for the firewall, malware protection, and other features. The Apps group in Windows Settings is where you would uninstall or choose default apps.

- 114.** A. The Power Options utility in the Control Panel is where you can find the setting for changing what happens when you close the lid, and other Sleep and Hibernate options. Windows 10 has an option in the Windows Settings app, System group, under Power options that says Additional power settings, which takes you into the Control Panel utility. Windows Settings in Windows 11 is missing this link, but in both versions of Windows, the other power settings (i.e., when to sleep, when to hibernate) are available in Windows Settings. Devices and Printers is where you would manage printers and print jobs, and other devices like connected cell phones. The System group in Settings controls Display, Sound, Notifications & Actions, and several other areas related to the system as a whole. The Devices group in Windows 10, Windows Settings allows you to configure Bluetooth, printers, and mouse settings. In Windows 11, this group is called Bluetooth & Devices.
- 115.** A, D. No, you can't upgrade directly from Windows 8 or 8.1 to Windows 11. Upgrading from Windows 10 to Windows 11 might be free based on the situation, but to upgrade from Windows 8, you would need to buy a Windows 10 or 11 license and perform a clean install. A PC can be upgraded from Windows 10 Professional to Windows 11 Professional directly from the desktop of the PC, but not to a different edition; for example, going from Windows 10 Home to Windows 11 Pro would require purchasing a Windows 11 Pro license. The other consideration is that hardware that ran a Windows 8 PC probably won't meet the hardware requirements for Windows 11.
- 116.** C. In many Linux distributions, the `apt` or `apt-get` command is used to download or remove software packages. The syntax for this command is `apt-remove [options] command`. There are too many options to explain them all here, but in the question we are uninstalling an app, so the command could be `apt-get purge [package name]`, but remember that you would want to precede the `apt-get` command with `sudo`. If the package name were `milou`, then the command would be `sudo apt-get purge milou`. Using `purge` deletes all configuration files as well as the package. The `sudo` command stands for superuser do, or substitute user do, and will run a single command as the alternate user. The `su` command (i.e., switch user, substitute user, or super user) is used to start another shell on a Linux computer. Without specifying the username, it's assumed you are trying to start a shell with super user (or `root`) authority. The `ps` command will list the processes that are currently running along with their Process IDs (PIDs).
- 117.** B. An in-place upgrade enables you to keep user settings, apps, and data while upgrading a system. You can also use an in-place upgrade to refresh an operating system's files if you're having difficulties and are unable to resolve them. Make sure you log in with an administrator account. Sometimes, the in-place upgrade doesn't work perfectly and changes something you didn't want it to change, so be certain that you have a backup before executing the upgrade, preferably as a system image. A clean installation wipes out everything on the hard drive and replaces it with a new operating system (OS). A program-only upgrade isn't a real term. A multiboot is having two OSs on a computer and choosing which one you want to use at startup. This is cumbersome at best, and the new OS wouldn't automatically have all your files.
- 118.** C. Device Manager is the first place to go when troubleshooting hardware. A yellow exclamation point will let you know that there is a problem that needs to be addressed.

Event Viewer keeps logs of system, security, and application events. Performance Monitor helps locate bottlenecks in a system by showing resources being used in real-time, and Disk Management allows formatting, partitioning, and managing storage drives.

- 119.** D. System Configuration (`msconfig.exe`) has been appearing in Windows operating system (OSs) since 2006, but its features have changed over time. The General tab lets you choose a Diagnostic startup that will load just basic devices and services, which can sometimes aid in troubleshooting. The Boot tab lets you choose other boot options. Timeout, on the right of the Boot tab, can be set if you have more than one OS on the hard drive and want time to choose between them. However, a more common option now is to use Virtual Machines (VMs) when more than one OS is needed. The Services tab is where you can stop and start many services, although that can also be done through the services console (`services.msc`), which has all of the services. The Startup tab only has a link to Task Manager, and the Tools tab is used to provide quick access to other Windows tools. Event Viewer (`eventvwr.msc`) keeps logs of system, application, and security events that can be used for activities, such as detecting attempted unauthorized access to resources. Performance Monitor (`perfmon.msc`) offers a graphic display of a wide range of counters to track how well hardware, such as Random Access Memory (RAM) drives and Central Processing Units (CPUs), are performing over time. System Information provides a snapshot of the system's hardware and software, including the OS version, RAM, processor, motherboard, and much more. The program to launch it is `msinfo32.exe`.
- 120.** B. Some of the more important files that you will need to work on are hidden by default as a security precaution. To make certain folders or files visible, you need to change the display properties of File Explorer. This can be done by going to the View tab of File Explorer Options in the Control Panel and deselecting Hide Protected Operating System Files (Recommended). Programs and Features is for uninstalling or changing programs and turning Windows features on and off. Indexing makes a log of the metadata of files and helps search work faster. The System utility of the Control Panel opens System in Windows Settings.

Note that the CompTIA A+ objectives list tabs and options available in File Explorer Options, which is found in the Control Panel. These options are a bit different than the ones you see when you open File Explorer from the taskbar, so you need to know which options you can access there. However, like most things in the Windows operating system (OS), there is more than one way to perform a task. When sitting for the CompTIA A+ exam, make sure you are familiar with the method that CompTIA has identified in their exam objectives.

- 121.** A. Terminal has long been the name of the command-line user interface in both macOS and Linux. In Windows 11, Microsoft added Terminal to their operating system (OS), which launches a PowerShell command-line interface and enables the user to include tabs for other command-line interfaces such as the original Command Prompt. In any command-line interface, a user can type commands to perform actions and launch programs. Often, for experienced users, using a command-line interface is faster than navigating menus. Finder is the macOS utility for drilling down through folders to find objects. Command Prompt is the name of the older Windows command-line user interface, and File Explorer is the Windows rendition of Finder.

- 122.** C. Windows Defender Firewall is a software firewall residing on the local system that provides features designed to protect your system from malware. Unfortunately, sometimes those settings interfere with other applications and need to be changed. Turning the firewall off is not advisable, but you can open it up to applications by clicking on Allow an app or feature through Windows Defender Firewall. Programs and Features is used to uninstall or change applications and turn Windows features on and off. Internet Options affect how browsers work and can be used to connect to a virtual private network (VPN). The Network and Sharing Center is the Windows Control Panel tool for viewing and configuring network connections and changing adapter settings.
- 123.** B. Most computer users don't need to look at file extensions, but sometimes as technicians, those extensions are very important! The option to hide or show file extensions is found on the View tab of File Explorer Options in the Control Panel. You can also hide them in File Explorer, which is not a Control Panel utility, by clicking on View, then Show, and unchecking the box that says File name extensions. Programs and Features is for uninstalling or changing programs and turning Windows features on and off. Indexing makes a log of the files' metadata and helps search work faster. File Explorer is incorrect because the question asks for a Control Panel utility, and it isn't one. File Explorer is opened through the folder icon on the task bar.

Note that the CompTIA A+ objectives list the File Explorer Options that you should know. Refer to the objectives list at the beginning of this chapter. Although most technicians would access common settings through File Explorer found on the taskbar, not all the File Explorer Options settings are found there. Like most things in Windows operating systems (OSs), there is more than one way to perform a task. Make sure you know at a minimum the way(s) that CompTIA is asking for.

- 124.** B. The Local Users and Groups application can be launched with the `lusrmgr.msc` command and provides quick access to modify users and the groups to which they belong. The Event Viewer can be launched with `eventvwr.msc` and tracks actions involving security, applications, and the system, and will audit failed or successful logins. Performance Monitor can be launched with `perfmon.msc`, and `groups.exe` isn't a real application in Windows 11.
- 125.** B. The `df` command (i.e., disk free command) is used to show free and used disk space on a volume. The syntax of this command is `df [option] [file]`. If you type `df` and press Enter, it will show the space available on all filesystems that are mounted. If you specify a particular file, it will provide information on that file. The `grep` Linux command will search for files with a pattern that you specify. The `ps` command will list the processes that are currently running along with their Process IDs (PIDs). The `dig` command (i.e., Domain Information Grouper command) works in Linux and macOS to find information about Domain Name System (DNS) name servers, mail exchanges, and hosts.
- 126.** A. The `gpedit` command allows the user to edit group policies, while the `gpresult` command will show the Resultant Set of Policy (RSoP) for a user or computer. RSoP is the culmination of all policies that affect the target user or computer. It is particularly helpful in troubleshooting conflicting policies. `gprefresh` is not a valid command. The `gpupdate` tool is used to update Group Policy settings immediately after policy changes have been made. It refreshes, or changes, both local and Active Directory(AD)-based policies.

- 127.** B. Local Users and Groups allows you to organize users by access need and assign permissions and access to the group rather than the user, thus simplifying access management. Incidentally, assigning New Technology File System (NTFS) permissions to groups rather than individuals is considered a best practice. Suppose your accounting manager suddenly quits and you hire a new one. Rather than setting up permissions for the new manager, you would merely add their username to the appropriate groups. (And, of course, disable the former manager's account.) Group Policy Editor allows administrators to further control what users and computers are allowed to do on the network, such as enforcing password complexity, disabling USB drives, and limiting what users can do in the Control Panel. Device Manager is a hardware management tool, and Certificate Manager allows you to view and manage certificates by user or computer. Certificates hold the private key of a key pair used in encryption.
- 128.** B. When an app hangs inside macOS, you can use Force Quit to force it to close. Most devices, whether running macOS or iOS, offer similar options. You get to Force Quit by looking at the Apple menu or by pressing Command+Option+Esc, which is analogous to pressing Ctrl+Alt+Del on a Windows PC. Task Manager is a Windows utility, Terminal is the macOS and Linux command-line user interface, and Time Machine is used for backups. Windows 11 includes Terminal, which opens a PowerShell command-line interface and enables users to open multiple tabs for different command-line interfaces.
- 129.** A, D. Although the graphs look different in each application, both the Performance tab of Task Manager and the Resource Monitor utility will show Central Processing Unit (CPU), memory, and Wi-Fi statistics in real-time. In Performance Monitor, a Wi-Fi connection could be found on the Network tab. Event Viewer logs system, software, and security events. The System Information utility, which can be found in Administrative Tools, shows a snapshot of a system's configuration, but not real-time information. Note: Administrative Tools is a utility in Windows 10 but is not a part of Windows 11. Instead, Windows 11 has the Windows Tools application, which has many but not all of the same utilities available in the Administrative Tools utility. Note that Windows Tools is not on the CompTIA A+ objectives, but Administrative Tools is.
- 130.** B. The Linux `ls` command lists information about files in the working directory. The `dir` command in Windows does the same. The `pwd` Linux command prints the complete path to the working directory, and the `grep` Linux command will search for files with a pattern that you specify.
- 131.** C. The Linux Terminal is a command-driven user interface that allows the user to interact with the shell by typing commands at a prompt, much like the Windows Command Prompt in Windows 10 and previous versions, or the Terminal in Windows 11. The command-driven user interface in macOS is also called Terminal. The shell is the part of the operating system (OS) that sits between the user and the rest of the OS, allowing the user to interact with the OS. Time Machine and Mission Control are features of macOS used for backups and viewing all open applications, respectively.
- 132.** D. Disk Cleanup (`cleanmgr.exe`) will look through your hard drive and show how much space unused files are taking up. You then have the option to choose which files you would like to delete. Clicking on a file type will provide a description of what is being deleted. On modern, large hard drives, the space saved is usually negligible. Resource

Monitor (`resmon.exe`) shows resources being used by process in real-time. Disk Management (`diskmgmt.msc`) is a graphic utility for creating, formatting, and managing volumes on any physical drives attached to the system. You can even use it to configure software Redundant Array of Independent Disks (RAID). The Registry is a huge database that contains information about all the users, hardware, software, and configuration information in a computer. Typically changing the registry by using the Registry Editor (`regedit.exe`) is a last resort, because changes are immediate and there is no undo button. The Control Panel and Windows Settings can do much of the registry management for you, and they're much safer.

- 133.** A. The Event Viewer can be launched with `eventvwr.msc`. Event Viewer tracks actions involving security, applications, and the system, and it will audit failed or successful logins. The Local Users and Groups application can be launched with the `lusrmgr.msc` command and provides quick access to modify users and the groups to which they belong. Performance Monitor can be launched with `perfmon.msc`, and `groups.exe` isn't a real application in Windows 11.
- 134.** C. Windows configuration information is stored in a special configuration database known as the Registry. This centralized database also contains environmental settings for various Windows programs. To edit the Registry, use the `regedit.exe` program. Be careful, though, because an incorrect Registry change can render a system inoperable. Changes are immediate and there is no undo. The System Information utility, `msinfo32.exe`, provides a snapshot of the hardware, software, and some configuration information for the system. Entering `compmgmt.msc` opens computer management, and `notepad.exe` launches the Notepad program, which is a simple text editor. Commands like these can be run using the Command Prompt, the Windows Terminal, or the run command, which can be accessed by pressing the Windows Logo Key+R.
- 135.** B. To stop (disable) programs from running on startup, use the Startup apps list in Task Manager, which is found by clicking its icon on the left of the Task Manager screen. The System Configuration utility was the place to go in older versions of Windows, but now it merely has a link to Task Manager. Services are programs that run in the background and are part of the operating system, not applications that have been added. A limited subset of them can be configured on the Services tab of Task Manager, or all services can be accessed through the Services Console (`services.msc`). Task Scheduler is used to automatically perform some action(s) when a trigger, such as a date, time, or other event, is reached.
- 136.** C. On a Mac, it's possible to run numerous things at one time, whether those things in question are apps or Windows Desktops. Apple's Mission Control is an easy way to see what is open and switch between applications. To access Mission Control, you can press the Mission Control key (identified by an image of three different size rectangles) on an Apple keyboard, click the Mission Control icon in Dock (or Launchpad), or swipe up with three or four fingers on a trackpad. Spotlight is used to search for files, folders, images, and such. Keychain is the macOS password-management feature, and Finder enables the user to drill down through directories to find what they're looking for, much like File Explorer in Windows.

- 137.** A. Clicking Devices and Printers in Windows 11 will take you to Settings, Bluetooth & Devices, where you can click on Printers and Scanners. From there, you can manage multiple printers and perform tasks, such as choosing a default printer, installing new printers, and changing printer settings. Programs and Features allows the user to add, remove, or troubleshoot installed programs (the options will change by program) and add or remove Windows features. The Network and Sharing Center is the Windows Control Panel tool for viewing and configuring network connections and changing adapter settings. Device Manager should be your go-to app when resolving hardware issues. From there, you can update or install drivers, see what isn't working, and disable hardware if need be.
- 138.** D. Fast Startup is similar to Hibernate in how it works, but instead of saving all of your applications and data as you had them so you're instantly back at work, it saves the system state. As described in the question, Fast Startup will close running apps and log off any users, then save the contents of Random Access Memory (RAM) to a hibernation file. When the computer starts back up, it reads the hibernation file and loads drivers, system state, and kernel much more quickly than it would if the system had to read all of that information individually back into RAM, like it would in a normal cold boot. Sleep stores everything that's open in RAM and enters a low-power state. The display and drives aren't using power, but power is needed to continually refresh memory so it can retain information. It uses very little power, but "wakes up" very quickly with everything open as it was. Hibernate stores open programs and data to the hard drive then shuts down the computer so it uses no power, but it does not resume its state as quickly as Sleep does.
- 139.** A. The nslookup utility will query the Domain Name System (DNS) server the computer is currently configured to use. The utility can be used to perform a variety of DNS queries. The netstat command shows what Transmission Control Protocol (TCP) connections exist on a computer and the port number they are using. The ping command is used to determine whether there is connectivity with a remote computer. When entered as ping localhost, it is used to determine if TCP/IP is running on the local computer, and tracert displays the path (i.e., routers) that a packet took to get to a remote computer. Traceroute is used in Linux for similar purposes.
- 140.** A. The chown command (i.e., change owner command) is used to change ownership of files in Linux. The syntax to change the owner of a file is `chown owner-name filename`. The chmod command (i.e., change mode command) is used to modify the mode of the file, meaning who has what access to the file. The cat command is a powerful tool that can be used to view contents of a file, create new files, and concatenate (i.e., put together) files. The cp command is used to copy files.
- 141.** B. Network & internet is the Settings category that provides options for setting up virtual private network (VPN) or dial-up connections. Network and Sharing Center is a Control Panel utility. The System category of Settings deals with display, sound, power, notification, and other settings. The Accounts category is useful for managing users and syncing settings. In Windows 11 (but not Windows 10), Windows backup is included in the Accounts category.
- 142.** A, C. When a motherboard uses basic input/output system (BIOS) rather than Unified Extensible Firmware Interface (UEFI) to manage firmware, it must use the Master Boot

Record (MBR) partition type, or the drive will not be bootable. A Globally Unique Identifier (GUID) Partition Table (GPT) partition will be able to be read but not booted to. MBR's partition size limit is 2 TB, but the newer GPT partition scheme can, in theory, support drives with up to 128 partitions of 18 EB each, but is limited by operating system capabilities.

- 143.** B. The Services console (`services.msc`) enables you to manage all the computer's services. The Services option in Task Manager is a subset of those services. There are several utilities where you can find out what services are running, with the option to enable and disable services. They include the Services console, Computer Management, and Task Manager. In Windows 10 but not Windows 11, they include the Control Panel's Administrative Tools utility. In Windows 11 only, services can be found in the Windows Tools utility. Note: Administrative Tools is on the CompTIA A+ exam, but Windows Tools is not. Disk Management does not have a link to the Services console, and Task Scheduler is designed to perform tasks when a trigger happens, such as a date, time, or event.
- 144.** C. A domain uses an Authentication, Authorization, and Accounting (AAA) server to determine whether a user is granted access to shared resources. In Windows, an Authentication server is also known as a Domain Controller. Domains are not available with Windows Home editions. Windows Home editions can only use a workgroup, and in that case the operating system (OS) on the device with the shared resource would allow or deny access. A file server is a computer that provides access to shared files. A Dynamic Host Configuration Protocol (DHCP) server is used to automatically assign Internet Protocol (IP) addresses and configure network settings. A DHCP server is often included in the software on a Small Office/Home Office (SOHO) router.
- 145.** B. Although you can turn off all notifications or manage if and how individual notification senders can interact with you in Windows Settings, the System group, then Notifications & Actions, this is not the correct answer because it doesn't stop the background activity, it only stops the notifications. Game mode, found in the Gaming options group, enables configuring the system to be optimized for gameplay and recording, including stopping unnecessary programs from running in the background. In addition to preventing driver update installations and stopping restart notifications, it changes some settings affecting the video frame rate. Windows Update settings don't address notifications. The Apps option lets you manage where apps can be installed from, default apps for opening files, and other application configuration settings.
- 146.** B. iOS is the proprietary operating system for iPhones. iPhone OS and Windows for iPhone don't exist. The Android OS was developed by Google and is used on smartphones, tablets, and other touchscreen devices. Other operating systems include iPadOS for use on iPads; Windows, Linux, and macOS found on desktop and laptop PCs; and Chrome OS, which is proprietary and found on Chromebooks.
- 147.** B. The App Store is where you would go to locate and download new programs. Finder enables a user to drill down through folders to find what they are looking for. Mission Control is an easy way to see what is open and switch between applications, and FileVault provides encryption.

- 148.** D. Image deployments are usually done in a large volume setting where you have many computers configured identically. One machine will have the operating system (OS) and applications installed, with the settings configured. An image is then created. This image can be stored on a network drive, a Universal Serial Bus (USB) drive, or other media. When it is installed, it will include the OS, software, and settings that were configured on the original machine. An upgrade installation will keep all your files and settings but install a different OS version on your computer. A recovery partition is often created on a laptop that is purchased from a major supplier. There will be a key (or multiple keys) to press while the computer is booting. The exact key(s) will depend on the laptop's manufacturer. Using a recovery partition will erase everything on the drive and restore the computer to the state it was in when it was received from the manufacturer. (This is sometimes called a factory reset.) A repair installation will use the same OS and attempt to leave all your files and settings while fixing any of the operating system files.
- 149.** B, C. An app can be deleted simply by dragging it to Trash, but if it has its own folder, you must look for an uninstall program. Right-clicking and deleting is how you might remove a file in a Windows operating system (OS). There is no uninstall option from the Apple menu.
- 150.** B. The chmod command (i.e., change mode command) is used to modify the file's mode, meaning who has what type of access to the file. The who is divided into the file owner, group members, and others (i.e., everyone else). The permissions that can be assigned are read, write, and execute. The command can be quite complicated, but in its basic form, it is `chmod [reference] [operator] [mode] file`. As an example, if I want to restrict a user (i.e., the owner) of a file named `bogus` from writing to that file, the command would be `chmod u=r bogus`. In the command, `u` is the reference to the user, `=` is the operator, and `r` is the mode. Then, to see the result, type `ls -l`, as shown in the following figure. Before changing the permission on the file named `bogus`, running the `ls -l` command may have shown `-rw-rw-r-`. The first `-` means it's a file, not a folder. After that, the three sets of characters (`rwx`) are as follows: first set for owner, second set for group, and third set for others. As shown in the graphic, after the `chmod u=r bogus` command runs, the permissions shown for the `bogus` file when `ls -l` is run should be `-r--rw-r--`, showing that the write permission for the owner was removed. The chown command (i.e., change owner command) is used to change ownership of files in Linux. The cat command is powerful and can be used to view contents of a file, create new files, and concatenate (i.e., put together) files. The cp command is used to copy files.
- 151.** A. Click Apple, then Preferences, and choose Accessibility options to find several features that make interacting easier for people with different abilities. Zoom can enlarge text on the screen. VoiceOver will read screen contents. Sticky Keys lets the user press key combinations one key at a time. There are several other accessibility options as well. Displays is obviously where you would configure display settings. Privacy is for privacy settings, and Time Machine is for backing up the system.
- 152.** B. Programs and Features allows the user to add, remove (i.e., uninstall), or troubleshoot (i.e., repair) installed programs (the options will change by program), and add/remove Windows features. From Devices and Printers, you can manage multiple printers and perform tasks, such as choosing a default printer, installing new printers, and changing printer settings. The Network and Sharing Center is the Windows tool for viewing and

configuring network connections and changing adapter settings. Device Manager should be your go-to app when resolving hardware issues. From there, you can update or install drivers, see what isn't working, and disable hardware if need be.

- 153.** C. The correct choice is Network, where you can see all the network connections of the MacBook. Ethernet and Wi-Fi are not choices in Preferences. Accessibility provides access to features that make working with a Mac easier for differently-abled people.
- 154.** B. The `grep` command (i.e., short for the impossibly long Globally Search a Regular Expression and Print) does just what it says it does: It searches for a string of text and then displays the results of what it found. The syntax is `grep [options] pattern [files]`. The `sudo` command stands for superuser do, or substitute user do, and will run a single command as the alternate user. The `cp` command copies files, and `ls` provides a list of the working directory's contents.
- 155.** D. Compact Disks (CDs) don't hold enough information to be used for installation media for Windows. Windows media can be installed from a Universal Serial Bus (USB) or external drive, or via a network connection, provided there is a way to boot to the network such as Pre-boot Execution Environment (PXE) support.
- 156.** B. The program used to encrypt a drive on a Mac is FileVault. BitLocker does the same in the Windows operating system (OS), so BitLocker is the one thing listed that you would not do on a Mac computer. Best practices for hardening a Mac system against malware include backing up the data using Time Machine, encrypting the drive, installing patches and updates as soon as they are available, disabling remote access, turning on the software firewall, using a password manager, using a non-admin account whenever possible, and setting a password-protected screen saver.
- 157.** C. A file with a `.dmg` extension is a disk image and treated like a drive in the macOS. It can be "mounted" like a physical hard drive, the contents read, and files opened or applications installed. A file with a `.pkg` extension on a Mac is a compressed package file. You might be able to view the file's contents in Finder. But if not, it would need to be extracted first. Files with a `.bat` extension are batch files used in Windows to run a string of commands that have been entered into a text file, and files with an `.app` extension are applications.
- 158.** B. The Printers & Scanners pane is where you would go to install a new printer or configure a printer in the macOS System Preferences folder. Printers and Devices are not options there; however, sharing is, and from there you can share your screen or files and choose from several other options.
- 159.** A, C. A Globally Unique Identifier (GUID) Partition Table (GPT) partition scheme is required with Windows 11. To create a GPT partition, your system must be using the Unified Extensible Firmware Interface (UEFI) instead of a Basic Input/Output System (BIOS) interface. The theoretical maximum partition size for a GPT partition is around 18 Exabytes, and because an 18-Exabyte drive isn't available commercially yet, your partition size is virtually unlimited. You can create it as large as your storage media is. Any partition table, whether GPT or the older Master Boot Record (MBR), keeps track of the partitions on your storage drive. GPT can address 128 partitions. MBR can only address four partitions. GPT also is more secure than MBR because it has a backup of the partition

table and uses a cyclic redundancy check (CRC) to ensure that the partition table is accurate. GPT partitions can be located in the same computer with drives that have an MBR to maintain backward compatibility.

- 160.** C. Unlike iOS for iPhones, the iPadOS has features such as Split View that allow it to use multiple applications at the same time. It also boasts support for external drives and displays. iOS is the operating system (OS) of iPhones, and the Android OS developed by Google is used on smartphones, tablets, and other touchscreen devices. iPhone OS is not a real thing.
- 161.** C. The `cat` command is powerful and can be used to view file contents, create new files, and concatenate (i.e., put together) files. For example, to view the line-by-line contents of the `bogus.txt` file, you would simply enter `cat bogus.txt`. To add line numbers to the output, the command would be `cat -n bogus.txt`. The `chown` command (i.e., change owner command) is used to change ownership of files in Linux. The `chmod` command (i.e., change mode command) is used to modify the file's mode, meaning who has what access to the file. The `cp` command is used to copy files.
- 162.** B. The Windows 11 feature USB selective suspend will suspend a Universal Serial Bus (USB) port when it isn't being used, placing it into a low-power state. The port should resume normal power when the attached device is used again, such as when a mouse is moved. Some devices don't work well with the USB selective suspend feature, and to remedy the situation, you'll need to disable it. The Power Options utility in the Control Panel has a setting to enable/disable USB selective suspend. To get there, choose Power Options, Change plan settings, and Change advanced power settings. Then click on USB settings in the Settings list and choose USB Selective Suspend; click to Disable the option. The other options are more drastic and might not fix the problem.
- 163.** B. The Apple File System (APFS) has been the filesystem used by macOS-based computers since 2017. It supports up to 9 quintillion files and folders, full disk encryption, and space sharing, so that a drive's free space is available to all volumes of that drive. Resilient File System (ReFS) is a feature available on Windows Pro for Workstations and Windows Enterprise editions. ReFS will detect when data on a mirrored drive has been corrupted and will use a healthy data copy on other drives to attempt to correct corrupted data and protect data. The ext4 filesystem is used in the Linux world, and New Technology File System (NTFS) is the Windows filesystem that supports file encryption and NTFS permissions for file sharing.
- 164.** C. Although the Duo products are made by Microsoft, they run an Android operating system (OS), not Windows. While Microsoft briefly developed an OS for smartphones, their last venture into that market was in 2017 and met its end-of-life (EOL) in 2020. There is currently no Windows version for smartphones. iPadOS and iOS are Apple's proprietary OSs.
- 165.** B, C. Since Snow Leopard (macOS 10.6), Apple has included malware detection, called File Quarantine, in its software. File Quarantine will not allow a known malware file to be opened. To protect your system from the most recent malware, you need to ensure that

updates will run automatically. This is done by going to the Apple menu, choosing System Preferences, then App Store, and checking Automatically check for updates and the box to Install system data files and security updates. It's also good advice to only download programs and files from reputable sources, like the App Store. You could install an antivirus or anti-malware product, but it probably isn't necessary. Finder is used to find folders and files in the directory structure, much like Windows File Explorer.

- 166.** A. In the macOS System Preferences, the Security & Privacy pane, Privacy tab is where you would enable location services, which is how Siri knows where you are to tell you about the weather, provide maps, and give you directions. The window for each type of privacy concern will show what applications have requested Location Services. Also on the Privacy tab are Contacts, Calendars, Reminders, Photos, Accessibility, and Analytics. Mission Control will show all the open apps for quick access. Accessibility allows you to configure settings for differently-abled people, and the Networks pane will show all of the computer's network settings.
- 167.** C. The Network and Sharing Center is the Windows Control Panel tool for viewing and configuring network connections and changing adapter settings. From here, you can also manually set up a new connection or network such as dial-up, virtual private network (VPN) connections, or even a wireless access point (WAP). From Devices and Printers, you can manage multiple printers and perform tasks, such as choosing a default printer, installing new printers, and changing printer settings. Programs and Features allows the user to add, remove, or troubleshoot installed programs (the options will change by program), and add/remove Windows features. User Accounts is the utility for adding new user accounts, changing their passwords, or managing profiles as well as other user-related configurations.
- 168.** B. This is a recovery partition installation. A recovery partition is often created on a laptop that is purchased from a major supplier. There will be a key (or multiple keys) to press while the computer is booting. The exact key(s) depends on the laptop manufacturer. Using a recovery partition will erase everything that is on the drive and restore the computer to the state it was in when it was received from the manufacturer. This is sometimes called a factory reset. An upgrade installation will keep all of your files and settings but install a different version of an operating system (OS) on your computer. A repair installation will use the same OS and attempt to leave all of your files and settings while fixing any of the OS files. Image deployments are usually done in a large volume setting where you have many computers configured identically. One computer will have the OS and applications installed and settings configured. Then an image of that computer is created. This image can be stored on a network drive, a Universal Serial Bus (USB) drive, or other media. When it is installed, it will include the OS, software, and settings that were configured on the original computer.
- 169.** A. Accounts is the group in Windows Settings that will enable you to add a new user. From there, click on Family & other users, then, in Windows 10, click Add someone else to this PC. In Windows 11, click Add other user. User Accounts is the Control Panel utility for managing users. From the Personalization menu of Windows Settings, you can change the desktop theme and background colors. The System group in Windows Settings has a multitude of settings including Display, Sound, Notifications & Actions, and Power, to name a few.

- 170.** A. The `find` command is used to find files and directories and perform operations on them. The syntax of the command is `find [where to look] [-options] [what to find]`. For example, `find Documents -name *.jpg` will find all the files in `Documents` and its subfolders that have `.txt` at the end. `Find` can also search by folder, name, creation date, modification date, owner, and permissions. The `ps` command will list the processes that are currently running along with their Process IDs (PIDs), and the `man` command displays a user manual for any Linux command, much like the Microsoft Windows `/?` command. `Nano` is a Linux text editor.
- 171.** B. Windows 11 requires at least a dual core, 1 GHz or faster processor. However, the application requires a 2 GHz processor, so to use the software, you must install a 2 GHz processor. (In reality, you'll probably already have a faster one.) Unlike Random Access Memory (RAM), where you must add the requirements together, choose a processor that is at least the fastest requirement of all the running software. In this case, the 2 GHz processor is needed for the application. You would not need to buy a 3 GHz processor to accommodate the new software.
- 172.** A. File Allocation Table 32 (FAT32) is more compatible than the other operating systems (OSs). It can be read by Windows, Linux, macOS, and many game consoles. Extensible File Allocation Table (exFAT) partitions require third-party software to be read by Linux, and New Technology File System (NTFS) doesn't play well with any OS other than Microsoft Windows. Fourth extended filesystem (ext4) partitions are used in Linux. Microsoft systems can't even recognize ext4 partitions.
- 173.** A, C. Once upon a time, Microsoft had a Windows version for smartphones, but they no longer do. On modern smartphones, you'll most likely find either iOS or Android, although there is also Tizen, which is a Linux, open-source mobile operating system developed by Samsung. macOS and Windows 11 are for laptop and desktop computers. BlackBerry once had a smartphone operating system (OS) but now relies on Android and is known for and focused on their security software for smartphones. Bada and Symbian are other discontinued smartphone OSs. Tip: Remember to focus on the mobile OSs that are listed on the CompTIA A+ objectives. Those are iPadOS, iOS, and Android.
- 174.** A. A restore point is a copy of your system configuration at a given point in time. Restore points are useful for when Windows fails to boot but the computer appears to be fine otherwise, or when Windows doesn't seem to be acting right, and you think it was because of a recent configuration change. In Windows 10, restore points are created in the System Protection tab of System Properties.
- 175.** D. Software intended for macOS and Windows are not interchangeable; however, some software packages come in a macOS version and a Windows version, so it's important to ensure you purchase the correct one. Windows can be run on a Mac, but not at the same time. You would need to run a program called Boot Camp to create a Windows partition on the Mac's hard drive, then install the Windows operating system (OS) on that partition. At boot, you can choose either Windows or macOS, but you can't run Windows applications on macOS.
- 176.** B, C. A video card can either be dedicated or integrated. If it is integrated, then the Graphics Processing Unit (GPU) resides on the processor, and the GPU will share Random

Access Memory (RAM) with the system. A dedicated video card will contain a GPU and Video RAM (VRAM) and be installed in an expansion slot.

- 177.** B. The Apps group of Windows Settings lets you delete or update apps, choose apps to start when you log in, choose default apps for opening files, and other application configuration settings. The System group has settings for display, power, sound and notifications, and several other options. Update & Security (Windows 10 only) has a plethora of tools, including Windows Update, troubleshooting, Activation, Recovery, and Windows Security. (The similar Settings group in Windows 11 is Windows Update, but it is only for updates and recovery options. Troubleshoot and Activation are found in the System group, and Windows Security settings are found in the Privacy & security group of Windows 11 Settings.) The Gaming option enables configuring the system to be optimized for gameplay and recording.
- 178.** C. You will be performing a clean installation. Clean installations happen on a new machine that doesn't have an operating system (OS) at all (i.e., bare metal), but can also happen when you want to completely wipe out the drive and begin fresh. An upgrade installation can only happen when there is an existing OS. An upgrade will keep all of your files and settings but install a different OS version on your computer. A recovery partition is often found on laptops, and sometimes on desktop PCs, that are purchased from a major supplier. There will be a key (or multiple keys) to press while the computer is booting. The exact key(s) will depend on the laptop manufacturer. Using a recovery partition will erase everything that is on the drive and restore the computer to the state it was in when it was received from the manufacturer. This is sometimes called a factory reset. Image deployments are usually done in a large volume setting, where you have many computers configured identically. One computer will have the OS and applications installed and settings configured. Then an image of that computer is created. That image can be stored on a network drive, a Universal Serial Bus (USB) drive, or other media. When it is installed, it will include the OS, software, and settings that were configured on the original computer.
- 179.** D. A multiboot is having two operating systems (OSs) on a computer and choosing which one you want to use as the computer is booting, before any OS files are loaded. This is cumbersome at best but necessary if you only have one set of hardware and it doesn't support using a virtual machine (VM). The other three options are methods of installing an OS, not a method of booting into one.
- 180.** A. Video Random Access Memory (VRAM) is memory dedicated solely to be used by the Graphics Processing Unit (GPU). The GPU takes the work of processing graphics away from the Central Processing Unit (CPU). GPUs can either be integrated (on the CPU) or dedicated (on a discrete graphics card). A graphics card will have its own cooler and VRAM. VRAM on a video card can't usually be upgraded. To increase it, you would need to buy a different video card. In this scenario, you might be able to replace the CPU for one with integrated graphics, if the system supported the new processor, but it isn't the best option.
- 181.** C. Linux has a built-in manual that can be accessed using the `man` command, similar to using Windows `help [command]` or `[command] /?` at a command prompt. The syntax is `man [command]`. The `find` command is used to find files and directories and perform operations on them. The `ps` command will list the processes currently running,

along with their Process IDs (PIDs), and Nano is a Linux text editor. The [command] --help command can also be used at a Linux terminal prompt to get help on a specific command.

- 182.** A. You will be performing an upgrade installation. An upgrade installation can only happen when there is an existing operating system (OS). It will keep all your files and settings but install a different OS version on your computer. A recovery partition is often found on a laptop purchased from a major supplier. There will be a key (or multiple keys) to press while the computer is booting. The exact key(s) depends on the laptop manufacturer. Using a recovery partition will erase everything that is on the drive and restore the computer to the state it was in when it was received from the manufacturer. This is sometimes called a factory reset. A clean installation happens on a new machine that doesn't have an OS at all (i.e., bare metal), but can also happen when you want to completely wipe out the drive and begin fresh. Image deployments are usually done in a large volume setting, where you have many computers configured identically. One computer will have the OS and applications installed and settings configured. Then an image of that computer is created. The image can be stored on a network drive, a Universal Serial Bus (USB) drive, or other media. When it is installed, it will include the OS, software, and settings that were configured on the original computer.
- 183.** B. You won't need to refresh the operating system (OS). Refreshing an OS reinstalls the same version over the existing one to correct issues with OS files. You don't need to do that when you are upgrading a system to a new OS. Whenever you're doing an upgrade, it is important to consider several things. Backups must be made in case something goes wrong. Before you start the upgrade, you'll want to ensure that the applications you run are compatible with the new OS and compatible drivers are available for your hardware. You'll also want to ensure that the hardware you have will work with the new OS.
- 184.** A. You can run a 32-bit software program on a 64-bit processor; it just doesn't take advantage of the 64-bit processor's full capabilities. However, you cannot run a 64-bit software program on a 32-bit processor. More RAM has nothing to do with the question at hand. It's a processor issue.
- 185.** D. Nano is a user-friendly text editor available in many Linux distributions. Other text editors, such as vim and emacs, may also be available, but nano is easier to use. The find command is used to find files and directories and perform operations on them. Find can also search by folder, name, creation date, modification date, owner, and permissions. The ps command will list the processes that are currently running along with their Process IDs (PIDs), and the man command displays a user manual for any Linux command, much like the Microsoft Windows [command-name] /? command, where [command-name] is replaced with the name of the command.
- 186.** B. The dig command can be used to retrieve the IP address of a website, for example, dig Sybex.com +short will return the IP address of Sybex.com. The chown command (i.e., change owner command) is used to change ownership of files in Linux. The top command displays dynamic information about the running processes, and the ip command is used in Linux or macOS to display configuration information for network interfaces.

- 187.** D. With managed Apple IDs, your company, not you, can reset your password. Your company owns a managed Apple ID, so there are restrictions set in place. A managed ID is created by a company for use in company business. Because it's linked to your company, your managed Apple ID can't be used to make purchases, and your company's IT administrator can restrict access to your account, remove it, or update it.
- 188.** A, B. Booting an operating system (OS) can happen in many ways, including solid-state and flash drives, internal drives, external or hot-swappable drives, Internet-based, and multiboot. In-place is a type of upgrade, not a type of boot, and formatting prepares a drive to be booted.
- 189.** D. Extensible File Allocation Table (exFAT) is optimized for flash drives because it has low overhead like the File Allocation Table 32-bit (FAT32) filesystem (as opposed to New Technology File System [NTFS]). However, like NTFS, it will support much larger file sizes than FAT32, which is limited to 4 GB. exFAT is less compatible with non-Microsoft operating systems (OSs) than FAT32 is, but more compatible than NTFS. For example, macOS can only read NTFS partitions, yet it can read and write to exFAT partitions.
- 190.** B. In Linux, the `mv` (move) command is used to rename files. As shown in the answer, the syntax is `mv [old-file-name] [new-file-name]`. The `cp` command copies a file, but that is a different process than moving it. The `rm` command is short for remove, and it deletes files. The `ren` command is a Windows command to rename files.
- 191.** C. To enable Internet-based computer booting, you need a network interface card (NIC) and Unified Extensible Firmware Interface (UEFI) or Basic Input/Output System (BIOS) that support loading a pre-execution environment (PXE). The PXE instructions exist on the NIC and must be preconfigured to request an IP address from a Dynamic Host Configuration Protocol (DHCP) server. It then requests information from a server holding the bootable image. It is possible to boot from the Internet, most likely using a Linux distribution. A network-based boot also requires PXE, but it gets its operating system (OS) from the local network, not the Internet. Be aware that some people use Internet-based and network-based interchangeably; they are not the same. Solid-state/flash drives or internal drives (e.g., SATA, M.2) hold the OS from which you boot. They don't need PXE.
- 192.** A. The System utility of the Control Panel provides a link to the System, About option in Windows Settings. The screen that pops up by default shows information about the PC, such as its name, its specific processor, how much physical Random Access Memory (RAM) is installed, the Windows version and edition, and so on. The Device Manager utility is used for troubleshooting hardware and installing device drivers. Devices and Printers is used for managing printers, multifunction devices, and other devices that are connected to the computer. Programs and Features helps in uninstalling, changing, and repairing applications and adding or removing Windows features.
- 193.** B. Files with an `.iso` extension are disk image files. To install the software they contain, you need to first mount the image. You might be able to double-click it, if not, right-click and choose Mount, or locate the file in File Explorer. Select the file, then click Mount under Disk Image Tools. Once the file is mounted, the operating system (OS) will treat it as a disk in an optical drive. You'll look for an installer or autorun file to start the software.

installation. When you’re done using the image, right-click it and choose Eject. Extract is a command for zipped files, not .iso files.

- 194.** A, B, D. Whenever you’re considering a new software purchase, there are many things to consider. The technical aspects such as operating system (OS) and application compatibility and hardware concerns are only a part of it. You must also consider what impact this will have on any devices, the network, how internal systems work, and the operation of the business, in addition to the business as a whole—how will it affect the company’s bottom line. In the case of the network-monitoring software presented in the question, consider whether the additional network overhead will cause a significant enough impact on the network to cause adverse effects on production, whether it will decrease company profits by slowing production, or whether is it a wise investment because it can help protect against malware. Will it work well with routers, switches, and other network hardware? Do the positive impacts outweigh the negative ones?
- 195.** D. With today’s hard drives measured in terabytes (TBs), storage is seldom a problem, but in an industrial setting, it might be. When determining how big a hard drive needs to be, add the storage requirements of everything that will be on that drive, including the operating system (OS), the applications that will be installed, and all the data that will be generated by those applications. With Random Access Memory (RAM), you need to consider what will be running at the same time. But with storage, you must consider all the applications and all the data, whether or not they are all working at the same time. It’s also important to consider what type of data files will be stored. Word documents take up much less space than video files do.
- 196.** A. In Linux, rm (remove) is the command for deleting files and directories. As shown, the syntax is simply `rm [option] [what-to-remove]`. If you’re removing more than one file at a time, simply list the files after the remove command, such as `rm file1.ext file2.ext`. With its options, the rm command can also remove directories and work in verbose mode, meaning that it will tell you what it’s doing. The del command is used to delete one or more files at a Windows Command Prompt. er is not a known command in either Linux or Windows, and rd is a Windows command to remove directories.
- 197.** A. A file with a .pkg extension in macOS is a compressed package file. You might be able to view the contents of the file in Finder, but if not, it would need to be extracted first. It can be installed by double-clicking it, or opening it with an installer. A file with a .dmg extension is a disk image and treated like a drive in the macOS. It does not need to be extracted. It can be “mounted” like a physical hard drive, the contents read, and files opened or applications installed. Files with an .app extension are applications, and files with a .bat extension are batch files used in Windows to run a string of commands that have been entered into a text file.
- 198.** D. A bare metal system is one that doesn’t have any software yet including the operating system (OS). It would not be able to download software to install. It could be used for a network installation of an OS if it supported Pre-boot Execution Environment (PXE) booting to the network; however, that would be using a local area network (LAN) to distribute software as opposed to downloadable distribution, which by definition, uses the Internet. Distributing software via download means that it could be the most up-to-date

version of the software. It costs less because no one must pay for the Universal Serial Bus (USB) or DVD to distribute it, and it only requires an Internet connection, not a DVD drive. Many new PCs don't have optical drives.

- 199.** B. A repair installation (or repair upgrade, as Microsoft calls it) means that you're installing the same version of the same operating system (OS) over top of the existing OS. A repair installation can be done from within the existing OS or from other media. It will go through a licensing screen and some others, eventually showing a screen where you will choose to Keep Windows Settings, personal files, and apps. An upgrade installation will also keep your files, apps, and settings, but you will be using a newer version of the OS. A clean installation wipes out everything on the hard drive. A remote installation is done across a network and could be any of the other three types.
- 200.** C. The `ip` command is used to configure and view network settings in modern Linux and macOS distributions, replacing the former `ifconfig` command. Like most Linux commands, there is a multitude of objects and options that can be used. Likely the most frequently used one is `ip addr show`, which will show all of the network interfaces and their respective IP addresses. The `ipconfig` and `ipconfig /all` Windows commands are for viewing IP configuration. `cfg` isn't an actual command.
- 201.** C. Windows supports a feature called Modern Standby. Modern Standby must also be supported by the hardware. With Modern Standby, the system will wake from the lowest power to allow short bursts (i.e., milliseconds) of software execution as the system needs them. The system uses just enough power to process background tasks but still preserve battery life. The result is that when in Sleep mode, a computer can stay connected to a local area network (LAN) and reacts much like a smartphone with instant on/instant off ability.
- 202.** A. The `net user` command can be used at a command prompt to add a user on-the-fly. The syntax is `net user username [password | *] /add [options] [/domain]`. In this example, you are adding a user named `student`, and the `*` replacing `password` tells the system to prompt you for a password. If no domain is specified, the command assumes the user is added to the local computer. As soon as this command is executed, the named user will appear in the Users utility of the Control Panel.
- 203.** D. Pressing the Windows Logo Key plus the X key simultaneously will open the Quick Link menu. On it in Windows 11, you will find shortcuts to Installed Apps, Mobility Center, Power Options, Event Viewer, System, Device Manager, Network Connections, Disk Management, Computer Management, Terminal, and Terminal Admin, which opens the PowerShell utility, Task Manager, Settings, File Explorer, Search, and Run. You can also click Shut Down or Sign Out from the Quick Link menu, or click Desktop, which will display or hide all open applications on the desktop. Pressing the Windows Logo Key+D will also hide or display all open applications. Pressing the Windows Logo Key+L is a quick way to lock the computer, and Windows Logo Key+I brings you to Windows Settings.
- 204.** B. The Windows operating system (OS) contains many drivers that will help make setting up a new OS easy. However, it would be impossible for the installation media to have all the drivers for all the devices available. When you have a device whose driver, or a compatible one, doesn't automatically install, you'll have to install the driver from a third party,

such as the motherboard manufacturer. Often, these drivers can be downloaded from an online source, such as the manufacturer’s website.

- 205.** C. The `top` command provides a dynamic chart of the running processes, with the details shown in the graphic. The top section of the screen shows resources used and process statistics. The bottom shows the processes currently running. The `dig` command can be used to retrieve the Internet Protocol (IP) address of a website. The `chown` command (i.e., change owner command) is used to change ownership of files in Linux, and the `ip` command is used to display configuration information for network interfaces.
- 206.** A, C. A file with a `.pkg` extension on a Mac is a compressed package file. You might be able to view the file’s contents in Finder, but if not, it would need to be extracted first. It can be installed by double-clicking it or opening it with an installer. A file with a `.dmg` extension is a disk image and treated like a drive in the macOS. It can be “mounted” like a physical hard drive, the contents read, and files opened, or applications installed from it. Files with an `.app` extension are applications, and files with a `.bat` extension are batch files used in Windows to run a string of commands that have been entered into a text file.
- 207.** C. Modern touchpads/trackpads and touchscreens can accept multiple finger gestures that function similarly to gestures on a smartphone or tablet, such as swipe left or right to move between pages. To see what gestures are available, click the Apple menu, then System Preferences, and Trackpad. Software Development Kit (SDK) is more of a programming term. Emergency notifications and power options have little to do with a trackpad or Magic Mouse. Incidentally, gestures are also available in Windows. To view or modify multi-finger gestures on your Windows 10 PC from Windows Settings, choose Devices, and then Touchpad. In Windows 11, from Windows Settings, choose Bluetooth & Devices, and then Touchpad.
- 208.** B. You would use the User Accounts Control Panel utility to add new accounts for the users. If you were on a Windows Pro or better computer, you could use the Local Users and Groups app, but that is not available in Windows Home editions. It also isn’t listed as a separate Control Panel utility, but in Windows 10 Pro and higher editions (not Windows 11), it can be accessed through Administrative Tools, then choose Computer Management, then Local Users and Groups. On Windows 11, you can access Computer Management through the Control Panel, Computer Management, but it’s faster to right-click the Windows icon in the taskbar and choose Computer Management. Or click Windows+R and in the Run box, type `lusrmgr.msc` to go directly to Local Users and Groups. The Administrative Tools utility doesn’t have a link to the Control Panel User Accounts utility, which is not as versatile as Local Users and Groups. The Mail utility is where you would configure user profiles for use with Microsoft Outlook.
- 209.** D. The scenario in the question describes a remote network installation. This differs from an Internet-based installation because an Internet-based installation generally refers to only the operating system (OS) install, while a remote network installation includes remote configuration of the device. An unattended installation is completed with a file that provides answers to the questions asked during installation, while a zero-touch installation includes the OS and configuration of the computer.

- 210.** A. The Control Panel's Indexing Options looks at words in files and metadata of files to provide faster file searches. The System group of Windows Settings enables you to configure notifications, power, and many other settings, but not Indexing. The Apps group of Systems is where you can choose default programs and remove applications that you no longer need. The Default Programs app of the Control Panel allows you to manage default applications for opening file types such as photos or mail by opening those settings in Windows Settings.
- 211.** A, B. When a computer logs in to a domain, access to resources is controlled through Active Directory (AD). The server that Active Directory resides on is called a Domain Controller (DC). In a workgroup, sharing would be configured on the computer providing access to the files. Running a batch file to copy the files to each user would result in multiple copies of the files, likely with all different information after a time, and not a single file repository where the files are shared among users.
- 212.** B. The scenario in the question describes a zero-touch installation. This differs from an unattended installation, because it's more than simply an answer file for installing the operating system (OS). As the IT administrator, you literally never touch the computer. Mobile Device Management (MDM) software is used to apply policies, profiles, and other security and compliance settings using pre-established configuration profiles. Internet and remote network installations use the Pre-boot Execution Environment (PXE) to install an OS, which then needs to be configured.
- 213.** C. Windows 11 maximum Random Access Memory (RAM) limits are 128 GB for the Home edition, 2 TB for the Pro edition, and 6 TB for the Pro for Workstations and Enterprise editions. They are the same limits for Windows 10 64-bit, but the maximum RAM for any 32-bit Windows operating system (OS) is only 4 GB.
- 214.** A. You would want a workgroup. By default, Windows 10 computers will join a workgroup called `workgroup`, making it easy to share files, printers, and other resources. Windows 11 computers don't, by default, join a workgroup called `workgroup`, but you can set it up as a member of a workgroup during the operating system (OS) installation process. Access to resources is configured on each workstation that is sharing a resource. The drawbacks of a workgroup are that security is configured on each PC, and it's only appropriate for very small networks. Homegroup was a networking scheme in prior versions of Windows that shared libraries. A personal area network (PAN) consists of a PC and its wireless devices, usually paired Bluetooth devices such as printers, headphones, and input devices. A domain is a network where access to resources is configured on a central server that all resource users must log in to. Home versions of Windows can't join a domain, but Pro, Pro for Workstations, and Enterprise editions can.
- 215.** C. When a Universal Serial Bus (USB) or other hardware device is required to ensure that the user has a valid license, the device is a hardware token. A remote certificate is a bit of software ensuring that the connection is valid and the certificate holder is who they say they are. Biometric devices use a reader and part of someone's body to identify them, such as a fingerprint, facial recognition, or retina scan.
- 216.** C. Updating packages only quarterly would be disastrous for the security of your systems. It's important to plan for updates and follow that plan. If your system has many Linux

installations, test package updates in a sandbox before installing them on all systems. Managing patches can be time consuming, which is why companies providing patch management services exist for both Linux and Windows installations. Checking for patches can be scripted using the yum command. Updates should only be downloaded from reliable sources, and if you're using Red Hat Linux, verify that the packages are signed by Red Hat.

217. A, B, D. The four main factors for a company to consider before adopting new software, according to the CompTIA objectives, are how it will impact the device, the network, the operation, and the business. Installation time is not a factor on its own, but could be part of how the software installation impacts the business.
218. B, C. To enable a user to retrieve their email from Microsoft Outlook, you would only need the user's email address and password. If the server is other than a Microsoft Outlook server, then you might need more information, such as the protocol the server uses and the server address. You don't need to know the port number. Email accounts may be configured in Settings by searching for mail and choosing the appropriate option, or by using the Mail applet in the Control Panel.
219. A. One of the best ways to always have the latest version of files, regardless of the device that you are using to access them, is to have them stored and accessed in the cloud. iCloud is Apple's answer to remote storage, and you can configure your Apple devices to place files there automatically or use it for backup. Finder enables a user to drill down through folders to find what they are seeking. Remote Disc is for using a shared optical drive, and Spotlight is used to search for objects in a macOS. It uses the familiar spyglass icon.
220. C. Making only monthly backups would likely not be often enough for anyone. In a business setting, it's important to have a backup plan, taking into consideration how much data you're willing to lose and how long it would take to restore said data, if restoring from a backup were needed. The 3-2-1 rule states that you need to have three backups on two different media, and one needs to be offsite. It's also important to consider having backups that are separate from your main system, so that an infection of the main system won't infect the backup. Your backup plan should include regularly verifying that the backups are able to be restored, meaning that the backups complete properly, are not corrupted, and your restore plan works. Even emergency medical services have practice runs from time to time to ensure that when a major event happens, they will be ready. You should too. Finally, document, document, document. If an event occurs, you need to ensure that you're restoring from the correct backups, and if the person in charge of backups is not available for any reason, a thoroughly documented backup system will make it easier for someone else to continue the process in their place and/or restore backups if needed.
221. A. The `format` command is used to format hard drives. Before you format any drive, be sure that you have it backed up or are prepared to lose whatever is on it. The `/fs: [filesystem]` switch specifies the filesystem with which to prepare the disk. `initialize` is not a command.
222. C. Time Machine is a part of the macOS, and it makes backups hourly daily and weekly that can be used to restore a single file from months ago if it was accidentally deleted. Mirrored drives provide redundancy if the hard drive fails, but not against human error. Online utilities are often set up to do the same. Backups should be a priority if retaining the

data is important. The only drawback with Time Machine is that if the external drive being used by it becomes full, it will start deleting the first backups to make room for new ones.

- 223.** A, D. A proxy server provides a connection to networks outside the current network, hiding the internal network Internet Protocol (IP) addresses from outside, and filtering traffic entering and exiting a network. To set up a proxy server in Windows Settings, you only need the server's IP address and port number to use. You likely should also check the box that says Don't use the proxy server for local (intranet) addresses. You would not need the router's IP address or the Dynamic Host Configuration Protocol (DHCP) server's IP address unless it is also functioning as the proxy server. A router decides if a packet belongs on the local area network (LAN) or another network, and a DHCP server's job is to provide IP addresses and other settings to devices that log in to a network.
- 224.** B. The search feature within macOS is Spotlight, and a magnifying glass icon in the upper-right corner of the Menu bar represents it (or you can press the Command key+spacebar from any app). Spotlight can search for documents, images, apps, and so on. Keychain is Apple's password management system. Finder enables a user to drill down through folders to find what they are seeking. Siri is Apple's voice-activated virtual assistant.
- 225.** C. Eight-character alphanumeric passwords are simply too easy to hack. Whether a Windows or Linux system, longer or more complex passwords should always be required. There are other ways to keep malware and viruses out as well. Linux has a few advantages on that front. First and foremost, there are numerous people looking at Linux code, which means many people to catch and rectify a vulnerability that could be taken advantage of by viruses and hackers. In Linux, the user and system are more compartmentalized. If malware attacks a user, it will only have access to what that user account has access to, not system files and folders. This means if you must run commands as root, it's extremely important to, whenever possible, do so using sudo instead of su. The sudo command will run just that command as root, but su opens up an entire new shell as root and a greater vulnerability to attack. If you're logged in as root, the whole system is vulnerable. Also, hackers know that root is the default name for the system administrator, so you should create another user and disable root so a hacker not only has to guess the password, but the username as well. It's always good advice to install an antivirus/anti-malware program and update it regularly (preferably automatically). Other Linux security actions are to configure a firewall to filter traffic on unused ports, keep the Linux packages and Kernel updated, remove any software that is no longer being used, and change the /boot directory to "read only" so it can't be changed. You'll also want to monitor failed login attempts and lock accounts after a reasonable number of failed logins. Email can be encrypted, and of course, train users about the dangers of opening email from unfamiliar sources.
- 226.** D. A domain is a group of computers that are tightly connected (or associated) and share a common domain name. It has a single authority (called a Domain Controller) that manages security and access to resources for all computers. All users will log in to the Windows domain using their centrally created user account. If no domain is used, then by default Windows computers will join a workgroup called workgroup, making it easy to share files, printers, and other resources. Access to resources is configured on each workstation

sharing a resource. A workgroup's drawbacks are that security is configured on each PC, and it's only appropriate for very small networks. Homegroup was a networking scheme in prior Windows versions that shared Libraries. A personal area network (PAN) consists of a PC and its wireless devices, usually paired Bluetooth devices such as printers, headphones, and input devices. A domain is a network where access to resources is configured on a central server that all resource users must log in to.

- 227.** C. In the View Your Active Networks pane, you can see that this network profile is set to Private network (i.e., not public). A private network is one that is trusted like where you work, or that you control like your home network. By default, this computer will be discoverable on the network, and File and Printer Sharing is enabled. To change these settings, you would click on Change advanced sharing settings. The other two types of network profiles are public and domain. To change the network type, go to Settings, choose Network and Internet, then Status. Click on Properties of the network connection that you want to change and choose the profile type. The domain profile type is detected automatically when the local computer logs in to an Active Directory (AD) domain.
- 228.** B, C. Mapping a network drive to a share makes it easy to access that share every time you log in to your computer, provided you're on the same network. Left-clicking on This PC will show the mapped drive in the right pane after it has been set up as a mapped drive, so you can easily choose it from there. The network share will appear on Quick Access after you've used it.
- 229.** A. Choosing to Block all incoming connections, including those in the list of allowed apps would certainly stop all incoming connections quickly. There is no Disable option under Private networks in the Windows Defender Firewall window. Turning Airplane mode on would stop the computer from communicating on wireless networks, but it wouldn't stop communication on a wired network, and turning off the firewall is the opposite of what you would want to do.
- 230.** C. Choosing Computer Management, then Shared Folders, and Shares will show all of the resources that are shared on the local computer. Some are created by default. Hidden shares will have a \$ at the end of the name and can only be accessed if you know the share name. Network & internet deals with configuring network connections, not network shares. Ease of Access is a Windows 10 utility that enables alternate configurations that work better for differently-abled people. Network and Sharing Center is used to configure networks, and it has settings to turn sharing on and off, but not a way to show all of the current network shares.
- 231.** A, D. Before you can use the WWAN, you need to configure it, which can either be done through Network and Internet Settings in the Settings app, or through the Network and Sharing Center in the Control Panel. WWAN is a cellular connection, not a mobile hotspot or Wi-Fi.
- 232.** B. A restriction means that you will not allow an application to communicate through a firewall, while an exception means that you will allow that application to communicate through the firewall. To configure a restriction in Windows Defender Firewall, open it from the Control Panel and click on Advanced Settings, then click on Outbound Rules and New

Rule. Ensure that Program is selected and click Next. Click on Browse to locate the program file, click to select it, then click Open. The program path should appear in the New Outbound Rule Wizard dialog box. Click Next, then choose Block the connection. Click Next twice, then give your rule a name and click Finish. A mapped drive means that you have assigned a drive letter on a local computer to a folder that is shared on a remote computer. A network share would take place on a computer with folders to which you want to allow others on your network to have access.

- 233.** C. Most of us are familiar with the local area network (LAN) in our home or office, and the personal area network (PAN) that we use to connect Bluetooth devices, such as wireless keyboards, mice, and headsets to our computers. A campus area network (CAN) could exist on a property owned by a single entity but housed in discrete buildings. The network might even cross government-owned streets. You might be less familiar with a wireless wide area network (WWAN). However, they are used more and more frequently. Unlike Wireless LANs, which use radio, microwave, or infrared signals, WWANs take advantage of the cellular network. You can purchase a WWAN device, often called a mobile hotspot, from a cellular service provider. They generally require a contract, but some don't. The great advantage of a WWAN is that they work almost anywhere—the cellular network is virtually worldwide. The biggest disadvantage is likely the cost.
- 234.** B, C. The fastest way to join your friend's network is to click on the globe icon (or Wi-Fi icon) and choose their network; however, going through Settings, Network & Internet, Wi-Fi, and Show available networks also works. Right-clicking a browser shortcut will show websites that you've recently been to and a few other options, including New window. Firewall & network protection, then choosing Private network, will enable you to configure firewall settings for use with a private network.
- 235.** A, C. You can drill down through Windows Settings to find Firewall & Network Protection Settings, but it's far easier to search for it, then choose Allow an app through firewall. Once there, if the app is in the list, check the Change Settings button, then check the box next to the application you want to allow access for under the listing for Private or Public network, depending on your needs. If it isn't in the list, click Allow another app. Drilling down through the Control Panel, choose Windows Defender Firewall, then Allow an app or feature through Windows Defender Firewall will take you to the same setup screen. The other two options in the question enable you to uninstall applications.
- 236.** B. A quick check of Device Manager and clicking on Network Adapters should show you what you have for network devices. Most likely you'll see a Bluetooth Device (personal area network) entry, possibly an Ethernet local area network (LAN) adapter, a wireless area network (WAN) adapter and, if you have one, a wireless wide area network (WWAN) adapter. If it doesn't show there, it either isn't being detected by the system, or one does not exist in your system. Disk Management is for configuring and managing drives. Apps & Features and Programs and Features both have the same job—that is providing a way to install or repair applications and add or remove Windows features. The former is in Settings, and the latter is in the Control Panel.
- 237.** B, C. Wireless wide area networks (WWANs) use the cellular system to connect to the Internet. To make a connection, you would need either a WWAN card in your laptop, or a

WWAN device, sometimes called a mobile hotspot device, and a cellular service connection. Some cellular companies require a contract for this type of cellular service, but not all do. The WWAN card or WWAN device needs to be compatible with your cellular provider. Wireless network interface cards (NICs) are used for Wi-Fi connections, and an RJ-45 connector is used for wired Ethernet connections.

- 238.** A. Metered network settings can be configured for wired, Wi-Fi, or a wireless wide area network (WWAN) connection. For example, to configure a Wi-Fi network as a metered connection, go to Settings, then choose the Network & Internet group, click on Wi-Fi, then Manage known networks, and select the Network. In Windows 10, you need to click Properties, but in Windows 11 you're already on the Properties screen. Locate the metered connection setting and turn it on. You can then set a data limit to control data usage. Performance Monitor won't show data usage. A WWAN can connect to a virtual private network (VPN), but it will still use data. Your connection might go through a proxy server when connecting to a network, but a proxy server's job is to filter network traffic. Anytime you're connecting to the Internet or a VPN via your WWAN connection, you'll be using data.
- 239.** C. File Explorer should be showing on the Windows taskbar, but if it isn't, pressing the Windows Logo Key plus the E key simultaneously will open the File Explorer window. Pressing the Windows Logo Key+X key, then selecting File Explorer from the menu will also work, but it's not the fastest or most direct way. Windows Logo Key+F will bring up a feedback window, and Windows Logo Key+M will minimize all the open windows, leaving you at the desktop.
- 240.** A, C. For a new Windows installation, the default network setting is to configure IP addresses dynamically, so the computer should get its IP address and subnet mask from the Dynamic Host Configuration Protocol (DHCP) server. All you need is a patch cable to connect to the router and a compatible network interface card (NIC) installed (with its drivers, of course) with a registered jack 45 (RJ-45) port. You would not use a wireless NIC for an Ethernet network. A wireless NIC is for a Wi-Fi network. You don't need to know the IP address and subnet mask because the DHCP server will assign them automatically.
- 241.** A, B. There are multiple ways to view the path to a resource. In File Explorer, you can right-click the resource, then choose Properties and the Sharing tab. The screen will say Network Path and list the path just below it. You can also see it at the top of File Explorer when you're in the resource. If it isn't there, click on the ellipsis (...), choose Options, then the View tab, and ensure that Show full path in address bar is checked. Shares in Computer Management shows what you are sharing, not what is being shared with you. Typing mynetworkdrives in a browser is invalid.
- 242.** A. Software on a mountable file or physical media should be equally easy (or difficult) to install, because it's the same software; only the method of delivery is different. Mountable media has a lower cost to distribute because there is no physical media to purchase and nothing to mail to someone else; mountable files can be distributed over a network. It's easier to change because changes can be made to the file and uploaded instead of retrieving existing media and making multiple copies of the new file. It's also easier to locate because there is no need to find a Universal Serial Bus (USB) drive among the several that someone

has. Files with an .iso extension are disk image files. To install the software they contain, you first need to mount the image. You might be able to double-click it. If not, right-click and choose Mount or locate the file in File Explorer. Select the file, then click Mount under Disk Image Tools. Once the file is mounted, the operating system (OS) will treat it as a disk in an optical drive. You'll look for an installer or autorun file to start the software installation. When you're done using the image, right-click it and choose Eject.

- 243.** A, B. Once a hard drive is installed, partitions must be created (even if there is only one), and the volumes must then be formatted before they will show in File Explorer and be ready for the user to store information on them. Disk Management (`diskmgmt.msc`) and `diskpart` are two excellent and powerful tools for doing just that. Disk Management is a utility with a user-friendly graphical user interface (GUI), while `diskpart` is run from the command line and is the more powerful of the two and worth spending some time exploring. Performance Monitor (`perfmon.msc`) shows resource usage in real-time, and the Services console (`services.msc`) shows all the services available in the system and their current status.
- 244.** D. Files with an .app extension are applications. A file with a .pkg extension in a Mac is a compressed package file. A file with a .dmg extension is a disk image and treated like a drive in the macOS. It can be “mounted” like a physical hard drive, the contents read, and files opened, or applications installed from it. Files with a .bat extension are batch files used in Windows to run a string of commands that have been entered into a text file.
- 245.** D. New Technology File System (NTFS) is the Windows filesystem that supports file encryption and NTFS permissions for file sharing. Resilient File System (ReFS) is a feature available on Windows Pro for Workstations and Windows Enterprise editions. ReFS will detect when data on a mirrored drive has been corrupted and will use a healthy copy of the data on other drives to attempt to correct corrupted data and protect data. The File Allocation Table 32 (FAT32) filesystem is most compatible between operating systems (OSs) but doesn't support NTFS permissions and file-level encryption. The Fourth Extended File System (ext4) filesystem is used in the Linux world.
- 246.** D. Although the XFS filesystem and Fourth Extended File System (ext4) are both filesystems used with Linux, the ext4 filesystem is most likely to be found on a Linux workstation. The XFS filesystem uses parallel execution and is designed to handle the large file sizes of database servers. File Allocation Table 32 (FAT32) is commonly used for memory cards, Universal Serial Bus (USB) drives, and external hard drives. It is the filesystem that was used when only 32-bit processors were available. It can still be used for compatibility issues with legacy devices; however, Windows 10 and Windows 11 require the New Technology File System (NTFS). NTFS has been available for decades and offers security features that FAT32 doesn't have.
- 247.** B. Windows 10 and Windows 11 require the New Technology File System (NTFS). NTFS has been available for decades and offers security features that File Allocation Table 32-bit (FAT32) doesn't have. FAT32 is the filesystem that was used when only 32-bit processors were available and can still be used for compatibility issues with legacy devices. It is commonly used when compatibility between different operating system (OS) platforms is required, and for memory cards, Universal Serial Bus (USB) drives, and external hard drives. The XFS filesystem and Fourth Extended File System (ext4) are both used with Linux.

- 248.** B. The Task Scheduler (`tasksched.msc`) enables users to set times and dates for programs to run, whether they run one time or repetitively. `automate` isn't a valid command. Disk Management (`diskmgmt.msc`) provides a quick graphical user interface (GUI) for managing volumes on storage drives, and Disk Defragment (`dfrgui.exe`) is a GUI where a user can defragment a hard disk drive (HDD).
- 249.** A. The `whoami` command returns information about the currently logged on user. It works in both Windows and Linux, but CompTIA only has it listed under Windows. Exactly what it displays depends on what computer you're using when you run it. On a workstation, it will display the computer name/username. On a Windows server, it will return the users along with their groups and privileges. `Users` is a folder that contains information about all the users of the computer. It isn't a command. The option of `idme` isn't a real command, and the `net use` command enables a person to use shared resources on a network.
- 250.** C. Administrative Tools, which can be found in the Windows 10 Control Panel, has many of the computer-management tools that are used to maintain and troubleshoot computer systems, not just the ones listed in this question. In Windows 11, Administrative Tools has been renamed to Windows Tools and is not identical to Administrative Tools. Computer Management is a Microsoft Management Console (MMC) that contains other tools as well. In it, you can find Task Scheduler, Event Viewer, Shared Folders, Performance, Device Manager, and Disk Management, as well as Services and Windows Management Instrumentation (WMI) Control. In Windows Pro and above editions, Computer Management also contains Local Users and Groups. Resource Monitor shows resources being used by process in real-time, and Task Scheduler is just as the name sounds—it can be used to schedule other applications, even batch files, to run based on time or other predetermined events.
- 251.** C. Administrative Tools, which can be found in the Windows 10 Control Panel, has many of the computer management tools that are used to maintain and troubleshoot computer systems. In Windows 11, Administrative Tools has been renamed to Windows Tools. Computer Management is a Microsoft Management Console (MMC) that contains other tools as well. In it, you can find Task Scheduler, Event Viewer, Shared Folders, Performance, Device Manager, and Disk Management, as well as Services and Windows Management Instrumentation (WMI) Control. In Windows Pro and above editions, Computer Management also contains Local Users and Groups. Resource Monitor shows resources being used by process in real-time, and Task Scheduler is just as the name sounds—it can be used to schedule other applications, even batch files, to run based on time or other predetermined events.
- 252.** C. One of the notable differences between Windows 11 and Windows 10 is the user interface. In Windows 10, the taskbar icons are all the way to the left, and clicking the Windows icon brings up a Start menu with live tiles. Windows 11 has centered taskbar icons, and clicking the Windows icon launches a Start menu with pinned icons and a search bar. Windows 8 didn't have a Start button. There is no Windows 9.
- 253.** D. File Explorer Options in the Control Panel has three tabs: General, View, and Search. In the General tab, under Browse folders, there is only one option, which is to choose whether to open each folder in the same window or its own window. The other two sections of the General tab control whether you single or double-click to open a file, and whether the list

of previously accessed files and folders is shown. The View tab has many advanced settings in the checklist shown in the graphic. The Search tab enables you to change how searches are conducted. There is no Options tab.

- 254.** A. In macOS, the `/Library` folder holds information that all users need for the system to function. `/Users~/Library` holds data and software for the particular named user. The `/System` folder holds files needed to run the operating system (OS). `/Applications` holds the files of applications that have been installed on the Mac, like the `\Program Files` folder in a Windows system does.
- 255.** B. In macOS, the `/Users` folder contains a folder named for each user in the system. The `/Library` folder holds information that is shared among all users, like system-wide fonts. `/System` holds the Mac operating system (OS) files. Don't rename or delete it! `/User` isn't valid in the macOS world. `\User` in a Windows system contains a list of all users who have logged in to the system.
- 256.** B, C. iMessage is the Short Message Service (SMS) software used by Mac devices, and FaceTime enables users to see the other person to which they're talking. iPhone is a platform, not an application, and Teams is Microsoft's sharing platform for Windows users.
- 257.** A. Continuity is an Apple feature that enables synchronization of information between Apple devices. iCloud plays a role in this synchronization but isn't the name of the feature. Individuality and Integration are not Apple features, and iCloud is Apple's online storage space.
- 258.** B, C. In a Linux system, `fsck` and `mount` are used for filesystem management. The filesystem consistency check (`fsck`) looks for and repairs errors in the filesystem. The `mount` command enables the user to add files from an external source to their directory tree so they can easily use them. `du` calculates and reports disk space usage, and the kernel files are the main part of the operating system (OS). The kernel accepts commands.
- 259.** C. In a Linux distribution, the `curl` command is used in the Terminal (Linux's command-line interface) to communicate with a specific client URL (cURL). `ping` tests connectivity. `traceroute` shows the routers a packet traverses to get from sender to destination, and `dig`, which is also used in macOS, provides several functions related to the Domain Name System (DNS) and provides DNS lookups.
- 260.** D. In a Linux distribution, the `dnf` command is used to install, update, and remove packages. `man` displays the manual (help) for the specified command. `cat`, short for concatenate, can read, display, and combine files. The `curl` command is used at a Terminal (Linux's command-line interface) to communicate with a specific client URL (cURL).
- 261.** A. In many (but not all) Linux distributions, the kernel loads `systemd`, which then initializes all the other processes needed to run the operating system (OS). The `bootloader` in Linux is akin to the `bootloader` in a Windows system; it is part of the master boot record (MBR) and is the file that finds and loads the OS files, in this case, the kernel. `traceroute` is a networking command used to see the path a packet takes to get from one point to another.

- 262.** C. The Linux root account has ultimate power in a Linux system. `systemd` is a part of the operating system (OS) that is loaded by the bootloader. It initializes the system and loads the kernel. `admin` is a common administrator username on some routers, and `boss` is not a real computing term.
- 263.** B. A hashed list of user passwords is held in the `/etc/shadow` folder. `/etc/passwd` holds other information about users, such as their username, ID, home directory and group, and a marker that points to their entry in the `/etc/shadow` file. The option of `/etc/hosts` is used to resolve hostnames to Internet Protocol (IP) addresses on the local network, and `/etc/resolve.conf` is used to specify Domain Name System (DNS) server IP addresses to be used in resolving domain names to IP addresses.
- 264.** C. The `/etc/hosts` folder contains a table resolving local hostnames to their IP addresses. `/etc/passwd` holds information about users, such as their username, ID, home directory and group, and a marker that points to their entry in the `/etc/shadow` file, which contains a hashed version of their password. `/etc/fstab` contains a configuration table for mounting and unmounting filesystems. It makes using devices like Universal Serial Bus (USB) drives easier because using it means the user doesn't have to manually mount and unmount drives. `/etc/resolve.conf` is used to specify Domain Name System (DNS) server Internet Protocol (IP) addresses to be used in resolving domain names to IP addresses.
- 265.** B. The `/etc/fstab` folder contains a configuration table for mounting and unmounting filesystems. It makes using devices like Universal Serial Bus (USB) drives easier because using it means the user doesn't have to manually mount and unmount drives. `/etc/passwd` holds information about users, such as their username, ID, home directory and group, and a marker that points to their entry in the `/etc/shadow` file, which contains a hashed version of their password. The `/etc/hosts` folder contains a table resolving local hostnames to their Internet Protocol (IP) address. `/etc/resolve.conf` is used to specify Domain Name System (DNS) server IP addresses to be used in resolving domain names to IP addresses.
- 266.** A, C. Usually when creating or configuring an online email service, all that is needed is the user's email address and a password.
- 267.** D. Linux doesn't have a specific online storage named Linux drive, but there are several online spaces that Linux users can use to collaborate, like Slack and Google Drive. Google Drive is a Google tool that provides not only storage but also the ability to share documents and collaborate. Microsoft's online storage solution, OneDrive, works with Office 365 Copilot. Dropbox is a third-party application for storing and backing up files.
- 268.** B, C. Synchronizing between an iPhone and an iPad is easy. Go to Settings, click on your name, then iCloud, tap iCloud drive, and click the button next to Sync this iPhone. Then on the iPad, the user can either perform the same synchronization setup or access the data from icloud.com.
- 269.** A. When giving new users access to Microsoft 365 apps for business, you will go to your admin account and choose Go to setup, which starts a wizard. You don't need to download and install Microsoft 365 at this time. Instead, go to the next screen and add users. They

will automatically be assigned one of your licenses. Then you have an option to print, email, or download the user's credentials. The user can then download and install Microsoft 365 on as many as five devices.

Chapter 7: Security

1. B. CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:
 1. Investigate and verify malware symptoms.
 2. Quarantine infected system.
 3. Disable System Restore in Windows Home.
 4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end user.
2. A. A spoofing attack is an attempt by someone to make something masquerade as something else. This type of attack is usually considered an access attack. The most popular spoofing attacks today are Internet Protocol (IP) spoofing, Address Resolution Protocol (ARP) spoofing, and Domain Name System (DNS) spoofing. This is an example of IP spoofing, where the goal is to make the data look as if it came from a trusted host when it didn't (thus spoofing the IP address of the sending host). On-path attacks occur when your data transmissions are intercepted enroute, then forwarded on to their destination, sometimes with changes, sometimes without. Zombie and botnet are attacks when the user of the computer doesn't know there is malware on their computer. Their computer is a zombie, and when many zombies are used to attack a system, it's known as a botnet attack. A non-compliant system is one that is not following best practices such as keeping the operating system (OS) and anti-malware updated and firewall enabled.
3. A. A smart card is a type of badge or card that gives the holder access to resources, including buildings, parking lots, and computers. It contains information about your identity and access privileges. Each area or computer has either a card scanner that uses Radio Frequency Identification (RFID), or a reader in which you insert your card. A security token is something you have that is used to verify your identity; it can be a software or hardware token. A smart card is a type of hardware security token. An access control vestibule is used to prevent tailgating. It is an area between two doors, often with a security camera and possibly a security guard, where people are held until their identity is verified and access is granted. The second door grants access to a secure area. A key fob is a small device used in multifactor identification. It can generate a number or have software on it that is read to gain access.

4. D. There are four wireless encryption methods available for Wi-Fi networks. From least to most secure, they are Wired Equivalent Privacy (WEP), Wi-Fi Protected Access (WPA), and two newer versions of WPA called WPA2 and WPA3. WPA3 is the latest and the most secure and should be used unless strange circumstances prevent you from doing so. Wi-Fi Protected Setup (WPS) is an easy way to configure Wi-Fi for devices like printers, where a number would be generated on a printer, for example, and the number would need to be entered on the access point, or vice versa. WPS has security flaws and is not listed in the CompTIA A+ exam objectives.
5. C. When an object is moved from one Organizational Unit (OU) to another, the object inherits the group policies and security settings of the new OU. Their rights, permissions, and group policies probably won't remain the same, unless the two OUs have the same settings. There is no need to create a new OU for moved employees.
6. B, C. Social engineering is a process in which an attacker attempts to acquire information about your network and system by social means, such as talking to people in the organization, shoulder surfing, tailgating, or other methods. When this is done via email or instant messaging, it's called phishing or smishing. Spoofing involves pretending to be a trusted resource, for example, by using a trusted resource's Internet Protocol (IP) address to gain access to something else. A brute-force attack usually involves software that keeps trying passwords or codes until it hits upon the right one to gain access.
7. D. Tailgating refers to being so close to someone when they enter a building that you can come in right behind them, without needing to use a key, a card, or any other security device. Using an access control vestibule, which is a small room that limits access to one or a few individuals, is a great way to stop tailgating. Revolving doors can also help prevent tailgating. Shoulder surfing is walking behind someone hoping to see passwords or other security information they may be entering. Privacy screens and physical barriers can help prevent shoulder surfing. On-path attacks occur when data transmissions are intercepted by someone enroute, then forwarded on to their destination, sometimes with changes, sometimes without. A brute-force attack involves software that keeps trying passwords or codes until it hits upon the right one to gain access.
8. C. In a Windows Active Directory (i.e., domain), password policies can be configured at the domain level using Group Policy Objects (GPOs). There are hundreds of variables that can be configured. Variables that can be configured relating to passwords include password complexity and length and the time between allowed changes to passwords. A firewall can be configured to block certain types of traffic based on things like IP address, protocol, or a Media Access Control (MAC) address. A virtual private network (VPN) is a secure path between a local and remote device. Data Loss Prevention (DLP) is the process of monitoring and identifying sensitive data to make sure it is only accessed by authorized persons.
9. A. Sometimes, the obvious solutions are the best ones! A key aspect of access control involves physical barriers. One of the easiest ways to prevent those intent on creating problems from physically entering your environment is to lock your doors and keep them out. Cable locks are used to secure mobile devices like laptops to a table or fixed device so they can't be carried away. An access control vestibule is a small room between two doors, where the secure access area is beyond the second door, and biometrics uses a part of the body to identify a person.

- 10.** B. Ransomware is software, often delivered through a Trojan, that takes control of a system and demands that a third party be paid. The “control” can be accomplished by encrypting the hard drive, by changing user password information, or via any of several other creative ways. Users are usually assured that by paying the extortion amount (i.e., the ransom), they will be given the code needed to revert their systems to normal operations. Even among malware, ransomware is particularly nasty. A rootkit is software that gains access to a system as administrator, giving it full control over a system. Rootkits are adept at hiding their presence and are difficult to eradicate. A Trojan is named after the Trojan horse of Greek mythology. Trojans are malicious software that hide in that fun game or screensaver that you just downloaded, and it installs when you install the innocent-looking files. Trojans often install a backdoor that a malicious actor can use later to access the infected system. Spyware is designed to watch what you do and where you go, hoping to gain information such as logins, passwords, and bank account numbers.
- 11.** A, B. When configuring a new small office/home office (SOHO) or any other wireless router, always change the default administrator username and password first. This prevents would-be hackers from having easy access to the router. Then change the default service set identifier (SSID). These default values can easily be found online and not changing them immediately makes your router vulnerable to attack. The radio power level might be changed later if you discover the signal is too weak or too strong. There is no actual guest account on a router.
- 12.** D. Port security involves disabling all unneeded protocols and ports. In this case, ports 80 and 443 are needed for Hypertext Transfer Protocol (HTTP) and HTTP Secure (HTTPS) access, and ports 25, 110, 143, 465, or 587 may be needed for email. That’s it. If you don’t need them, remove the additional protocols, software, or services, or prevent them (i.e., disable them, or block them, as the setting is typically called on a router) from loading. Ports left open but not in use present an open door for an attacker to enter. Media Access Control (MAC) filtering is an option on most routers that will only allow devices with specific MAC addresses to access the router. Content filtering blocks undesirable traffic, such as social media or hate sites on a corporate network. Port forwarding/mapping will send all traffic that comes in on a specified port number to a specific node on the network.
- 13.** B. When you move a file or folder on the same New Technology File System (NTFS) volume, in this case the D:\ drive, it will keep its original permissions. If you copy it or move it to a different volume, it will inherit permissions from its new parent directory.
- 14.** B. When users log on to a computer or network, they are generally required to provide credentials such as a username and password. In multifactor authentication (MFA), the user is required to provide two or more factors proving who they are. These items are generally from two of four categories: Something they know, such as a password, something they have, such as a code from a security token, something they are, such as a fingerprint or palmprint scan), or somewhere they are based on global positioning system (GPS) location or Wi-Fi and cell tower triangulation. A firewall is a software or hardware device that will block traffic into or out of a network based on parameters that the administrator specifies. An access control list (ACL) exists for each resource. It defines who has what level of access to that resource. The principle of least privilege states that you give a user only enough access to do what they need to do their job and nothing more.

15. B, C. The best methods for destroying sensitive data without destroying the drive are using either overwrite or drive wipe programs. Overwriting the drive entails copying over the data with new data. A common practice is to replace the data with 0s. Drive wipes do a similar thing. Formatting the drive does not guarantee that others can't read the data. Using electromagnetic fields (or degaussing) isn't reliable and can damage the hard drive, and it won't work at all on solid-state drives (SSDs).
16. B. Endpoint detection and response (EDR) monitors network endpoints continuously in an attempt to recognize, remediate, and prevent spread of any malware or data loss in a system. They also provide reporting capabilities. Managed EDR (MDR) is EDR managed by a third party. Distributed denial-of-service (DDoS) is an attack performed by many computers to keep legitimate traffic from reaching a server. A potentially unwanted program (PUP) is often installed with other legitimate software and although it can launch any malware, it generally is used for browser redirection and adware.
17. D. When Windows is installed, one of the default accounts it creates in local users and groups is Guest, and this represents a weakness that can be exploited by an attacker. While the account cannot do much, it can provide initial access to a system, and the attacker can use that to find another account or acquire sensitive information about the system. To secure the system, disable all accounts that are not needed, especially the Guest account, which is disabled by default, although verifying this should be a part of your security plan. The Administrator account should be renamed. If a hacker knows a valid username, then they are halfway into your system. The DefaultAccount is an account that is managed by the system and is disabled by default. Power User is not an account that is installed with Windows 11, however, there is a Power Users group that is kept for backward compatibility.
18. A. On-path attacks clandestinely place something (such as a piece of software or a rogue router) between a server and the user, and neither the server's administrator nor the user is aware of it. The on-path attack intercepts data, then sends the information to the server as if nothing is wrong. The on-path attack software may be recording information for someone to view later, altering it, or in some other way compromising the security of your system and session. A non-compliant system is one that is not in line with acceptable security policies and procedures. Zombie and botnet are attacks where the user of the computer doesn't know there is malware on their computer. Their computer is a zombie, and when many zombies are used to attack a system, it's known as a botnet attack. Spoofing occurs when another system pretends or appears to be a trusted system.
19. B, C. Setting strong passwords is critical to network security. They should be as long as possible, with a maximum of 64 characters. Eight characters is the minimum for standard users, but in secure environments or for privileged user accounts the minimum required should be 15 characters. Passphrases, such as a line from a favorite poem, are longer than the eight character minimum, but easier for the user to remember. Password complexity means using a combination of uppercase and lowercase letters, a number, and a special character such as #, @, &, or others. It's important to note that just before release of the exam, the National Institute of Standards and Technology (NIST), which makes recommendations for computer security in the United States of America, had dropped the recommendation for enforcing password complexity and password expiration. They are

mentioned here because they are included in the CompTIA objectives for the 220-1202 exam.

20. A. With New Technology File System (NTFS), each file, directory, and volume can have its own security. NTFS tracks security in access control lists (ACLs) for each resource. The ACL will contain the user or group name and the level of access they have been granted. The basic permissions to choose from are Full Control, Modify, Read & execute, List Folder Contents, Read, and Write. There are also special permissions and settings that can be applied. A token is software or hardware that is used in multifactor authentication (MFA) and falls under the category of something that a user has. Badges may use radio frequency identification (RFID) or other technology that is read to allow physical entry to a secure area. Control rosters are used in areas that have security guards and contain a list of people who are allowed to enter.
21. D. The Guest account is created and disabled by default (and should remain disabled) and is a member of the Guests group. For the most part, members of Guests have the same rights as Users, except they can't get to log files. The best reason to make users members of the Guests group is to access the system only for a limited time. Although there is a Standard User account type, there is no group named Standard Users by default. There are groups created automatically called Users, Administrators, Power Users, Guests, and a few others. The Power Users group is kept for backward compatibility, but they are the same as someone in the Users group. Administrators have complete control over the systems that they are an administrator on.
22. C. One of the big problems larger networks must deal with is the need for users to access multiple systems or applications. This may require a user to remember multiple accounts and passwords. The purpose of single sign-on (SSO) is to give users access to all the applications and systems that they need when they log on. Some systems may require users to enter their credentials again, but the username and password will be consistent between systems. SSO is often configured as a part of the network's directory services. Encrypting file system (EFS) is used to encrypt volumes, files, and folders in Windows OSs. Mobile device management (MDM) enables an IT department to retain some control, even though an organization may allow users to bring your own devices (BYOD) to the workplace. User account control (UAC) requires entering an administrator password to verify that the person has the authority to change a Windows system before allowing them to make any changes.
23. B. A keylogger seems to be running on the system, monitoring and copying all that is typed on the keyboard. Obviously, this malware needs to be removed and incident response steps taken. The other three options would not cause the symptoms stated.
24. A. A software-based firewall on the workstation would be able to stop unwanted network traffic, including port scans and probes. Anti-phishing training teaches users to avoid malicious emails. Anti-malware and antivirus are software designed to recognize and quarantine or eradicate malicious code. Viruses are a subset of malware.
25. C. The software token is stored on a general-purpose device, such as a PC or smartphone. The hardware token option would involve carrying an added key fob or device. A fingerprint

reader would be unacceptable as it involves biometrics. A second password defeats the benefit of using multifactor authentication (MFA).

26. B. Temporal key integrity protocol (TKIP) is an encryption protocol, used in Wi-Fi protected access (WPA) for wireless connections. It was intended to replace the weak encryption of wired equivalent privacy (WEP) by creating a unique key for each data frame. It has since been subject to wireless attacks and is deprecated. A virtual LAN (VLAN) occurs when devices from multiple local area networks (LANs) are joined together virtually and can act as if on the same physical network even though they are not, while a virtual private network (VPN) is similar because it creates a private tunnel through a public network using encryption protocols. A VPN might be used by someone working remotely to access a corporate server. Advanced encryption standard (AES) is the successor to TKIP and is used in WPA2 along with TKIP for backward compatibility; however, AES is also vulnerable to certain attacks. WPA3 uses the simultaneous authentication of equals (SAE) protocol on networks, and the opportunistic wireless encryption (OWE) protocol on open networks. Although WPA3 is most secure, its adoption has been slow due to compatibility issues and vulnerabilities (leaked passwords) that have been discovered. Most routers offer WPA2/WPA3 mixed mode, which can be used until all devices are updated to WPA3. Despite its vulnerabilities, WPA3 is the most secure of these standards.
27. B, D. Group policy/updates and assigning login scripts are common ways to push and enforce security settings on Active Directory objects. Encrypting file system (EFS) is used to encrypt volumes, files, and folders. Disabling unused ports is an important part of device/network hardening and is performed on a firewall, which may be a service of a router or a separate firewall device.
28. A. Advanced encryption standard (AES) is used in Wi-Fi protected access, version 2 (WPA2). A virtual private network (VPN) is a connection that transmits data across a public network using encryption. Remote authentication dial-in user service (RADIUS) and Kerberos are both authentication protocols.
29. D. Remote authentication dial-in user service (RADIUS) was originally designed to authenticate remote users to a dial-in access server but is now used in several authentication situations. Temporal key integrity protocol (TKIP) is a wireless encryption protocol used in Wi-Fi protected access (WPA), which made WPA more robust/secure than wired equivalent privacy (WEP). Terminal access controller access-control system (TACACS+) is an authentication protocol for centralized authentication, and a virtual private network (VPN) uses encryption to create a private connection using a public network.
30. A. By using directory services, like Active Directory settings or the Local Group Policy Editor, you can restrict the number of failed log-in attempts before the user is locked out of their account. This is important to help prevent a brute-force attack, which attempts to guess passwords until it hits upon the right one. Antivirus/anti-malware is important to have installed and identifies malicious software based on its signature code but is not at work here. A bollard is a physical post intended to block vehicular traffic, and a rootkit is a particularly difficult malware to eradicate, because it is working with administrator rights and it's good at hiding in a system.

- 31.** C. The organizational unit (OU) is a subdivision within which users, groups, more OUs, and other objects can be placed. The OU exists on a domain, which is a group of users and resources under a single administrative control. Windows domains are managed by software called an Active Directory, which is organized into organizational units, usually for security purposes. A home directory is where an individual user stores their documents and such, and in a Windows domain, that location is usually on the Domain Controller or another server.
- 32.** A. CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:
- 1.** Investigate and verify malware symptoms.
 - 2.** Quarantine infected system.
 - 3.** Disable System Restore in Windows Home.
 - 4.** Remediate infected systems.
 - 5.** Update anti-malware software.
 - 6.** Scan and removal techniques (e.g., safe mode, preinstallation environment).
 - 7.** Reimage/reinstall.
 - 8.** Schedule scans and run updates.
 - 9.** Enable System Restore and create a restore point in Windows Home.
 - 10.** Educate the end user.
- 33.** A, C. An equipment lock and door lock would slow down a would-be thief. A security token is involved in multifactor authentication (MFA) and an external hardware token is one of two types of security tokens, the other being a software token.
- 34.** C, D. Often an access control vestibule will have either a security guard, or video surveillance, or both. Once in the vestibule, the second door could be opened remotely by someone watching through the surveillance camera, or by a guard who personally clears the person trying to gain access. A bollard is a post used to block vehicular traffic. A motion sensor detects movement and is often used to trigger an alarm, turn on a light, turn on a camera, or a combination of those.
- 35.** B. Folder redirection allows users' profile folders to be stored in a more centralized location on the network, instead of on the local machine. A profile stored this way is called a roaming profile. The home folder is the specific location where a user's documents and such are stored. An organization unit (OU) is a management tool that can be used to organize Active Directory (AD) resources and can contain users, computers, and other resources. A virtual private network (VPN) is created across a public network by using strong encryption protocols.
- 36.** B. Wi-Fi protected access, version 2 (WPA2) replaced Wi-Fi protected access (WPA), which had replaced wired equivalency protocol (WEP). WEP was the first wireless security protocol. WPA was developed next and used temporal key integrity protocol (TKIP) for encryption. WPA2 uses TKIP for backward compatibility and the more secure advanced encryption standard (AES). Wi-Fi protected access, version 3 (WPA3) was released in 2018 to replace WPA2, whose security had been broken. WPA3 also includes better security for the proliferation of Internet of Things (IoT) devices. WPA, WPA2, and WPA3 all have personal

and enterprise options, and all have been proven to have vulnerabilities, but WPA3 is the most secure.

37. D. Operating system (OS) and application patches may fix vulnerabilities in the software and should be applied as soon as possible after they are released. In a corporate environment, it would be best to test them in a sandbox first to avoid any problems. In a Windows PC's settings, Windows Updates manages the process for you.
38. A, C. Security groups in Windows Active Directory (AD) are similar to groups in a workstation; they are used to group objects (i.e., users, computers, etc.) together that need the same permissions (i.e., the same access to resources). For example, if I belong to the accounting clerk group, I will have access to the accounting folders but not the production folders. Conversely, organizational units (OUs) are used mainly for applying group policies. You would likely use an OU to apply updates to client computers.
39. B. To log in to a domain instead of a workgroup, you can either right-click the Windows icon on the taskbar and choose System or go into the Control Panel and choose System. Both take you to the System screen in Settings. From there, choose Domain or Workgroup, and click on change. Windows 10 Administrative tools has been renamed Windows tools in Windows 11, and it won't take you to the screen you need. Computer management is for managing drives and volumes. System information tells you about the hardware, software, and users in a system, but it doesn't provide a way to change anything.
40. A, C. An access control vestibule is a holding area between two doors that often uses video surveillance and has a security guard that will grant or deny physical access to an area. They may employ other means of authentication as well and are considered physical security, as are simple door keys. Multifactor authentication (MFA) is security that requires identification and two or more methods of authentication, such as a password and key fob. Authentication can be verified by something you know (e.g., passwords), something you have (e.g., key fob, smart card, etc.), something you are (e.g., fingerprint, palmprint, retina scan), or somewhere you are (e.g., using Global Positioning System [GPS] position or Wi-Fi network and cell tower triangulation). Firewalls are logical security devices that filter incoming and outgoing packets to allow or reject them based on criteria you choose.
41. C. A person in the IT department is not likely to ask for your password. If they want you to reset it, they can use software to reset it, which will make you choose a new password on next login. This is a social engineering attack. Social engineering means using kindness, coercion, or fear to get you to give up privileged information like your password. Spoofing is when a website or server, for example, is made to look like a trusted one, but in reality, there is an attacker lurking there. A brute-force attack uses software to repeatedly try different passwords to break into a system.
42. A. Authenticator apps run on devices like smartphones or PCs and provide a unique key that changes every few seconds. An authenticator app can be a part of multifactor authentication (MFA) and device hardening but is not described in the question. A fingerprint scan is a type of biometric authentication. Device hardening means taking steps to protect devices and the data on them from attack. Anytime there is more than one authentication method required, it's MFA. In this case, it does involve using biometrics, but the password is not a biometric

factor. MFA requires two or more of the following four types of inputs: something you know (e.g., password), something you have (e.g., token), something you are (e.g., biometrics), or somewhere you are (i.e., Global Positioning System [GPS] or other location services).

43. C. Tailgating refers to being so close to someone when they enter a building that you can come in right behind them without needing to use a key, a card, or any other security device. Using an access control vestibule, which is a device such as a small room that limits access to one or a few individuals, is a great way to stop tailgating. With a door lock or ID badge, the tailgaters could still follow the other employee in. An entry control roster is merely a list of people who are allowed access to an area and isn't much use without a guard to check it.
44. B. Adding AOShea to the Administrators group will certainly work, but it's not the recommended approach. Because members of the Administrators group have such power, they can inadvertently do harm, for example, accidentally deleting a file that a standard user could not. To protect against this, the practice of logging in with an Administrators group account for daily interaction is strongly discouraged. Instead, system administrators should log in with a user account with lesser privileges and change to the Administrators group account with elevated privileges only when necessary. The original Administrator account shouldn't be renamed to this user, because there is usually more than one administrator. The Power User's group is only kept for backward compatibility.
45. A. Biometric authentication requires identification of a physical feature of the user, such as a fingerprint or palmprint. Laptops and other mobile devices commonly use your fingerprint to prove who you are. Most modern laptops can also use a facial scan to identify you. DNA and retina scanners are considered a form of biometric authentication, but they are not commonly used today with mobile devices. (Imagine your phone needing to collect blood or saliva to authenticate you—no thanks!) DNA isn't on the CompTIA A+ objectives yet, but facial recognition, retina scanners, and fingerprint and palm print scanners are. A swipe lock is not a type of biometrics. It's also not secure!
46. B. BitLocker allows you to use drive encryption to protect files—including those needed for startup and log-on. For removable drives, BitLocker-To-Go provides the same encryption technology to help prevent unauthorized access to the files stored on them. Encrypting file system (EFS) is used to encrypt volumes, files, and folders on a drive. Advanced encryption standard (AES) is an encrypting protocol for Wi-Fi.
47. C. Biometric devices use physical characteristics to identify the user. Biometric systems include fingerprint/palm/hand scanners, retinal scanners, face scanners, and soon, possibly, DNA scanners. To gain access to resources, you must pass a physical screening process. ID badges often use radio frequency identification (RFID) to communicate with a reader and verify your identity. Bollards are vertical posts used to block vehicular traffic. Tokens can be either hard (e.g., key fob) or soft (e.g., software on a system) and are often used in multifactor authentication (MFA).
48. B. Stalkerware is any software whether a commercial app or a malware that is used to perform surveillance on a person or business for malicious intent, which is stalking. A keylogger records keyboard input for a malicious actor to use later. A Structured Query Language (SQL) injection happens when a poorly written website doesn't specify limits on

what an input field can contain, and that field is used by a malicious actor to insert code into the website. SQL is used to interact with databases, and most websites have databases running on the backend to take orders or capture visitor data for newsletters and such.

A Trojan is malware that appears to be a useful program and is unwittingly downloaded by the victim, then often installs a backdoor for a malicious actor to use later for accessing the system.

49. B. Companies normally generate a huge amount of paper, most of which eventually winds up in dumpsters or recycle bins. Dumpsters may contain information that is highly sensitive in nature, and attackers may seek it out by practicing dumpster diving. In high-security and government environments, sensitive papers should be either shredded or burned. Shoulder surfing is literally looking over someone's shoulder to see passwords or other sensitive information. Social engineering happens anytime someone tries to coerce, threaten, or cajole someone into giving up privileged security information. A brute-force attack is repeatedly trying passwords in an effort to guess the correct one.
50. A. The systems are not up-to-date and therefore are more vulnerable to attacks. These systems are considered non-compliant systems. It's a violation of security best practices to fail to keep all software on your network up to date. Zombie and botnet are attacks where the computer's user doesn't know there is malware on their computer. Their computer is a zombie, controlled by a bad actor, and when many zombies are used to attack a system, it is known as a botnet attack. A brute-force attack usually involves software that keeps trying passwords or codes until it hits upon the right one to gain access. A zero-day attack happens when a hole is found in a web browser or other software and attackers begin exploiting it before the software developer or anti-malware vendors have time to plug the hole.
51. C. When a hole is found in a web browser or other software and attackers begin exploiting it the very day it is discovered by the developer (i.e., bypassing the one- to two-day response time that many software providers need to put out a patch once the hole has been found), it is known as a zero-day attack (or exploit). Zombie and botnet are attacks where the computer's user doesn't know there is malware on their computer. Their computer is a zombie, controlled by a bad actor, and when many zombies are used to attack a system, it's known as a botnet attack. Non-compliant systems are those whose software is not up to date or they are not following best practices or corporate restrictions and rules. A brute-force attack usually involves software that keeps trying passwords or codes until it hits upon the right one to gain access.
52. D. When there are conflicting New Technology File System (NTFS) permissions, generally they are combined, and the most liberal is granted. The exception to that is when there is an explicit Deny. As in this case, Deny overrides any allowed permissions.
53. C. Microsoft wanted to create a group in Windows that was not as powerful as the Administrators group, which is how the Power Users group came into being. The idea was that membership in this group would be given Read/Write permission to the system, allowing members to install most software but keeping them from changing key OS files or accessing other user's data. However, for many Windows versions now, the Power Users group now assigns permissions equivalent to the Standard user, a member of the Users group. There is no group called Superuser, or Standard Users, or Advanced Users.

- 54.** A, D. You should disable the default Administrator account because most people are familiar with its existence, so part of the work of hacking in is already done if it isn't disabled. Renaming it isn't enough because it will still have the same Security Identifier (SID), and an attacker can use that to identify the Administrator account. Disabling it is the preferred way to keep it safe, not removing it from the group. Any users with administrative privileges should have a regular account and an admin account, and only use administrative privileges when necessary, such as when a User Account Control (UAC) window pops up, entering their admin password.
- 55.** A, C. Browser history should be cleared when you exit the browser for privacy and to maintain browser performance. Clearing it doesn't trigger synchronization unless you are logged in. To clear just the history of the computer you're on, log out of the browser. Clearing data doesn't clear invalid certificates. That's done usually under Manage Certificates or a similar setting.
- 56.** B, D. NTFS permissions affect users regardless of whether they are at the local computer or accessing the resource across the network. They can also be applied to individual files, whereas Share permissions only work across a network and can be applied only to folders. One set of permissions is not inherently more restrictive than the other, as either type can be used to deny access in a given situation (at least when accessing across the network). When New Technology File System (NTFS) and Share permissions affect the same folders, the most restrictive permission applies.
- 57.** D. An unauthorized router with a seemingly legitimate configuration is specifically known as an evil twin. Those can lead to on-path attacks, which involve clandestinely placing something (such as a piece of software or a rogue router) between a server and the user, and neither the server's administrator nor the user is aware of it. The unauthorized device in the middle intercepts data and then sends the information to the server as if nothing is wrong. The unauthorized device software may be recording information for someone to view later, altering it, or in some other way compromising the security of your system and session. A zombie is a computer system that a hacker has a backdoor into and can use to perpetrate attacks, unknown to the computer system's legitimate user. A botnet is a system of zombie computers engaged in an orchestrated attack on a target. Spoofing occurs when an attacker causes a system or node to appear to be a different one. It's like impersonation but is technology-based rather than human-based. A non-compliant system is one that is not updated or not following company protocols regarding security.
- 58.** A, D. Changing security group membership can be done in Active Directory Users and Computers by right-clicking either the user or the group and clicking either the Member Of or Members tab, then clicking Add. Moving them to a new organizational unit (OU) does not change the security group membership. There is no need to delete and re-create a user, and in fact that could cause many other problems!
- 59.** A, C. Bollards are vertical posts that are short and sturdy, sometimes made of cement or steel. They can be placed closely enough together so that a vehicle can't go through an area, but people can. Fences can also be erected to keep vehicles and people out of an area. Motion sensors can be used to trigger alarms, but won't actually keep anyone out, and good lighting is always a deterrent, but again it won't physically keep anyone out.

60. C. A locator app is what you need. Apple supplies a free locator app called Find My, and Google has the Google Find My Device app. Together with their respective websites, these apps allow multiple mobile devices to be located if powered on and attached to the Internet (via 5G, 4G, 3G, Wi-Fi, Ethernet, and so on). For Apple devices, if not attached to the Internet, nearby devices can identify your device and tell you where it is. Both Find My and Google Find My Device allow the device to be controlled remotely so as to lock it, play a sound (even if audio is off), display a message, or even wipe it clean.
61. A. File systems such as the New Technology File System (NTFS), and security devices such as firewalls, can track security in access control lists (ACLs). ACLs can hold permissions for local users and groups, and each entry in the ACL can also specify what type of access is given. This allows a great deal of flexibility in setting up a network. Encrypting file system (EFS) is used to encrypt volumes, files, and folders, but not entire drives. A virtual private network (VPN) is a type of network connection that uses encryption to create a private network that traverses a public one. Personal identification numbers (PINs) are used in many applications to identify a user.
62. C. On any individual file or folder, you can right-click and choose properties to see the Read-only and Hidden attributes, then click Advanced to see whether the file is ready for archiving (i.e., needs to be backed up). If it needs backing up, then it has been modified. You can also open a folder in File Explorer and click on Date Modified to sort the files by the last date modified. Simply typing `attrib` at a command prompt will show the file attributes for everything in that folder. Attributes are information such as whether the file is a system file (S), hidden (H), read only (R), or ready to be archived (A). To see the attributes for a single file, type `attrib filename`. The `attrib` command is not specifically listed in the CompTIA A+ objectives, but file attributes are. Archive is not a valid command.
63. B. Professional and higher operating system (OS) editions in either Windows 10 or Windows 11 will support BitLocker. Home editions will not, regardless of what version of the Windows OS they are.
64. C. Spyware differs from other malware in that it works—often actively—on behalf of a third party. Rather than self-replicating, like viruses and worms, spyware is often spread to machines by users who inadvertently ask for it. The users may have downloaded other programs that included the spyware, visited infected sites, and so on. The spyware program monitors the user's activity and gathers information about the user to pass on to marketers, or intercepts personal data such as credit card numbers. Zombies and botnets are innocent computers that are used by a hacker to perpetrate an attack on someone else without the user's knowledge. A spoofing example is using an IP address that should be someone else and pretending to be them to gain system access to a system. Ransomware locks a system in some way or encrypts data and won't allow access until the system's owner pays a ransom.
65. C. The new administrator should have a non-administrative user account to use for day-to-day tasks. They also need an account with administrative privileges to perform the administrative duties. When creating user accounts, follow the principle of least privilege: Give users only the permissions they need to do their work and no more. This is especially true with administrators. Those users should be educated on how each of the accounts should be used. A third account is not necessarily needed.

- 66.** A, C. Password attacks occur when an account is attacked repeatedly with the intent of determining the password that will gain access. This is accomplished by using applications designed to break the password by sending possible passwords to log in to the account in a systematic manner. Two types of password attacks are brute-force and dictionary attacks. Zombie and botnet are attacks where the user of the computer doesn't know there is malware on their computer. Their computer is a zombie, and when many zombies are used by a bad actor to attack a system, it's known as a botnet attack. A spoofing attack is an attempt by someone or something to masquerade as someone or something else.
- 67.** C. All options will improve the smartphone's security. For just the basic level of security, though, enable a screen lock. A user will need to enter a personal identification number (PIN) code, fingerprint, pattern, or facial recognition to gain access to the device. Multifactor authentication (MFA) occurs whenever you need two or more ways to prove who you are (i.e., something you know, something you have, something you are, or someplace you are). Full device encryption would mean encoding the data and requiring a key to decrypt it. Remote wipe is a feature that can remove all the personal or corporate data from a phone if it is lost or stolen.
- 68.** A. An authenticator app can help securely verify your identity online, regardless of the account you want to log into. Different apps work in different ways, but the general procedure is that the app will generate a random code for you to type in, along with your username and password. The random code helps identify you and tells the site you are logging into that you really are who you say you are. The other options are not actual application types.
- 69.** B. A dictionary attack uses a dictionary of common words to attempt to find the user's password. Dictionary attacks can be automated, and several tools exist in the public domain to execute them. As an example of this type of attack, imagine guessing words and word combinations found in a standard English-language dictionary. Brute-force is trying repeatedly to guess a user's password. Social engineering is using kindness, coercion, or fear to get you to give up privileged information such as your password. Shoulder surfing is literally someone looking over your shoulder in an attempt to gain privileged information.
- 70.** A. Trojans are programs that enter a system or network under the guise of another program. A Trojan may be included as an attachment or as part of an installation program. It can create a backdoor for an attacker to use later or replace a valid program during installation. Spyware watches what you do and reports back to someone. A virus is spread from computer to computer because of some contact between the machines, often through email. Whaling is phishing for "big fish," such as very wealthy or influential people. Phishing gets its name from fishing for information.
- 71.** C. Degaussing is using a large electromagnet to destroy any magnetic media, such as a hard drive or backup tape set. This process helps ensure that information doesn't fall into the wrong hands. Overwriting and zero-writing write random binary (or all zeros) on a magnetic hard drive using software. The process is done several times by the software to be effective. Incineration means simply burning the drive.

72. C. Certain metadata pertaining to a file are called attributes. The most commonly used attributes are system (S), hidden (H), read only (R), and archive (A). There are others that can be viewed by typing `attrib /?` at a command prompt. The `attrib` command is how you add attributes, such as `attrib myfile +R` to make `myfile` read only. You can also remove attributes using the same command with a minus sign. In the Windows 10/11 Graphical User Interface (GUI), you can view attributes by right-clicking a file or folder and choosing properties. Windows 11 will display a screen like the one in the graphic. The `attrib` command is not specifically listed on the CompTIA A+ objectives, but file attributes are. The archive bit is set when a file has been modified and needs backing up. New Technology File System (NTFS) permissions, such as read only and full control, are part of the security measures of the NTFS file system. Share permissions are less granular than NTFS permissions and only apply when a resource is accessed across a network.
73. B. BitLocker drive encryption allows you to use drive encryption to protect files—including those needed for startup and log-on. This is available only with Windows Pro and higher editions. For removable drives, BitLocker-To-Go provides the same encryption technology to help prevent unauthorized access to the files stored on them. Encrypting file system (EFS) is used to encrypt volumes, files, and folders but is not capable of encrypting the entire drive.
74. C. Rootkits are software programs that can hide certain things from the operating system (OS); they do so by obtaining (and retaining) administrative-level access. With a rootkit, there may be several processes running on a system that don't show up in Task Manager, or connections that don't appear in a Netstat display may be established or available—the rootkit masks the presence of these items. Rootkits are known for being particularly difficult to eradicate. A virus is spread from computer to computer because of some contact between the machines, often through email. Whaling is phishing for “big fish,” such as very wealthy or influential people. Phishing gets its name from fishing for information. Ransomware holds a machine or network hostage, making it and its data inaccessible, until a ransom is paid.
75. D. Encrypting file system (EFS) is available in most editions of Windows, and it allows for encryption/decryption of files stored in New Technology File System (NTFS) volumes. All users can use EFS, whereas only administrators can turn on BitLocker. It does not require any special hardware, while BitLocker benefits from having the trusted platform module (TPM). As an additional distinction, EFS can encrypt just one file, if so desired, while BitLocker encrypts the whole volume and whatever is stored on it. BitLocker is device encryption. BitLocker-To-Go is for mobile use, not on a storage drive in a desktop computer.
76. B. Anti-malware software will help protect computers from malicious programs. Typically, anti-malware does everything that antivirus software does as well as identify threats beyond just viruses. In fact, viruses are a type of malware. Often anti-malware software is marketed as antivirus software. A firewall is a hardware or software device designed to prevent certain types of traffic from entering or leaving a network. Encrypting file system (EFS) allows a user to encrypt individual volumes, files, or folders, and user account control (UAC) is designed to prevent users from making changes that they are not authorized to make.

- 77.** D. Educating users to recognize phishing is one of the most important steps in preventing hackers from acquiring login credentials. One way to do this is to hire a consulting company to send phishing emails and see which employees respond when they should not and therefore need additional training. Phishing is usually done through email and is an attempt to “fish” for information from an authorized network user, such as logon information. Whaling is phishing for high-profile or wealthy targets. A zero-day attack is one that happens the same day a vulnerability is discovered, so there has not been time to rectify the vulnerability.
- 78.** B. When a file or folder is copied on New Technology File System (NTFS) volumes, the new file or folder will inherit its NTFS permissions from its new parent folder. The file in question was copied, so it inherits Read control and the old permission (i.e., Modify) is discarded. However, when files and folders are moved, versus copying them, the original permissions are retained at the new location.
- 79.** B. Only New Technology File System (NTFS) permissions can be applied to individual files. Both NTFS and Share permissions can be applied to volumes and folders. Share permissions are only effective when the resource is accessed via a network. NTFS permissions are effective whether the person access the resource locally or via a network. NTFS permissions are inherited from a parent folder. Share permissions do not have inheritance.
- 80.** A. CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:
1. Investigate and verify malware symptoms.
 2. Quarantine infected system.
 3. Disable System Restore in Windows Home.
 4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end user.
- 81.** A. Adware differs from other malware in that it works—often actively—on behalf of a third party. Rather than self-replicating, like viruses and worms, spyware is spread to machines by users who inadvertently ask for it. The users often don’t know they have asked for it but have done so by downloading other programs, visiting infected sites, and so on. The adware program monitors the user’s activity and responds by offering unsolicited pop-up advertisements, gathers information about the user to pass on to marketers, or intercepts personal data such as credit card numbers. Ransomware is software that takes over a computer and won’t allow access to the data until a ransom is paid. Zombies are computers that have been taken over by another party and are used to perform malicious acts. When there are many zombies acting together, they form a botnet. The computer user is generally unaware of the presence of the attacker. A Trojan is software that is downloaded when the user downloads an innocent-looking software or digital image. Once downloaded, the Trojan loads into the computer system.

82. A. Encrypting File System (EFS) allows for the encryption/decryption of individual volumes, files, and folders stored in New Technology File System (NTFS) volumes, while BitLocker and BitLocker-To-Go encrypt entire drives. However, neither of them is available in Home editions of Windows. If there is supporting hardware, (trusted platform module [TPM] enabled in basic input output system/unified extensible firmware interface [BIOS/UEFI] and secure boot enabled), then device encryption can be used instead. Windows 11 requires TPM v. 2.0. With device encryption, only someone with authorization to use the device will be able to decrypt it. You must be logged in as an administrator to turn on device encryption, which can be found in Windows Settings. If device encryption isn't there, then it isn't available on the device. You can also see if the hardware supports it by launching the System Information Utility as an administrator, then scrolling down to Device Encryption Support.
83. A, D. These are share permissions, not New Technology File System (NTFS) permissions. Share permissions have no effect when someone logs on locally; they only take effect when being accessed via a network. (NTFS permissions apply whether logging on locally or via the network.) Share permissions can only be applied to folders, not individual files. The only share permission set on this folder is that everyone can read it. No one has permission to change it.
84. C, D. In the graphical user interface (GUI), attributes are accessed by right-clicking the object and choosing Properties, General tab. For some attributes, such as compression and encryption, you need to click Advanced under the Attributes section of the General tab. Compression is an advanced attribute that uses algorithms to remove repeated characters and excess spaces making files take up less space. The user does not need to be an administrator to change attributes. File attributes are available in volumes other than NTFS. In addition to right-clicking the object, you can change attributes using the `attrib` command.
85. A. Antivirus software needs continual updates of virus signatures as new viruses are unleashed daily. The updates are known as definition files and ensure that the antivirus engine will recognize new viruses. However, today's threat environment requires better tools, such as memory scanning and behavior analysis to catch fileless viruses that hide in memory. Firewalls can be software- or hardware-based and are designed to block or allow network traffic based on certain criteria. Once established, settings are not often changed. Access control lists (ACLs) are tied to objects in a system and are compared to an authenticated user's information to determine whether to grant access. These also are seldom changed once they are configured. New Technology File System (NTFS) permissions are part of what creates access control lists. NTFS permissions for an object are granted to a user and can include Full Control, Modify, Read & execute, List Folder Contents, Read, and Write. Share permissions also affect access to a resource, but only when a user accesses it via a network.
86. B. Impersonation is an attempt by someone or something to masquerade as someone else. You might think of impersonation attacks as affecting network systems, but they can affect phone systems as well. A zombie is a computer system that a hacker has a backdoor into and can use to perpetrate attacks, unknown to the computer system's legitimate user. A botnet is a system of zombie computers engaged in an orchestrated attack on a target. A zero-day attack occurs when a vulnerability is used to attack a system on the very day that the vulnerability is discovered, before preventive measures to block the vulnerability can be created. In a phishing attack, the attacker uses coercion or other means to attempt to gain passwords or other privileged information.

- 87.** C. Because the user is accessing the New Technology File System (NTFS)-based resource over the network, both NTFS and Share permissions are applied. If there is a difference between the two of them, the most restrictive permissions are used. Therefore, the user has Read access only.
- 88.** B. Regardless of what other permissions may be granted, Deny will override all of them and the effective permission will be Deny.
- 89.** C. Disable AutoRun/AutoPlay should be selected on computers connected to the network. (It is never a good idea to put any media in a workstation if you don't know where it came from or what it is.) The simple reason is that the media (i.e., CD, DVD, USB, and SD) could contain malware. Compounding matters, the malware could be referenced in the autorun.inf file, causing it to be summoned when the media is inserted in the machine and requiring no other action. User permissions are not effective on external drives whose content changes all the time. A basic input/output system/unified extensible firmware interface (BIOS/UEFI) password would prevent the computer from being booted and enabling data encryption can't be done on media that is subject to change. Note that the CompTIA objectives mention AutoRun, but the feature is now known as AutoPlay. You might see either term used when working in IT.
- 90.** B. An unauthorized router with a seemingly legitimate configuration is specifically known as an evil twin. A zombie is a computer system that a hacker has a backdoor into and can use to perpetrate attacks, unknown to the computer system's legitimate user. A botnet is a system of zombie computers engaged in an orchestrated attack on a target. A non-compliant system is one that is not updated or not following company protocols regarding security. Distributed denial-of-service (DDoS) is the attack perpetrated by a botnet, which floods an unsuspecting server with so many requests that legitimate server users are unable to connect to it.
- 91.** B, C. These are New Technology File System (NTFS) permissions, not Share permissions. They will be inherited by any folder created inside this folder, which happens to be the C drive. NTFS permissions are effective regardless of whether the user accesses them locally or over a network. (Share permissions are only effective when the resource is accessed via a network, they can only be applied to folders, and share permissions are not inherited.) Inheritance in NTFS is enabled by default but it can be disabled by clicking the Advanced button (shown in the figure in the bottom right), and selecting Disable Inheritance.
- 92.** B. Locks and keys are some of the simplest yet most effective physical security measures. The device shown in the figure is a laptop cable lock. The user has a key to unlock the device. The heavy cable is looped around something solid like a table leg, and the end where the key is inserted locks into a special slot in a laptop or other mobile device. Security tokens can be either soft tokens or external hardware tokens. External hardware tokens are objects a user carries, such as a key fob. Soft tokens are software installed on a system. A magnetometer measures magnetic fields and can be used in a mobile device to determine your location with respect to Earth's magnetic north and south.
- 93.** C. Kerberos was developed and named by computer scientists at MIT. It is an open-source authentication protocol that uses a third party to verify user credentials and symmetric key cryptography to encode transmissions between parties. Terminal access controller

access-control system (TACACS+) is an authentication protocol developed by Cisco that is now an open standard. Remote authentication dial-in user service (RADIUS) is an authentication protocol that was originally used for dial-in access. It has morphed into a protocol used for authenticating remote Wi-Fi or on-premises users. Advanced encryption standard (AES), which is for wireless encryption not authentication, has been around since 2001, and it is the successor to temporal key integrity protocol (TKIP).

94. B. Mobile device management (MDM) is a software technology that enables an IT department to retain control over corporate data while allowing users to use their personal devices. Bring your own device (BYOD) policies can save companies money on hardware but present a security risk. Using MDM, an IT administrator can restrict the type of data and applications that are used with company information. They can also wipe all corporate information off a lost or stolen device, or if an employee leaves the company. Encrypting file system (EFS) is used to encrypt files and folders in Windows operating systems (OSs), excluding Home editions. The purpose of single sign-on (SSO) is to give users access to all the applications and systems that they need when they log on. Some systems may require users to enter their credentials again, but the username and password will be consistent between systems. User account control (UAC) verifies that someone has the authority to change a system before making any changes by requiring them to enter an administrator password for certain operations.
95. C. Bollards are a method of physical security that can be used to keep vehicles out of a particular area. Voice calls, email, and short message service (SMS) can all be used to deliver a one-time code for multifactor authentication (MFA).
96. A, C. Both key fobs and smart cards are external hardware tokens. Hardware tokens are physical security devices that can be carried about by the user. A key fob generates a random number every few seconds that can be entered into a system as part of multifactor authentication(MFA). A smart card has a chip whose data can be accessed by a reader device to enable a user access to a secure area or computer system. Retina scanners are biometric devices, because they use part of your body as authentication/identification, and while motion sensors are a part of physical security, they're generally used in conjunction with alarm systems.
97. A. A magnetometer measures magnetic fields and can be used to locate a person's position on Earth. As a part of multifactor authentication (MFA), that location is compared to an allow or block list, and, if the device to be accessed is in an allowed location, access may be granted. A retina scanner is a biometric device that scans a person's eye to determine if access should be granted. A key fob will generate a code that changes every few seconds. It is a type of external hardware token used for authentication.
98. D. An authenticator application, a type of soft token, is a logical, rather than a physical, security measure. It is often used in multifactor authentication (MFA). An authenticator app is software, often found on your cell phone, which generates a code that when input, will grant access to a website or other resource. The other three options—proper lighting,

equipment and door locks, and motion sensors that trigger alarms—are physical deterrents to keep would-be attackers out.

- 99.** C. An external hardware token is a security device that a computer user has in their possession, such as a key fob or smart card. External hardware tokens are often used in multifactor authentication (MFA). Fingerprint readers, retina scanners, and palm print scanners are biometric devices. Biometric devices are those that use a part of your body to identify you and either deny or allow access to a system based on your identity.
- 100.** C. To prevent shoulder surfing, a user could install a display privacy filter. In shoulder surfing, a potential attacker is literally looking over someone's shoulder to try and read what is on their screen. Privacy filters are either film or glass add-ons that are placed over a monitor or laptop screen to prevent the data on the screen from being readable when viewed from the sides. Only the user sitting directly in front of the screen can read the data. An access control vestibule is an area between two doors that helps to prevent tailgating. Video surveillance occurs when there are security cameras watching a secure area and a person observing the output of those cameras. Smart cards are devices a user can carry that will authenticate them to a system as a part of multifactor authentication (MFA) login.
- 101.** B. Many viruses will announce that you're infected as soon as they gain system access. They may take control of your system and flash annoying messages on your screen or destroy your hard disk. When this occurs, you'll know that you're a victim. Other viruses will cause your system to slow down, cause files to disappear from your computer, or take over your disk space. Many viruses today are spread using email. The infected system attaches a file to any email that you send to another user. The recipient opens this file, thinking it's something that you legitimately sent them. When they open the file, the virus infects the target system. A botnet is a group of computers used to perpetrate an attack without the knowledge of the authorized user of that computer. The computer is called a zombie and is controlled by a third-party attacker. A Trojan is malicious software that hides in that fun game or screensaver that you just downloaded, and it installs when you install the innocent looking files. A rootkit is malware that gains access to a system as administrator, giving it full control over a system. Rootkits are adept at hiding their presence and so are difficult to eradicate.
- 102.** B. Vishing, phishing, and whaling are variations of the same type of attack—social engineering. In all of these, someone attempts to gain usernames and passwords or other information by intimidation, coercion, or other means. Then they'll use that information to attack your company's systems. They're all a play on the word fishing. The attacker is casting a line and hoping you will bite on it. Vishing is using voice calls, phishing uses email, and whaling is phishing for powerful or wealthy fish (i.e., people). An evil twin attack happens when someone plugs an unauthorized wireless access point (WAP) into your network and gives it the same service set identifier (SSID) that your valid network has.
- 103.** A. Bring your own device (BYOD) policies can save companies money on hardware and make users happy but they present a security risk. Mobile device management (MDM) is software technology that enables an IT department to retain control over corporate data while allowing users to use their personal devices. Using MDM, an IT administrator can restrict the type of data and applications that are used with company information. They can

also wipe all corporate information off a lost or stolen device, or when an employee leaves the company. The purpose of single sign-on (SSO) is to give users access to all the applications and systems that they need when they log on. Some systems may require users to enter their credentials again, but the username and password will be consistent between systems. User account control (UAC) verifies that someone has the authority to change a system before making any changes, by requiring them to enter an administrator password for certain operations.

- 104.** A. When an operating system (OS) is at end-of-life (EOL), it means that the software company will no longer be supporting the software with feature updates or company support. That might not be a problem if you're an expert with the software and it meets your needs. The security problem arises because EOL software will no longer receive security updates, making your system and by extension, your network, vulnerable to attack. The OS won't magically stop working on the EOL date, but it becomes a threat.
- 105.** C. When a virus infects the boot sector, the master boot record (MBR), or a partition table of a hard drive, it is called a boot sector virus. Boot sector viruses load before the operating system (OS) and security software can load. They may delete or modify files needed to boot the system, or the system may show no signs of being infected until an antivirus program is run. Removing the boot sector virus from a system may require booting to a different OS or drive. Spyware is designed to watch what you do and where you go, hoping to gain information such as logins, passwords, and bank account numbers. Ransomware locks a system in some way or encrypts data and won't allow access until the system's owner pays a ransom. A keylogger is malware that records every keystroke and reports it back to a third party. This information might include user IDs and passwords, or even bank account numbers and login information.
- 106.** C. Keyloggers, viruses, and spyware are all types of malware, although anti-malware and antivirus are often used interchangeably. Windows Recovery Environment (WinRE), formerly known as the recovery console, is a tool used to repair problems with the operating system (OS). In addition to other tools such as startup repair and refreshing the OS, it provides access to a command prompt utility that can be used to correct problems without booting into the Windows OS.
- 107.** B. Fileless malware hides in memory, so there is no digital footprint, thus making it impossible to use signature files to detect this malware. Instead, anti-malware for fileless attacks relies on memory scanning and behavior analysis, sometimes using Artificial Intelligence (AI) and Machine Learning (ML) to find and eradicate the malware. Trojans pretend to be a useful or desirable program but when the user installs them, they often open a backdoor for a user to infiltrate later. Boot sector viruses hide in the boot sector, which includes the master boot record (MBR) and partition table and launch before the operating system (OS) is loaded. Stalkerware is any software, whether a commercial app or a malware, that is used to perform surveillance on a person or business for malicious intent, which is stalking.
- 108.** A. When someone who is an authorized user on your system attempts to gain access to something they should not or attempts a malicious act on your computer system, an insider

threat has occurred. An evil twin is when an unauthorized wireless access point (WAP) appears on your network, using your service set identifier (SSID) and users are able to connect to the network using the unauthorized access point. Whaling is going after a big target using phishing or phishing. Social engineering is an attempt to acquire information about your network and system by social means, such as talking to people in the organization, shoulder surfing, tailgating, or other methods.

- 109.** B. This is a type of denial-of-service (DoS) attack. Someone spoofs your IP address (making it look like you) and sends out requests all at once to multiple hosts who respond to your IP address. Your server is flooded with those responses and crashes. It's called a denial-of-service attack, because users who want to use the server for legitimate purposes, such as placing an order, are unable to do so because of all the malicious traffic. Whaling is using phishing to go after a big target. Distributed denial-of-service (DDoS) attacks happen when many computers are used, as in a botnet. An evil twin attack happens when someone plugs an unauthorized wireless access point (WAP) into your network and gives it the same service set identifier (SSID) that your valid network has.
- 110.** A. In this case, the user has Full Control. When there are conflicting New Technology File System (NTFS) permissions, generally they are combined, and the most liberal is granted. This holds true for conflicting permissions between groups or between a user's account and group memberships. The exception is Deny, which overrides all other permissions.
- 111.** C. This system is vulnerable to attack because it is unprotected. The remedy is to turn on the system's software firewall and antivirus protection. Zero-day attacks happen the same day a vulnerability is discovered, and attackers are able to evade antivirus programs, because the antivirus companies have not had the time to respond to the vulnerability yet. A structured query language (SQL) injection occurs when an attacker puts code into a database instead of data, and the code is executed, giving the attacker access to the data in the database. Cross-site scripting (XSS) is similar to an SQL injection, except it uses a website and hypertext markup language (HTML) or JavaScript instead of a database. Code is injected into the website and used to gather data from legitimate website users, because their systems don't see the normally trusted website as a threat.
- 112.** A. Using a home folder on an Active Directory server to store the user's files adds a level of security because the user's data is not on the local drive and is less subject to being stolen. A security group is used to grant permissions to a shared resource. Organizational units (OUs) are groupings that can include people, computers, and resources. Group policies can be applied to OUs ensuring that all computers and users in that group are given the proper access to resources. A login script is used to automate activities when a user or computer logs in to a domain.
- 113.** D. Cryptominers are malware that use your computing power rather than steal your data. You might notice that the computer is performing more slowly than usual. Spyware is designed to watch what you do and where you go, hoping to gain information such as logins, passwords, and bank account numbers. Ransomware locks a system in some way or encrypts data and won't allow access until the system's owner pays a ransom. A keylogger is malware that records every keystroke and reports it back to a third party.

- 114.** B. Installing a keylogger would be installing malware, and exactly the opposite of what you need to do to keep the system safe. Educating users about malware types, including recognizing them, avoiding them, and what to do with suspicious emails, phone calls, and so on, is one of the best things you can do to protect a system. Keeping antivirus/anti-malware software updated so new malware can be detected, and keeping operating system (OSs), browsers, and applications updated to patch vulnerabilities is the key to keeping malware out.
- 115.** C. This is an untrusted source. Not only have you never used it before, but there is a problem with the website's certificate that caused the warning message the user received. There is no evidence that it is a spoofed site. Clearly it does not have a valid digital certificate, and you've never used it before, so it's not a trusted site. Digital certificates are issued by certificate authorities (CAs), who confirm that a website, person, or company is who they say they are.
- 116.** A. User account control (UAC) settings is where you can change when the operating system (OS) requests an administrator password before making changes to the system. The options range from Always Notify to Never Notify, with Notify Only if Apps Try to Make Changes between the two. UAC can be found in Windows 11 by going to the Control Panel, then choosing System and Security. Once there, select Security and Maintenance, then click Change User Account Control settings (and in Windows 10, choose Security and Maintenance in the Control Panel). Then click Change User Account Control settings. But in both versions of Windows, it's easier to simply search for UAC. Windows Defender Firewall is a software firewall included in Windows OSs. Facial recognition is a logon option, and Personalization allows you to change items such as themes, colors, and backgrounds.
- 117.** B. In both Windows 10 and 11, a quick search for virus & threat protection will bring you to the Windows settings for that feature. Windows Defender Firewall is a built-in firewall found in the Control Panel. Windows Update, which is in the Settings app, is for keeping the operating system (OS) files patched. Device security is also found in the Settings app, and it has settings and information for the security features of your computer, such as the trusted platform module (TPM) chip.
- 118.** C. A distributed denial-of-service (DDoS) is caused by a botnet attack. It is a denial-of-service (DoS) attack because legitimate users are unable to access resources. The "distributed" part of the name comes from the fact that there was traffic from many infected computers (i.e., zombies), in different locations, attacking your server at the same time, also known as a botnet. Bots, by themselves, are a form of software that runs automatically and autonomously and are not harmful. *Botnet*, however, has come to be the word used to describe malicious software running on multiple zombies and under the control of a bot-herder, the person perpetrating the attack. Both DoS and DDoS attacks can be launched by botnets, as can many forms of adware, spyware, and spam (via spambots). A brute-force attack uses software to repeatedly try to discover a password. Zero-day attacks happen the same day a vulnerability is discovered. Such attacks are able to evade antivirus/anti-malware programs because antivirus/anti-malware companies have not had time to respond to the vulnerability yet. A non-compliant system is one that is not updated or complying with corporate security policies.

- 119.** D. Cross-site scripting (XSS) is similar to a structured query language (SQL) injection, except it uses a website and hypertext markup language (HTML) or JavaScript instead of a database. Code is injected into the website and used to gather data from legitimate website users, because their systems don't see the normally trusted website as a threat. Zero-day attacks happen the same day a vulnerability is discovered. Such attacks are able to evade antivirus programs because antivirus/anti-malware companies have not had time to respond to the vulnerability yet. An SQL injection occurs when an attacker places code into a database instead of data and the code is executed, giving the attacker access to the data in the database. An unprotected system is one that lacks normal measures of security such as a software firewall on the system and antivirus/anti-malware.
- 120.** B. An organizational unit (OU) is a grouping of resources including people, computers, servers, printers, and so on, into a single centrally controlled unit. A domain is managed by Active Directory software. One best practice is to group the users into security groups and then establish access to resources on the group level, which will then give that access to members of the group. Home folders provide a central place on a server to store users' documents, each with their own home folder, which gets the documents off of the local computer, consolidating security for those folders into one place.
- 121.** C. Whaling is an attack on a powerful or wealthy fish (i.e., person), phishing uses email, and vishing is using voice calls to gain information. Vishing, phishing, and whaling are variations of the same type of attack. In all of them, someone attempts to gain usernames, passwords, or other information by intimidation, coercion, or other means, collectively known as *social engineering*. Then they'll use that information to attack your company's systems. All the options are a play on the word fishing. The attacker is casting a line and hoping you will bite on it. An evil twin attack happens when someone plugs an unauthorized wireless access point (WAP) into your network and gives it the same service set identifier (SSID) that your valid network has.
- 122.** D. Active Directory is the name given to the software and large database that is used to manage resources on a Windows domain. Using a home folder on an Active Directory server to store the user's files adds a level of security because the user's data is not on the local drive and is less subject to being stolen. A security group is a group of computers or users that need the same access to resources. Permissions are granted to the security group and passed on to the group's members. Organizational units (OUs) are groupings that can include people, computers, and resources. Group policies can be applied to OUs, ensuring that all computers and users in that group are given the proper permissions.
- 123.** A. Virus and threat protection can be found in the Settings app, in the Windows security section. There you can see when the last update was done and run a system scan, among other options. Virus and threat protection is not found in the other locations.
- 124.** A, D. The Windows built-in firewall can be configured either in the Settings app, using Firewall & Network Protection, or in the Windows Defender Firewall, which is found in the Control Panel. It isn't found in the other two locations.
- 125.** A, C. The firewall can be configured to allow an application through (or block one) in both the Firewall & network protection settings of the Settings app or in Windows Defender

Firewall in the Control Panel. Virus & threat protections are for configuring antivirus. It is not configured in the Virus & threat protection settings of the Settings app. Administrative tools is found in Windows 10, but not Windows 11 where it was replaced with Windows Tools, and it doesn't have settings for the firewall, although it does contain a shortcut to the Windows Defender Firewall.

126. B. Use the Windows Logo key + L key simultaneously to lock the Windows desktop. Windows Logo key + X key brings up the Power Menu, which has shortcuts to many often-used tools. Windows Logo key + Right arrow will snap the active window to the right half of the screen, and Windows Logo key + the D key displays the desktop by minimizing all the other apps. These keyboard shortcuts work in both Windows 10 and Windows 11.
127. A, B. A laptop cable lock is a type of equipment lock that uses a special slot on the laptop's side and a very strong cable wrapped around something solid, like a desk, to secure the laptop to the work area. A key is used to free the laptop from the cable when you want to take it somewhere. Mobile device management (MDM) software can be used to wipe a laptop remotely if it is stolen. Placing a laptop in a desk drawer might get it out of sight, but it is still vulnerable, and you should never let a laptop out of your sight when you're in a public place.
128. C, D. Fingerprint scanners and facial recognition technology are both biometric logins and require a fingerprint reader and camera, respectively, as well as special software to interpret the input. Many laptops come equipped with this hardware, but not all. Both could be added to a laptop or desktop that is missing the hardware by connecting them via a universal serial bus (USB) port. A username and password can also be used, and a personal identification number (PIN) is used.
129. D. Passwords should be a bare minimum of eight characters long, and complexity should be required using at least one upper- and lowercase letter, number, and special character. If you must choose between a longer password or a more complex password, then longer is better. Four characters is definitely not long enough.
130. A, C. Password complexity should be enforced. Passwords created by a user are better than randomly generated passwords, because the user can remember them easier without having to write them down. They should not, however, be something that is easy for someone else to guess, like their dog's name or someone's birthday. Passwords should expire after a reasonable time, making it more difficult for someone to use a compromised password. A length of 180 days (i.e., six months) is too long of a time between password expiration, but 45–90 days is more reasonable.
131. C. A domain is a grouping of resources, including people, computers, servers, printers, and so on, into a single centrally controlled unit. The domain is managed by Active Directory software. One best practice is to group the users into security groups and then assign permissions to the security groups. Security group members will all have the access that was assigned to the group. Home folders provide a central place for the users' documents, each with their own home folder on the server. This removes the documents from the local computer, consolidating security for those folders into one place.

- 132.** D. Password policies such as history, password age, length, and complexity can be found by searching for and choosing Local Security Policy, then opening Password Policy. User Accounts in the Control Panel is for adding and managing users. You can set the password there, but not the password policies. Administrative Tools is available in Windows 10, but not Windows 11, where it was replaced with Windows Tools. Local Security Policy is in Pro editions of Windows 10 and 11 only, not Home editions.
- 133.** B. Security assertions markup language (SAML) is a protocol that passes an identity token between an identification provider (IdP) and a service provider (SP), enabling secure single sign-on (SSO). A one-time password (OTP) is often delivered via email or short message service (SMS) and is only valid for that session. This helps verify that the person requesting access is the person who previously entered their email or phone number into a system. Privileged access management (PAM) keeps track of any entity that has more than standard access to resources, whether the entity is human, application, or machine. Identity access management (IAM) is similar to PAM, except that it is for any entity, not just privileged entities. It provides a framework for monitoring identities and access using adaptive multifactor authentication (MFA).
- 134.** A. When setting up a Windows 11 Home PC for the first time, you are required to use a Microsoft account. The setup will allow you to create an account during setup. Pressing F10 does not change the type of account you need to set up Windows 11 Home. A local account can be used whether they have Windows 11 Home or Pro, but when setting up the Home version, it must be set up with a Microsoft account. It is possible to add a local account later and use it to log in to either Windows 11 Home or Pro.
- 135.** C. You will be able to use your computer if you log in using your Microsoft account, even if the Internet is down. It will just use cached versions of files. All other options are true.
- 136.** A. Administrators have access to everything in the system, but a Standard user account is limited in what they can do. They are not able to add or manage another user's account, for example. Nor are they able to access another user's files. Local Users and Groups is available in Pro or greater editions, but a Standard user still won't be able to manage users there or with the command line.
- 137.** C. What is known as a low-level format now (also called a Zero-fill) is drastically different than it was years ago. The intent is the same though, which is to erase all data on the hard drive so it's not recoverable. Technically, the low-level format needs to happen first. Then the drive is partitioned, creating one or more sections, and a standard format is used to create the file allocation table and root directory.
- 138.** A, C, D. Windows Hello is a passwordless way to sign on to a Windows workstation. Instead of a password, a user can enter a personal identification number (PIN) that is only valid for that one device or use biometrics—a fingerprint or facial recognition—to log in to their device. Multifactor authentication (MFA) is using more than one method to prove who you are.
- 139.** C. Zero filling a drive will make data that was once on the drive unreadable, but it is not a physical destruction method. Methods of physical destruction include drilling, shredding, degaussing, and incinerating.

- 140.** D. A password manager is software that uses algorithms to generate secure passwords. The passwords are encrypted in the software manager. In a browser, the user typically only needs to remember their email or login password to gain access to the others. Most password managers will use two-factor authentication (2FA) to allow the user to log in and change any passwords. Websites that you access are stored in a cache on your computer so that the next time you visit the website, it will only download the changes and make websites load much more quickly. If a website you visit isn't updating properly, clearing the cache should resolve the issue. Certificates are issued by a certificate authority and prove that the website (or person) is who they say they are. A browser might warn you or block your access to a website whose certificate is expired or invalid.
- 141.** A, B. Before you give a computer to someone else, you will certainly want to remove all of your data from it by using a drive-wiping software. But to be sure everything is gone, zero-write (also called a low-level format) the drive to restore it to its factory default condition. This can often be accomplished with a utility provided by the computer manufacturer, or in Windows, by using options in the Windows Recovery Environment (WinRE), also known as the Recovery Console. A standard format creates the master file table (MFT) and root directory.
- 142.** B. In the Windows Recovery Environment (WinRE), choose Troubleshoot, then Reset this PC. Choosing Reset this PC will give you two options. You can choose to keep your personal files but remove apps and settings or remove everything including your files and perform a fresh install. In this scenario, choose to remove everything. Refresh, restore, and repair do not have the option to reset the PC to factory default.
- 143.** A. Choice A, use the Local Users and Groups app to create groups, set up permissions for each group on shared files, then add users to the group as needed, is considered a best practice. By arranging security in this way, when someone changes jobs, leaves the company, or joins the company, all you need to do is remove the user from the group and/or add them to the group with the security access that they need. This process saves on human error, as there is just one place that security is set up (for the group) instead of establishing the settings for each individual user. Local Users and Groups is available in Pro or better versions of modern Windows Operating Systems (OSs).
- 144.** B, D. One of the best practices you can do to protect a network is to train employees on how to handle IT information and events. All too often, users place their passwords where they are easy for them to find, but they are also too easy for someone with malicious intent to find. Passwords need to meet complexity requirements but be simple enough for users to remember. Other tools for securing passwords are to use password management software and multifactor authentication (MFA). Windows Credential Manager and macOS Keychain are two utilities that can manage passwords for users. Credential Manager is not on the CompTIA A+ objectives, but Keychain is, as is using password managers.
- 145.** D. A supply chain/pipeline attack occurs when a malicious actor attempts to infiltrate a larger company by attacking one of their suppliers. QR code phishing happens when an unsuspecting person scans a QR code and visits a site that they think is legitimate, but it's actually a phishing site intended to gather their personal information. Ransomware is software that holds your company's network or information hostage in a logical way, such

as encrypting your hard drive and refusing to give you the key until you pay a ransom. Whaling is phishing for a wealthy or influential target.

- 146.** B, C. Configuring all the computers to lock the screensaver after a short period of inactivity would help mitigate the problem. If a user was still at their desk but doing something else, they could easily enter their password and log in again. Training employees on network and data safety is always helpful. Firing them would be a very drastic measure, but depending on the environment, it might be the company's policy. However, it won't prevent someone from accessing a system. Enforcing password complexity should always be done, but it also won't prevent someone from accessing a system that isn't locked or logged off.
- 147.** A. Data-at-rest is any data that is sitting on a drive or stored somewhere. It's not moving between network locations but needs to be protected. Letting employees choose what to encrypt with encrypting file system (EFS) is not a good solution, because it opens too much possibility for human error. There are third-party companies that specialize in protecting data-at-rest. Other solutions are to use mobile device management (MDM) software. Using MDM, the IT administrator can enforce encryption on remote devices, even those owned by employees who are using their personal devices for company business. If the device is lost or stolen, company data can be wiped from it using MDM software. BitLocker is a solution for encrypting entire hard drives, but it requires Pro or higher editions of both Windows 10 and 11, and a trusted platform module (TPM) chip or module on the motherboard. BitLocker stores an encryption key in the TPM, and the TPM will only allow access to the key when the computer starts as expected.
- 148.** D. Facial recognition and fingerprint readers are available on most smartphones and mobile devices. Facial recognition uses your cell phone's camera, sensors, and a dot projector to make a 3D map of your face. Your phone then uses that 3D map to recognize you for future transactions. Personal identification number (PIN) codes are numbers that you enter to gain access. Fingerprint scanners require that you touch a spot repeatedly to configure the scanner so it will identify you. Once the device has a map of your fingerprint, you can use your finger to log in or authorize certain transactions. Device encryption is not a method of identifying the user.
- 149.** C. Some mobile devices allow the user to draw a pattern on the screen that is recognized by the device, then the user is allowed access. The problem with using this security device is that, because the pattern is repeatedly drawn on the screen, someone may see the oils left behind by your skin and be able to figure out the pattern that is drawn. Facial recognition uses the mobile device's camera to make and store a 3D map of your face. To gain access to the device, the camera reads your face again and compares it to the stored image. Fingerprint readers compare your fingerprint to one stored on the device for access. With a swipe lock, the user merely swipes across the screen to unlock it.
- 150.** C. Most mobile devices will lock after a period of inactivity. For some, merely swiping across the device will unlock it. Because this can be done by anyone, it isn't secure. Facial recognition is a biometric type of identification (i.e., something that you are), so it is quite secure depending on the software used to recognize the face. Personal identification number (PIN) codes and patterns are something that a user must know

and although a hacker might figure them out, they're still more secure than merely swiping across the device.

151. A. Because the camera communicates over port 4150, the port would need to be open and have port forwarding configured, so your remote connection can access the camera, through the router, using that port. You know that the camera is properly connected to the router because you can access the video stream on it from a computer connected to the same router. Disabling the firewall should not be done because the firewall is a vital part of your network's security.
152. A. Content filtering is the process of blocking objectionable content from either websites or email. Many routers and firewalls will provide content filtering services. In many cases, a reference service is used to block websites, and filters can be implemented to scan emails for prohibited content. Disabling ports stops traffic from entering the network; it does not filter for content. Virtual private network (VPN) access means that a user can access the network remotely just as if they were sitting in the office. Port forwarding/mapping is used when you need traffic on a particular port to go to a particular network device. It is often used for gaming and security cameras.
153. C. One method of “protecting” the network that is often recommended is to turn off the service set identifier (SSID) broadcast. The SSID is the name of your network. The access point is still there and can still be accessed by those who know of it, but it prevents those who are looking at a list of available networks from finding it. This should be considered a weak form of security because there are still ways, albeit a bit more complicated, to discover the presence of the access point besides the SSID broadcast. Wi-Fi protected access 3 (WPA3) is the most recent secure Wi-Fi encryption standard; however, it has suffered password leaks. The vulnerabilities are expected to be mitigated with future updates. Media access control (MAC) filtering allows or denies access to the network based on the MAC address associated with a network interface card (NIC). Reducing radio power levels won’t send the network’s signal as far, but it won’t hide the network’s name from anyone within range.
154. D. Just like computers, routers occasionally need their software updated to add new features or correct security holes. On a router this is called a firmware update, because it is updating software that is embedded in chips on the router’s circuit board (i.e., the router’s firmware). Port forwarding will send traffic for a specified port number to a specified computer. Content filtering inspects packets for specified content and rejects or allows packets to enter or leave the network based on those criteria. The service set identifier (SSID) is the name of the network.
155. B, D. Facial recognition and fingerprint readers are available on most smartphones and mobile devices, and they can identify you faster than you can enter numbers on a screen. Facial recognition uses your smartphone’s camera, sensors, and a dot projector to make a 3D map of your face. The phone then uses that 3D map to recognize you for future transactions. Fingerprint readers can use capacitive, optical, or ultrasonic sensors, but regardless of the method, they make a map of your fingerprint and, like facial recognition, compare that map to your body. With either one, you can gain access to a device or authorize a transaction in about one second. PIN codes are a number that you enter to gain

access. They can be entered quickly but can also be guessed, so they're not as secure as biometrics (i.e., fingerprint scanning and facial recognition). Using a swipe to unlock a mobile device is fast, but not secure.

- 156.** C. Most often enabling and disabling features can be found in the browser settings, although the exact path depends on the browser being used. For example, in the Opera browser, extensions can be found on the toolbar. Your browser history keeps track of where you've been on the Internet. The browser's website might tell you how to enable and disable features, but isn't where you would configure them, neither is Windows Settings.
- 157.** A. A personal identification number (PIN) code is a number that you enter to gain access to a mobile device. Fingerprint scanners and facial recognition systems are biometrics, meaning that they use a part of your body to identify you. Once a 3D map of your face or fingerprint is made, that map is compared to the new one generated when you touch the screen or look into the camera. If they match, access is granted. Drawing a pattern on the device's screen is also sometimes used.
- 158.** B. Although your first instinct might be to think you're the victim of a malware attack, it's most likely that your company made you sign a mobile device management (MDM) policy or bring your own device (BYOD) policy that says they can install content filtering software on your device. Content filtering is used to block any incoming or outgoing traffic that may be dangerous, sensitive, or inappropriate. It's likely that the policy also says that they can remotely wipe their data and applications from your device if you leave the company. Application updates are one of the many actions you should take to protect/harden a system, and a malware attack is unwanted software that invades your system and harms you in some way.
- 159.** B. On your router, you would configure a static wide area network (WAN) Internet provider (IP) address. That is the address that the Internet service provider (ISP) has assigned to you. Usually the ISP uses dynamic addressing, and your WAN setting would be Dynamic WAN IP, so having a static WAN IP generally involves higher fees paid to the ISP. Universal plug and play (UPnP) is a protocol that lets devices find and communicate with each other on your local area network (LAN), such as your laptop and printer. Unfortunately, UPnP could also be used by malware to spread to other devices on your network. A screened subnet uses one or more routers to create a separate area on a network where servers, such as a web server, can be accessed either from inside the LAN or from the Internet. It provides greater security and protects the LAN.
- 160.** D. Universal plug and play (UPnP) is a protocol that lets devices find and communicate with each other on your local area network (LAN) such as your laptop and your printer. Unfortunately, UPnP could also be used by malware to spread to other devices on your network. Wi-Fi protected access version 3(WPA3) and Wi-Fi protected access version 2 (WPA2) are wireless networking encryption protocols. A personal identification number (PIN) is used to authenticate to a computer system.
- 161.** C. Wi-Fi protected access version 3 (WPA3) is the newest and most secure wireless encryption protocol for your small office/home office (SOHO) router; however, the devices that you've had for a few years might not be able to work with it. For the time

being, until those legacy devices can be replaced, it's best to use the WPA2/WPA3 mixed mode so that all your devices can connect to the network as securely as possible. Wired equivalent privacy (WEP) and Wi-Fi protected access (WPA) should no longer be used, as they are not secure. WEP and WPA are not listed in the CompTIA A+ exam objectives, but WPA2 and WPA3 are. A better alternative than mixed mode, if possible, is to put the older devices on their own network using WPA2 until they can be replaced and the devices that support WPA3 on a network with only WPA3 to protect that part of the network at a higher level.

- 162.** A. Configuring IP filtering enables you to set which IP addresses are allowed to communicate through your router and which are not. Untrusted sources are websites that your browser has deemed suspicious or dangerous, and it warns you of such. Hashing is the act of translating a character string into code. Port filtering is a way of allowing or denying access to a network based on the port number in the packet. Filtering router traffic by port is also an excellent security practice.
- 163.** A. A company may have many policies and procedures that employees must agree to as a condition of employment. The bring your own device (BYOD) policy describes the conditions for an employee using their own device for company business. This policy likely includes that the company will use mobile device management (MDM) software to secure the company information on the user's device. Companies may have many other policies like cell phone policies and remote work policies, but those are not the name given for using your own device for work.
- 164.** A. Failed log-in attempt restrictions will destroy all local data on the phone if incorrect passcodes are entered ten times in a row. While this is recommended for users with phones that contain sensitive data and that are frequently taken into public venues or placed in compromising positions, the casual user should not turn on this feature unless they can be sure there will always be a recent backup available. Screen locks require authentication to access the device. Remote wipes enable a user to wipe their data when a device is lost or stolen. Locator applications can help you (or police) find your phone.
- 165.** D. A screened subnet uses two or more routers with packet filtering to create a separate area on a network where servers, such as a web server, can be accessed from either inside the local area network (LAN) or from the Internet. This arrangement provides greater security and protects the LAN from network traffic. A static wide area network internet protocol (WAN IP) is one that doesn't change and needs to be configured on your router. Universal plug and play (UPnP) is a protocol that lets devices find and communicate with each other on your local area network (LAN), such as your laptop and your printer. Unfortunately, UPnP could also be used by malware to spread to other devices on your network. A WAN IP is the IP address a company gets from the internet service provider (ISP), and it can be dynamic (i.e., it changes) or static (i.e., it doesn't).
- 166.** D. Exactly how to wipe your device depends on the device. If you have configured failed log-in restrictions on your device, then after the prescribed number of failed attempts, the device will either lock or, in the case of an iOS device, ten failed tries will cause the device to be erased. For Android devices, you can use Google Find My Device to remotely wipe it, and for iOS devices, you can use the Find My app using a different iOS device.

Mobile device management (MDM) software can also be used to wipe Apple, Android, or Windows devices. Disabling guest access is a good security practice, but it won't wipe the device's data.

- 167.** A. A kitchen is one of the worst places for a router to be. First, there will be electromagnetic interference (EMI) from appliances like refrigerators and microwaves, which will interfere with the wireless signal, and if they're too close to the router or wires, they could interfere with the wired signal too. Second, having easy access to the router might be good for the IT person, but it's a terrible idea for security. For physical security, place the router in a room or an enclosure that can be locked and out of reach of passersby. Any guest access or guest accounts should be disabled. If your company needs to have Wi-Fi available for visitors, place it on a separate virtual local area network (VLAN), so that your network isn't exposed to those connections. IP addresses that are able to log in to the router should be restricted. Other things you can do to secure a router are to obviously change the router's default service set identifier (SSID), username, and password, and if possible, use access control lists to limit access in addition to ensuring you keep firmware updated to protect against malware attacks. For Wi-Fi routers, take a walk around with a Wi-Fi meter and ensure that the signal doesn't extend into areas where it should not be. If it extends too far, you might need to turn the power down or possibly move the router.
- 168.** C. Turning your signal power to maximum would likely increase interference if there were nearby Wi-Fi networks, and it won't enhance security. You do need to ensure that the appropriate encryption scheme is enabled. If you expect to have guest users, create a virtual local area network (VLAN) for them and use it to restrict access. In addition, it's important to update the router's firmware to protect against any new malware.
- 169.** C. Trusted software sources are sources that you know and work with all the time (e.g., Microsoft, HP, or other manufacturers' websites), and there are untrusted sources; you should differentiate between them. Don't use or let your users use untrusted software sources. Generally, common sense can be your guide, but there are "safe lists" of trusted software vendors from authoritative watchdog companies like Comodo. Access control lists (ACLs) define who can have access to a resource. The question does not describe an authenticator website.
- 170.** A, B, C. You must be logged in to your browser for it to synchronize with other devices. You can enable or disable synchronize on one or more devices, if you don't want a certain device to synchronize. Synchronization usually happens in the background. Because we're talking about browser synchronization, you can synchronize between Windows and Apple devices. Browser synchronization depends on the browser, not the operating system (OS).
- 171.** A. Social engineering is a process in which an attacker attempts to acquire information about you, your network, and your system by social means, such as talking to people in your organization. A social engineering attack can occur over the phone, by email, or in person. When an attempt is made through email or instant messaging, it is known as phishing or smishing, respectively, and is often made to look as if a message is coming from sites where users are likely to have accounts (e.g., banks, eBay, and PayPal are popular). Ransomware is software that holds your computer hostage in a logical way, such as encrypting your hard drive and refusing to give you the key until you pay a ransom.

Spoofing is when someone or something pretends to be something else, such as an attacker's server using a familiar look and feel of a website, even a similar IP. Whaling is phishing for a wealthy or influential target.

- 172.** B, C, D. Using a swipe to unlock a mobile device does not protect your device or your data. At the very least, using a personal identification number (PIN) is far safer than using a swipe to unlock a mobile device. Keeping operating systems (OSs) up to date to plug any vulnerabilities is especially important. All devices should have some form of antivirus, even if it is one that is built into the OS. Make sure that you are using a remote backup application to ensure that if your mobile device is lost or stolen and you must remotely wipe all the data, you will be able to download it to a new device.
- 173.** A, B. Cached files are parts of the web page that have been downloaded to make subsequent website page loading faster. Cookies store information, like your username, shopping cart, or first name, that a website uses to personalize your experience. Both cached files and cookies can cause conflicts with websites and can slow down your browser if too much is stored. Your history is a record of where you have been. Deleting it protects your privacy. Clearing passwords will not make the pages load faster, but passwords should be stored in a separate password manager for better security.
- 174.** A. The best solution is to enable private browsing mode. You might be thinking that you could simply clear the browser's history, but that would clear her history too, which she might not want you to do. Certificates are issued by a certificate authority and prove that the website (or person) is who they say they are. Certificates are updated by the website owners, not you. Changing the date might cause websites to give you certificate warnings and keep them from opening for you. It also won't keep the computer from recording the browsing history. Proxy browsers are similar to the network address translation (NAT) feature found in routers. A proxy browser will hide your actual IP address to protect information about your location or even personal information from being captured by someone else. A proxy browser will still store your browsing history, and you would need to have it installed on the computer to use it.
- 175.** B. Pop-up blockers are available in virtually every browser to stop those annoying ads from overtaking your screen. Look in the browser's settings for this option. Private-browsing mode, or incognito mode, stops the browser from saving your browsing history or cookies and keeps your activities from being seen by others on the same Wi-Fi, or later by another user of the device. Password managers provide a single login for you and are able to generate unique and complex passwords for all the websites that you browse. Certificates are digital identifications for a website. They are not involved in pop-ups.
- 176.** A. Data destruction contractors (who are third-party vendors) can be certified by groups such as National Association for Information Destruction (NAID) or can show that they follow government rules (e.g., Health Insurance Portability and Accountability Act [HIPAA] in the United States) for data destruction. They can provide proof of destruction, which would be difficult to do on your own. Once you drop a drive off at a recycling center, you have no idea where that drive or its data might end up. While you could destroy the data on your own either physically or logically, it would be better in this case to have a third-party vendor certify the data destruction.

- 177.** C. Motion sensors are commonly used to trigger alarms that will turn on lights or otherwise warn of an intruder or something moving. Lighting and equipment locks are also physical security measures. An authenticator application, a type of soft token used for multifactor authentication (MFA), is a logical, rather than a physical, security measure.
- 178.** D. A mobile digital key is contained in a smartphone's wallet and is available on many newer vehicles to lock and unlock doors and start vehicles. They can also be used to lock and unlock buildings and rooms. Lighting can discourage access by making intruders more visible. Equipment locks are placed on servers and laptops to discourage stealing data or equipment, and motion sensors trigger lights or other alarms/deterrents.
- 179.** D. Data loss prevention (DLP) is the process of identifying and monitoring sensitive data to ensure it's only accessed by authorized persons and doesn't leave the company, whether it is on a server, in the cloud, or on an endpoint device. DLP can help ensure that a company is in compliance with government regulations regarding sensitive data. A firewall can be configured to block certain types of traffic based on things like IP address, protocol, or MAC address. A virtual private network (VPN) is a secure path between a local and remote device. In a Windows domain, password policies can be configured at the domain level using group policy objects (GPOs). There are hundreds of variables that can be configured. Variables that can be configured relating to passwords include password complexity and length, and the time between allowed changes to passwords.
- 180.** D. Identity access management (IAM) provides a framework for monitoring identities and access using adaptive multifactor authentication (MFA). Adaptive MFA changes the factor required based on the situation. For example, logging in from an unexpected location would require a different authentication factor than logging in from an expected location. Single sign-on (SSO) enables a user to enter their identification and authentication one time to access multiple services or applications. SSO is supported by security assertions markup language (SAML), which is a protocol that passes an identity token between an identification provider (IdP) and a service provider (SP), enabling secure SSO. Privileged access management (PAM) keeps track of any entity that has more than standard access to resources, whether human, application, or machine. Identity access management (IAM) is similar to PAM, except that it is for any entity, not just privileged entities. It provides a framework for monitoring identities and access using adaptive MFA.
- 181.** A. The Windows Recovery Environment (WinRE), also known as the recovery console, in Windows 10 and 11 provides a command-line tool (among other tools) that allows the administrator to copy or remove directories, enable or disable services, write a new Master Boot Record (MBR), format volumes, and much more. If you have a virus that has infected the drive's boot sector, the only way to access the system before the boot sector virus loads is to boot to another drive, either a DVD or USB that contains either the Windows installation media or bootable antivirus. Using the installation media is one way to enter the WinRE. Typically, the system will automatically enter the WinRE if booting into Windows has failed three times in a row. You can force this to happen by turning the power off as soon as Windows starts to load and repeating that until the system boots into WinRE. From the recovery environment's main screen, choose Troubleshoot, then Advanced Options, and finally Command Prompt to get to the command prompt. Here you can enter commands or run antivirus software to remove a boot sector virus on the other hard drive. Remote

authentication dial-in user service (RADIUS) is an authentication encryption protocol. Administrative tools can be found in the Control Panel of Windows 10 and is a collection of commonly used tools. Administrative tools is renamed Windows Tools in Windows 11. Active Directory is the database and software used to control and manage a Windows domain.

- 182.** A. Although your first instinct might be to think you're the victim of a malware attack, it's most likely that your company made you sign a mobile device management (MDM) policy or bring your own device (BYOD) policy that says they will remotely wipe any company files on your device if you leave the company. Content filtering is used to block any incoming or outgoing traffic that may be dangerous, sensitive, or inappropriate. Application updates are one of the many actions you should take to protect/harden a system, and a malware attack is unwanted software that invades your system with the intent of harming you in some way.
- 183.** A, D. Each option is a part of mobile device security, but application updates and operating system (OS) updates are the necessary actions for patch management. Content filtering blocks undesirable or dangerous sites on a corporate network, and screen locks keep people from accessing your computer.
- 184.** C. Secure Domain Name System (DNS)\Domain Name System (DNS) over hypertext transfer protocol secure (HTTPS) is probably enabled on your browser right now. It's not just a corporate setting. It protects your IP address and sign-in information, while DNS is translating the human-friendly website name that you type into an IP address. You might need to configure it in your browser; usually it's found in Settings. For example, in Google Chrome, click on the three stacked dots next to your user icon, scroll down and choose Settings, then Privacy and Security. Then click on Security and scroll down to find the Advanced settings, which includes DNS settings.
- 185.** B. Single sign-on (SSO) enables users to enter their username and password one time to access multiple systems. It typically requires the Kerberos authentication protocol and a domain to implement it, although there are also third-party and cloud solutions. Kerberos uses keys to keep users' passwords hidden as they traverse the network or Internet. A personal identification number (PIN) is a series of numbers known only to the person logging in. Facial recognition software compares the face presented with a stored image, using measurements like the width of the nose or the distance between eyes, to determine whether to grant access. Usernames and passwords provide identification and attempt authentication, respectively.
- 186.** C. An access control list (ACL) can be viewed by right-clicking, choosing Properties, and then clicking the Security tab on a file or folder in a New Technology File System (NTFS) environment. The ACL provides a list of users or groups that have been assigned NTFS permissions for the chosen object. The path can be viewed on the shortcut tab. Content filtering allows or denies network packets based on specified criteria and is set up in a router or network security device. User account control (UAC) is the box that pops up when a user tries to access a restricted resource. It requires entering an administrator password to continue.

- 187.** B. Folder redirection requires a shared folder on the server and is configured in the Active Directory group policy. The group policy is then applied to the appropriate organizational unit (OU). Folder redirection allows users' profile folders to be stored in a more centralized location on the network, rather than on the user's local device. A profile stored this way is called a roaming profile. The home folder is the specific location where a user's documents and such are stored, such as \\%servername%\home\%username%, then usually mapped to drive H:\%username%, making it simple for end users. An OU is a management tool that can be used to organize Active Directory resources and can contain users, computers, and other resources. A virtual private network (VPN) is created across a public network by using strong encryption protocols.
- 188.** C. Hashing is an algorithm that is computed on the sender and receiver to ensure that data is not intercepted and changed. Using trusted sources to download drivers or software, IP address filtering, and port filtering are all important security concepts, but filtering is generally done on a router or firewall.
- 189.** C. A proxy server makes requests for resources on behalf of a client. Proxy servers are known for three things. One, the proxy server can cache the information requested, speeding up subsequent searches. Two, the proxy can act as a filter, blocking content from prohibited websites and blocking sensitive data from leaving the network. Three, the proxy server can modify the requester's information when passing it to the destination, blocking the sender's identity and acting as a measure of security; the user can be made anonymous. A domain name server (DNS) server resolves IP addresses to domain names. An authentication server verifies the identity of a user and their access to resources, and a web server provides information in files that can be read by a web browser, whether internal to the company or on the Internet.
- 190.** C, D. Certificates are issued by a certificate authority and prove that the website (or person) is who they say they are. When they expire, the browser gives an indicator that the certificate is expired or invalid and may block your access to the website. Websites that you access are stored in a cache on your computer, so that the next time you visit the website, it will only download the changes and make websites load much more quickly. If a website you visit isn't updating properly, clearing the cache should resolve the issue. Browser history should be cleared when you exit the browser for privacy and to maintain browser performance.
- 191.** A, B. Data destruction contractors (who are third-party vendors) can be certified by groups such as National Association for Information Destruction (NAID), or they can show that they follow government rules (such as the Health Insurance Portability and Accountability Act [HIPAA] in the United States) for data destruction. They can provide proof of destruction, which would be difficult to do on your own. While you could destroy the data on your own, either physically or logically, it would be better to have a third-party vendor certify the data's destruction. The data destruction company pays for the equipment, and you pay them for their services. You likely would only zero-write the drives if your company policy required you to do so.
- 192.** C, D. Mobile device management (MDM) software can be used to deploy configuration profiles to remote devices. For initial installation, it could be as simple as scanning a quick

response (QR) code to install the required software, which enables the company to push policies and policy changes to the end users. A company can create multiple different configuration profiles for different roles, such as executive, salesperson, and so on. You can't always have an employee bring their device in, and sent instructions could be intercepted.

193. B. The Enforce Password History policy enables the administrator to choose a setting between 0 and 24, which represents the number of unique passwords that a user must set *before* they can reuse a password. The Maximum Password Age policy determines how long a password can exist *before* it must be changed. The Minimum Password Age policy defines how many days must pass *before* a user is allowed to reset their password. The Meeting Password Complexity Requirements policy forces the user to use at least one each of uppercase letters, lowercase letters, digits 0 through 9, and special characters like ! and \$.
194. C. Some services are needed all the time, so they must be constantly running. Depending on the situation, other services are likely never needed. Those services that are never needed should be disabled to reduce the computer's attack surface. Some services turn themselves on when they're needed and off when they aren't.
195. A. Like any IT expert, you've set an account expiration date for them and now need to reset it. Account expiration dates, especially for temporary staff, are a great way to ensure that unused accounts are not left open, which a hacker could use to access a network. Also accounts of employees who've left the company should be disabled immediately upon their exit. Group membership and their computer's inclusion shouldn't be a problem. Although a malware attack is always a possibility, it isn't likely in this situation.
196. A, D. A user password can be configured in the basic input output system (BIOS) interface or unified extensible firmware interface (UEFI) so that the operating system (OS) won't load without it. If an intruder does access the OS, they can't quickly load malware by inserting a universal serial bus (USB) drive if AutoPlay is disabled. Restricting login times is a hardening process, but it won't protect against someone using a USB drive during working hours. The guest account is disabled by default, but ensuring its disabled status is also a hardening policy. However, neither of these options will keep someone from loading the OS. If the AutoRun/AutoPlay feature isn't disabled, a malicious actor can use a USB to quickly load malware or run their own OS and access a network.
197. A, D. Remediating infected systems is the next step in the procedures for malware removal. While the exact steps for eradicating malware depend on the type of malware and the damage done, it's easier to get rid of the malware files if you don't boot to the drive the malware is on. You could boot into safe mode, which is a limited operating system (OS), and run anti-malware; or boot with installation media from a completely separate drive and run anti-malware on the infected drive; or boot from a bootable universal serial bus (USB) drive that was made by using tools from your favorite anti-malware company and running its antivirus/anti-malware eradication tools. In any case, you will want to ensure that you've downloaded the most current malware definition files or other updates available to scan and remove the threat. This is not the time to boot into Windows as normal, and hopefully you won't need to rebuild the Registry before you're done troubleshooting.

CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:

1. Investigate and verify malware symptoms.
 2. Quarantine infected system.
 3. Disable System Restore in Windows Home.
 4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end user.
- 198.** C. It's unlikely that Windows would be able to predict when a system crash is about to happen, so it isn't going to create a restore point. There are, however, common activities that can present a risk to a system, such as installing new hardware drivers or new applications. In those instances, Windows will create a restore point before the software or hardware driver is installed. A system restore point is also created by default once a week, and you can manually create them whenever you would like.
- 199.** A. An educated end user who is aware of the signs of malware is one of the best protections against malware.
- CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:
1. Investigate and verify malware symptoms.
 2. Quarantine infected system.
 3. Disable System Restore in Windows Home.
 4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end user.
- 200.** A. Because problems tend to occur no matter how careful you are, it's important to back up devices and be able to restore your device from those backups after an incident. Google Sync is available for backups and synchronization of data between Android-based devices and PCs that have a Microsoft Exchange account. Google Cloud is their Infrastructure-as-a-Service (IaaS) platform. Sync My Phone and Bogus Cloud are not real services.
- 201.** C. A restore point is a copy, or snapshot, of your system configuration at a given point in time. It's like a backup of your configuration but not your data. Snapshots are created within Windows by clicking the Search icon, typing Create a Restore Point, and selecting it from the list of results. The System Properties window opens. It should open on the System

Protection tab. If not, click the System Protection tab, and near the bottom of the screen is the Create button next to Create a restore point right now for the drives that have System protection turned on. Clicking the Create button begins the process of creating a restore point. A restore point does not back up the hard driver or create a copy of the users' folder and system configuration, nor does it create bootable media.

- 202.** D. CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:

1. Investigate and verify malware symptoms.
2. Quarantine infected system.
3. Disable System Restore in Windows Home.
4. Remediate infected systems.
5. Update anti-malware software.
6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
7. Reimage/reinstall.
8. Schedule scans and run updates.
9. Enable System Restore and create a restore point in Windows Home.
10. Educate the end user.

- 203.** C. You don't want an infected system to infect others on your network!

CompTIA has developed specific steps for removing malware from small office/home office (SOHO) networks. The ten steps of the malware removal process are as follows:

1. Investigate and verify malware symptoms.
2. Quarantine infected system.
3. Disable System Restore in Windows Home.
4. Remediate infected systems.
5. Update anti-malware software.
6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
7. Reimage/reinstall.
8. Schedule scans and run updates.
9. Enable System Restore and create a restore point in Windows Home.
10. Educate the end user.

- 204.** B. A smart card is a type of badge or card that gives you access to resources, including buildings, parking lots, and computers. It contains information about your identity and access privileges. A protected computer or area has a badge reader in which you insert your card. In the case of radio frequency identification (RFID), the reader is a wireless no-contact technology, and the user does not need to touch the card to the reader. A personal identification number (PIN) code is a number that would be entered to gain access to a device. A soft token is usually software on a cell phone or mobile device that generates a code for the user to input. Biometrics uses part of a person's body to prove identity.
- 205.** B. Released in 1993, terminal access controller access-control system (TACACS+) is an authentication protocol developed by Cisco that is now an open standard. It separates the Authentication, Authorization, and Accounting (AAA) packets and encrypts them.

Remote authentication dial-in user service (RADIUS) is an authentication protocol that was released in 1997. Kerberos is an open-source authentication protocol that has been around since the 1980s. Advanced encryption standard (AES), which is for wireless encryption not authentication, has been around since 2001, and is the successor to temporal key integrity protocol (TKIP).

- 206.** D. A key fob is a small device about the size of a car key that can easily be carried in a pocket or on a keychain. It generates a random number every few seconds that can be used for multifactor authentication (MFA) to gain access to a secure system like a bank account. Key fobs are also a type of external hardware token. The other three choices—an identification (ID) badge, a radio frequency identification (RFID) badge, and smart card—are all something that can be carried by an employee to gain access to a specific area. Smart cards or RFID badges store electronic information that could be used to access equipment as well. Information on them is accessed by devices called readers.
- 207.** C. A structured query language (SQL) injection happens when a poorly written website doesn't specify limits on what an input field can contain, and that field is used by a malicious actor to insert code into the website. SQL is used by databases, and most websites have databases running on the backend to take orders or capture visitor data for newsletters and such. A keylogger records keyboard input for a malicious actor to use later. Stalkerware is any software, whether a commercial app or a malware, which is used to perform surveillance on a person or business for malicious intent, which is stalking. A Trojan is malware that appears to be a useful program that is unwittingly downloaded by the victim, and then often installs a backdoor for a malicious actor to use later.
- 208.** D. Smishing is a type of social engineering attack that is perpetrated via short message service (SMS) messages. Social engineering is a process in which an attacker attempts to acquire information about you, your network, and your system by social means, such as talking to people in the organization. A social engineering attack may occur over the phone, by email, or in person. When the attempt is made through email, it is known as phishing and often made to look as if a message is coming from sites where users are likely to have accounts (e.g., banks, eBay, and PayPal are popular) or a relative or friend. Ransomware is software that holds your computer hostage in a logical way, such as encrypting your drive and refusing to give you the key until you pay a ransom. Whaling is phishing for a wealthy or influential target.
- 209.** C. When assigning user permissions, follow the principle of least privilege, where you give users only the bare minimum that they need to do their job and nothing more. Assign permissions to groups rather than users and make the users members of groups (or remove them from groups) as they change roles or positions. You would not let anyone log in as a Guest user or give them Read and Write access to all your server files, and placing them in the Administrator group would negate your security settings, unless the setting was an NTFS Deny setting, because Deny overrides every other setting, even for administrators. (Caution! Don't deny the Administrator group on anything!)
- 210.** A. Quick response (QR) code phishing occurs when an unsuspecting person scans a QR code and visits a website that they think is legitimate, but it's actually a phishing site intended to gather their personal information. Ransomware is software that holds your

computer hostage in a logical way, such as encrypting your hard drive and refusing to give you the key until you pay a ransom. Whaling is phishing for a wealthy or influential target. Smishing is a type of social engineering attack perpetrated via short message service (SMS) messages.

211. A. Spear phishing is a social engineering attack aimed at a specific person for a specific purpose. In this case, the payroll manager was the “fish.” Spyware watches what you do and reports back to someone. A virus spreads from computer to computer through some contact between the machines, often through email. Whaling is phishing for “big fish” who are very wealthy or influential people. Phishing gets its name from fishing for information.
212. C. A business email compromise (BEC) occurs when someone impersonates another person (or entity) in an attempt to gain sensitive information from someone. Spear phishing is a social engineering attack aimed at a specific person for a specific purpose. In this case, the payroll manager was the “fish.” Spyware watches what you do and reports back to someone. Whaling is phishing for a “big fish,” who is very wealthy or influential. Phishing gets its name from fishing for information.
213. A, B. Following the principle of least privilege, users should be given only the access that they need and nothing more. If a user needs to read files but not change them, then they should be restricted to reading those files only. Sometimes, even the most careful users can make changes that they did not intend. If a user works only Monday to Friday, then they should not be able to log in on the weekend. Having their log-in available gives a hacker one more way to access your system. The guest account is disabled by default and should remain disabled. Even administrators should have a standard user account that they will use unless they are doing something requiring administrative access. Then they would only log on as an administrator while doing that activity, or enter their administrator password into a user account control (UAC) pop-up box.
214. C. Your friend is the victim of a potentially unwanted program (PUP) attack, which occurred when they installed the game. A PUP can launch almost any type of attack, but often they are used for browser redirection or to install adware. PUPs differ from Trojans in that a Trojan makes you believe it's a harmless software, and a PUP is usually bundled with something else, and you agreed to install it. Structured query language (SQL) is used to interact with a database. Smishing is using small message service (SMS) for phishing attacks. OS merely stands for operating system.
215. D. The appliance described is an email security gateway, which examines incoming and outgoing email for numerous possible problems and can quarantine emails until their intent is confirmed. Structured query language (SQL) is used to interact with a database. Endpoint detection and response (EDR) protects a network’s endpoints such as servers and workstations from attacks. A proxy server hides internal nodes from the outside world and can filter traffic based on various specifications.
216. C. When all else fails in your attempts to eradicate malware, you can perform an operating system (OS) reinstallation, which effectively wipes the system clean. It takes time to rebuild the settings and reinstall or restore programs and data, but sometimes it’s the only way to truly clean the system. Structured query language (SQL) is used to interact with a database.

Endpoint detection and response (EDR) protects a network's endpoints like servers and workstations from malware. A potentially unwanted program (PUP) is often installed with other legitimate software, and although it can launch any malware, it generally is used for browser redirection and adware.

- 217.** A. Endpoint detection and response (EDR) becomes managed EDR (MDR) when EDR systems are provided by a third-party vendor that manages EDR for you. EDR monitors network endpoints continuously in an attempt to recognize, remediate, and prevent the spread of any malware or data loss in a system. They also provide reporting capabilities. Distributed denial-of-service (DDoS) is an attack performed by many computers to keep legitimate traffic from reaching a server. A potentially unwanted program (PUP) is often installed with other legitimate software, and although it can launch any malware, it generally is used for browser redirection and adware.
- 218.** C. When an endpoint detection and response (EDR) system investigates, identifies, reports, and responds to information gathered from multiple places and security levels like the cloud and email, applications, endpoints, and networks, it is considered an extended EDR (XDR) system. These systems are so complex that they need automation and artificial intelligence (AI) to sort and analyze the data in a timely manner. Managed EDR (MDR) systems are EDR services provided by a third party. Similarly, managed XDR (MXDR) systems are XDR managed by a third party. EDR, MDR, and XDR are on the CompTIA exam; however, MXDR is not.
- 219.** C. You can't launch a program as an administrator by typing %command% admin in the run box. One best practice for an administrator is to log in as a standard user and only use administrator privileges when required. To run a program as an administrator, you can right-click a program and choose Run as administrator or launch the program and type an administrator password in the user account control (UAC) box, or you can open the command prompt as an administrator and then launch a program from the command prompt. Remember that administrators can do anything in a system, while a standard user can't, so only work as an administrator when it's necessary to do so.
- 220.** A. With a zero-trust model, a user is not assumed to have access to resources because they have logged in to a network as a specific user. They must provide authentication information on a recurring basis. The principle of least privilege states that you only give a user access to the resources that they need and nothing more. Inheritance means that when an object is inside a container, it takes on the access rules of the parent container. User accounts control (UAC) is a method of requiring authentication before being able to run a restricted program.
- 221.** B. A time-based one-time password (TOTP) expires after a given period of time and can't be used to authenticate a user after that time. Single sign-on (SSO) assumes that a user is who they say they are, because they've signed in to a network with their username and password. It's essentially the opposite of the zero-trust model. Privileged access management (PAM) is a system for monitoring who and what has administrative access and reporting unusual events to mitigate cybersecurity attacks.

- 222.** C. A One-time password (OTP) is often delivered via email or short message service (SMS) and is only valid for that session. This helps verify the person requesting access is the person who previously entered their email or phone number into a system. Single sign-on (SSO) assumes that a user who has gained access to a network is that person and is not required to authenticate again, although they may be required to enter an OTP or other credential to access some resources. Just-in-time (JIT) systems grant access to resources only when needed and for a specific time period. JIT is part of privileged access management (PAM). PAM tracks, monitors, and manages access beyond a standard user, whether the user is a person, an application, or a machine.
- 223.** B. Just-in-time (JIT) systems grant access to resources only when needed and for a specific period of time. JIT is part of privileged access management (PAM). PAM tracks, monitors, and manages access beyond a standard user, whether the user is a person, an application, or a machine. Single sign-on (SSO) assumes that a user who has gained access to a network is that person and is not required to authenticate again, although they might be required to enter a one-time password (OTP) or other credential to access some resources. An OTP is often delivered via email or short message service (SMS) and is only valid for that session. This helps verify that the person requesting access is the person who previously entered their email or phone number into a system. Identity access management (IAM) supports SSO but uses adaptive multifactor authentication (MFA), where the specific factor used is based on situations such as time of day, location, IP address, device, and so on.

Chapter 8: Software Troubleshooting

- 1.** A, C. Bluetooth must be turned on in Settings before it will work. Airplane mode must be off for Bluetooth or any other wireless connection to work. Typing **Bluetooth** at a command prompt will not enable it.
- 2.** C. The first thing to try when you get a blue/black screen of death (BSOD) error is to reboot. (In Windows 11, the black screen of death was reverted to the familiar blue screen. A black screen of death means that the build of Windows is outdated.) If the problem goes away, it may have been a one-time glitch. Often BSOD errors are caused by hardware or drivers, and because you just installed a new sound card and drivers in Windows, that would be the likely suspect. Use the Windows Recovery Environment (WinRE) to boot into safe mode. Once in safe mode, uninstall the driver and look for an updated one on the sound card manufacturer's website.
- 3.** B, C. There are a number of reasons intermittent wireless connections can occur, but the two most common are lack of a good signal and interference. Increasing the number of wireless access points (WAPs), or being closer to one, can address the lack of a good signal. Interference can be addressed by reducing the number of devices competing for the same channel or by moving away from walls, appliances operating on the same frequency, or obstacles. A poor wireless signal can cause video buffering, not the other way around, and Wi-Fi antennas for mobile devices are often found inside the display housing, not a retractable antenna.

4. A, B, D. There are a number of reasons why your browser might be running slowly (experiencing degraded performance). First, close any tabs that aren't needed. Having more than one instance of a browser open can also slow down the browser. A full cache will also slow down your browser, and if you've added any new extensions or add-ons, try uninstalling them and see if the performance is better. Of course, malware or a browser that isn't up to date can cause degraded browser performance. Too much RAM is never a problem!
5. B. This is a classic symptom of browser redirection, which means that you type in a specific Uniform Resource Locator (URL) and are taken to a different website. The perpetrator has one goal, which is to direct you to websites that they want you to visit, regardless of what you actually want to see. Removing the redirector might be as simple as uninstalling an application (by dragging it to the Trash and emptying it), or it might require full-scale malware mitigation.
6. B. When an application crashes, you want to isolate the cause of the crash. It could be a compatibility issue, hardware, or a host of other problems. Once it's isolated, you can solve the issue. One step to take early in the resolution process is to look for updates, patches, or fixes to the application released by the vendor. It's not likely to be a malware issue because you just installed this application and haven't mentioned any malware symptoms. Deleting and reinstalling Windows is a drastic measure that would be your last-ditch effort. Compatibility settings can be found in the Properties menu of a program file.
7. B. Lack of Bluetooth connectivity is often caused when a device is not turned on and/or has an improper setting for discoverability. Make sure the device is turned on and discoverable (checking the manufacturer's documentation if necessary).
8. B. There are many reasons why a profile might load slowly. If the user hasn't logged on to this computer before, the entire profile is downloaded instead of only what needs updating. If they have and it's still slow, then it may be a very large profile. Sometimes the profile is corrupted, which can show as a screen looking strange. Rebuilding the Windows profile will fix a corrupted profile. Roaming profiles tend to experience problems, most of which can be reliably fixed by rebuilding the Windows profile.
9. A. One of the more clever ways of spreading a virus is to disguise it so that it looks like an actual anti-malware program. When it alerts the user to a fictitious problem, the user then begins interacting with and allowing the rogue program to do all sorts of damage. One of the trickier tactics that troublemakers use is to make the program look as if it came from a trusted source—such as Microsoft—and mimic the user interface enough to fool an unsuspecting user. The other three options are not likely to occur.
10. C. If you need installation media, search for and download the Windows media creation tool, which will enable you to create a bootable universal serial bus (USB) or DVD. In addition to creating bootable media, you can download an international organization for standardization (ISO) file, which can be stored on a server and accessed over a network. Copying the contents of the C drive will not create installation media, and the drive won't be bootable. Windows Security in the Settings app will bring you to several security options, but none of them can create installation media; neither does backing up and syncing your settings.

11. B, D. Because you just installed a new application, chances are that it is the cause of all the problems you're having now. It's possible that malware was introduced into your system. If the scan finds nothing, then it might be a problem with the application. In that case, a restore point will restore any system settings that may have been changed and may uninstall the software, but your data won't be affected. Reinstalling Windows is likely not necessary. You would not want to reformat the drive unless the system could not be repaired.
12. B. If you save many large files, and the storage drive gets to be under ten percent of free space, its performance can slow down dramatically. The Disk Cleanup utility will show how much disk space is being taken up by temporary files, log files, the Recycle Bin, and other items that can easily be deleted. This could free up some disk space. You will possibly need to delete some files as well. The Optimize and Defragment Drive utility will help with mechanical hard disk drives (HDDs), but not solid-state drives (SSDs). In fact, running it could damage an SSD. Although it could help a sluggish system perform better, it doesn't free up space. The Registry Editor is a tool that should only be used when there isn't another utility that can do the same task. Improperly changing the Registry could cause the operating system to crash. Run system file checker (SFC) if you're having problems related to system files; it won't free up space on your drive.
13. A. Sadly, if the user hasn't backed up this file, it is likely lost. A restore point backs up system configuration, not user files. If a file won't open in the graphical user interface (GUI), it probably won't open at a command prompt either. The Windows Recovery Environment (WinRE) can fix problems with the system booting or restore the entire machine from an image, but if the files aren't on the image, then WinRE can't restore or open the file either.
14. C, D. Rebooting the computer should close the app and clear anything out of random access memory (RAM), but you might be able to solve the problem with less-drastic measures by ending the process using Task Manager. Double-clicking the program file and right-clicking in the window won't help because the program is corrupted and not responding.
15. A, D. Slow performance is often related to random access memory (RAM). Look for any apps that are running and can be closed or perform a soft reset (i.e., cycle power off and on again) to try to free up memory. Resetting to the factory default will delete all data on the device. You can't upgrade the RAM in an iPad, because the RAM is soldered directly to the motherboard and is not designed to be user replaceable.
16. C. Most likely this is a malicious application that is trying to steal your login or other personal information (PI). Misspellings are a red flag that the application is an attempt by a malicious person to spoof your bank's app. Uninstall the offending app immediately and run a malware scan to ensure that nothing malicious was loaded on your system when you downloaded the app. Whatever you do, don't enter your username and password! You could also call the bank and let them know about the app so they can warn other bank patrons. Running spell check on the app wouldn't help you or even be possible on the app.
17. D. Pop-ups are annoying but not necessarily an indication that your browser or computer is infected with anything. Most likely, the website is programmed to show a pop-up advertisement. Adware pop-ups usually spam your desktop with multiple (if not dozens of) windows at the same time. Spyware generally doesn't announce its presence, and viruses generally do more damage than a simple pop-up ad does.

- 18.** B. An invalid certificate usually means that the certificate that you have (or the one the website has) has expired. It could mean that the website is fine. But it could also mean someone has set up a Trojan that imitates the website you are seeking. Do not visit it. If it's a website you are not familiar with, the best bet is to avoid it altogether. An invalid certificate could also indicate that the time and/or date on your computer is incorrect.
- 19.** D. Rebooting (i.e., powering off and back on) any device will clear what is in its memory and sometimes help with application problems, so try rebooting the phone and try the app again. If that doesn't work, you might want to remove and reload the app. Be sure to check the vendor's website for any known problems. You would not want to perform a factory reset for a problem with one app, because that would delete everything on your phone. Performing a force-stop on the app would close it if it were open, but in this scenario, you can't load the app.
- 20.** C. If an app on your smartphone is locked up, then you need to force-close the app, which is done on many devices by swiping the app up. Depending on the device, it may be done differently. Apps running in the smartphone's background aren't really running or using resources, unless you've set them up to refresh in the background. (Android apps aren't as good at this as iPhone apps are.) You likely won't get an "out of memory" error message, but you might run out of storage space. If your phone is sluggish, it's likely that the battery is low or you're running out of storage space. You don't need to close apps when you're done with them for the day. If they're in the background, they aren't using resources.
- 21.** B. The email could be real, but most likely it's a fake security warning. Worse yet, it could be malware itself, and by clicking the link you will activate it on your computer. Always check a reputable source, such as a trusted anti-malware vendor for information on the latest threats. At a minimum, delete the email and don't click the link!
- 22.** C. If an app does not load, the first thing to try is rebooting. If that does not work, attempt to uninstall and reinstall the app. Be sure to check the vendor's website for any similar problems (and solutions) encountered by others. Cycling the power is turning the device off and on again. The user has already done that. A reset to factory default wipes the device, and would be the last remedy you would try for repairing any device problem, whether the device is a phone, a tablet, or any other computing device. A force-stop, also called a force-close, is merely closing the app, which you can't do because it won't open.
- 23.** A, B. If you save many large files, and the hard drive gets to be under ten percent of free space, its performance can slow down dramatically. The Disk Cleanup utility will show how much disk space is being taken up by temporary files, log files, the Recycle Bin, and other items that can easily be deleted. This could free up some disk space. Optimize and Defragment Drive will help with mechanical hard disk drives (HDDs), but not solid-state drives. In fact, running it could damage a solid-state drive like your M.2. As you access and change files on a drive, the parts of the files can end up scattered in different places. With a mechanical drive, retrieving the files will be faster if the file's pieces are next to each other on the drive. This isn't as important in a solid-state drive. Defragmenting the drive rearranges it and places each file's scattered pieces together. System file checker (SFC) should be run if you're having problems related to system files. It won't free up space on your drive.

24. A. Adware pop-ups usually spam your desktop with multiple (if not dozens of) windows at the same time. The website could be poorly written, but that's not the most likely issue. If a website is using pop-ups to gather information from you, they wouldn't have so many that you can't see their website. A website may have legitimate pop-up ads, but they won't have so many that it sends you to another website.
25. D. Malware can change more settings than you might be aware of on a computer. For example, adware might be obvious because of the pop-ups and browser redirects, but it can also change the client-side IP settings that point to a Domain Name System (DNS) or proxy server. Check the IP configuration on the client computer and be sure it's set properly. The other options are not likely the cause or fix to this issue and may cause other problems.
26. A, B. Updating the network settings manually or rebooting should apply the new Domain Name System (DNS) information. Disabling the firewall or booting to safe mode will not help the issue.
27. A, B, D. If you're able to use the operating system (OS), then go to the Settings app and search for System Recovery, which provides recovery options, including resetting the OS without touching your files. Another option on the same screen is Advanced Startup, where you can click Restart Now. This will restart the computer and bring up the Windows Recovery Environment (WinRE). In WinRE, one of the options is to boot into safe mode, which will enable you to use the options in Settings, as already explained. Alternately, hold the Shift key while restarting the computer. This will also cause the PC to boot into the WinRE. *Read carefully:* A Windows Repair Disk will enable you to boot into safe mode via WinRE, but without knowing what the “emergency” repair disk is, you don’t know what it will do. It could be an anti-malware boot disk, or another bootable disk with troubleshooting tools.
28. A, D. When an application crashes, you want to isolate the cause of the crash—it could be a compatibility issue, hardware, or a host of other problems—and solve it. One early step to take is to look for updates/patches/fixes to the application released by the vendor. You can also try to repair the installation through the Control Panel. If needed, you can delete and reinstall the software, but you should try patching or repairing first. You would not want to remove and reinstall Windows.
29. D. Whatever message appears in the pop-up window is likely logged in the mobile application log. Steps for accessing the log will vary by device and operating system. If it was too fast for the user to read, it's probably too fast for you to read too. You would not want to install any additional software until this problem is resolved, and reinstalling the application may not be necessary.
30. A, C. Tips for increasing battery life include keeping operating system (OS) updates applied (they may include energy-saving patches), avoiding ambient temperatures that are too high or too low, letting the screen automatically dim, and turning off location-based services. Also turn off Wi-Fi if you're away from your network or not using Wi-Fi, because if it's on and not connected, the phone will continually search for Wi-Fi connections. You should also disconnect peripherals and quit applications that are not in use. (Bluetooth, for example, uses power when enabled, even if you are not using it to connect to anything.) A reset to factory

defaults won't help with battery life, and you'll lose all your stuff! Installing an antivirus app also won't help here.

31. B. Every network device must have a unique IP address. Many networks use a Dynamic Host Configuration Protocol (DHCP) server to assign IP addresses, because keeping track of them manually would create a great deal of work. If there are two identical IP addresses attempting to access a network with DHCP, then at least one of them very likely has its IP address configured manually. Ensuring that this computer is set to obtain an IP address automatically should be your first step. If it isn't, then you have found the problem. If it is, then you could ping the IP address using `ping -a ipaddress`, substituting the duplicated IP address for the variable *ipaddress* in the command. This will return the hostname of the other computer. Every network admin should have a list of computer names and where they are located. You could then ensure that the other computer is also set to obtain an IP address automatically, or if the other device requires a static IP, remove the IP address in question from the available pool of addresses on the DHCP server. Manually configuring an IP address is what caused the problem. The `ipconfig /release` and `ipconfig /renew` commands wouldn't help in this situation.
32. C. Don't click anywhere on the warning! This is a fake security warning. It is either a hoax, or when you click on the pop-up, it will install malware. Even clicking the X to close the window may install malware, so don't do it. Your best course of action is to shut down the computer, reboot, and initiate a malware scan using your anti-malware software. Note that if the computer is on a wired network, you should disconnect the cable before restarting, or if on Wi-Fi, disable Wi-Fi before restarting to protect the rest of the network.
33. C. Occasionally, a rogue system will begin automatically shutting down and/or restarting while in use. Although it could be indicative of a hardware problem (e.g., a malfunctioning motherboard or faulty internal connector), it can also indicate a setting misconfiguration or driver problem. The most likely setting problem is with sleep settings, such as hibernation mode. If that's not it, then it could be a corrupt driver. To begin ruling out possibilities, boot the system into safe mode, and then see whether the problem continues. If the problem does not occur while in safe mode, then boot normally and begin testing what occurs as you eliminate drivers/devices one by one (e.g., sound, video, etc.) until you find the culprit. The boot order in the basic input/output system/unified extensible firmware interface (BIOS/UEFI) settings would have nothing to do with this problem. While you might need to go into Windows Recovery Environment (WinRE) to fix the problem, that would not be your next step. You certainly don't need to reinstall Windows, at least not yet.
34. B, D. Although it may appear to be a problem with the operating system (OS), this is classic behavior for a system that is overheating. There are a few things to do here. Ensure that all system vents are free of dust and debris, so that air can move freely through. Use compressed air or an antistatic computer vacuum to remove dust from inside the case. Note that the vacuum cleaner must be one designed for use on electronics. Other vacuums cause static, which can damage the computer. Dust on a motherboard can act as a blanket holding heat in, or worse, conductive particles in dust can cause a short circuit and damage the motherboard. Make sure there is adequate room around the case for airflow; if the system is overclocked, revert to running the central processing unit (CPU) at its manufacturer's recommended speed. If none of those remedy the situation, try replacing the processor's

thermal paste with new thermal paste. Reinstalling Windows or checking system files is not necessary when the computer is overheating.

35. A, C. If the computer was fine yesterday and slow today, your first thought should be that it might have been attacked by malware. Malware running in the background is notorious for taking up system resources. Scan your system with anti-malware, or shut down the system and restart with an anti-malware boot device (which can detect malware loaded before the operating system [OS] is loaded). If malware is not found on your system, look next at the Processes tab of Task Manager. Click Memory at the top to sort the list by how much memory each program is using. It may be software launched at startup that you don't need or another program that doesn't need to run all the time. Based on what you find there, take appropriate action.
36. B. Active Directory (AD) stores user information on a Windows domain, including their profile. The first time a user logs on to a machine on the domain, the entire profile is downloaded, which may take a few minutes. For subsequent logons on the same machine, only the changes to the profile are downloaded, making the process much faster. If the user then logs in to a different machine, the entire profile must be downloaded so that the logon won't be as fast as the user is accustomed to. They don't need to be listed as a user on this computer as long as they are a user on the Active Directory. A peripheral being connected or not should not affect the profile download, and entering the wrong password would quickly generate an error message stating that fact.
37. D. When the Print Spooler service is not running, a user will not be able to see or print to any of their devices. Open the Services console and restart the Print Spooler to remedy the situation. It's unlikely that someone deleted their printers, but if that's the case you have security concerns to address. If the printers were offline or out of paper, most likely the printer would send a message stating this fact to the user's screen.
38. B. The option you would choose when right-clicking the time on the taskbar is Adjust Date and Time, not Internet Time. Occasionally, the time on a computer is off because of errors in settings in Windows or a domain controller. If the time is off by exactly an hour, or exactly several hours, then most likely the time zone is set manually and incorrectly. If it's off by minutes, then it's something else causing it, but you can sync the time now and correct the settings using the Date & Time options on the Time & LANGUAGE tab in the Settings app. On an Active Directory (AD) domain, the domain controller uses the Windows time service and Network Time Protocol (NTP) to synchronize the time of all the computers on the domain, so it's important to ensure that the Window Time service is running.
39. C. If the operating system (OS) is missing, it could be due to a bad or corrupted boot sector on the hard drive, or the OS may indeed be missing. Your first step would be to ensure that the boot files are not corrupted. To do this, boot to the installation media (you might have to set your basic input/output system/unified extensible firmware interface [BIOS/UEFI] to boot to the installation media drive), then navigate to Startup Repair and follow the onscreen prompts. Typing **startup repair** at a command prompt returns an error message. System file checker (SFC) is used to verify OS files, not a program you can open and choose something in, and you wouldn't be able to boot into safe mode because the computer thinks the OS is missing. You might be thinking it could be non-bootable media in a drive, but the question states that the computer is set to boot from the C: drive.

- 40.** A, B. There are many reasons why a system would be running slowly. If it suddenly starts running slowly, suspect that malware might be involved and take steps to locate and remove it. If no malware is found, check the physical and virtual memory. You might need to increase the physical random access memory (RAM) or change virtual memory settings. It could also be that a RAM module has failed or needs to be reseated. Other possibilities are a too-full hard drive (which rarely happens with today's huge hard drives) or a problem with hardware. Ensuring that the operating system (OS) is up to date is always a good idea. You would not roll back to a prior update, and restoring from a restore point would not necessarily help here.
- 41.** A, C. The first place to look for updates would be an option on the application's menu. If nothing is found there, check the application's company website. Programs and Features in the Control Panel and Apps & Features in the Settings app have options to uninstall, change, or repair, but not update, applications.
- 42.** B. With all due respect, you should have verified that your system meets the application's minimum requirements before you even purchased or downloaded it. Remember, too, that you'll need enough random access memory (RAM) for all the programs that are running at the same time. If your operating system (OS) is newer than the application's required OS, you could check the manufacturer's website for an update, but that would happen after you compare your system to the application's requirements. You certainly would not reinstall Windows because an application won't start, and although you could find a different application that meets your needs, that's not the best solution here.
- 43.** D. Your first thought in this situation should be that there is malware on your computer. You would perform the procedures for malware removal immediately. It's unlikely that you would need to reinstall the Word program or Windows, and while it's possible that someone has been playing tricks on you, that's not the most likely reason, unless that someone is the person who wrote the malware.
- 44.** B, C. All services can be found in the Services console and a link to it can be found in Computer Management. A subset of those can be found on the Services tab of Task Manager in Windows 10, but not Windows 11. If the service needed isn't there, a link at the bottom of the page will take you to the full list of services. Device Manager is intended for managing hardware devices and drivers.
- 45.** D. The first concern when a system is running too slowly is that there may be malware. Once you've verified that there isn't any malware, if the system is still running slowly, check the page file size. The page file is the file that holds virtual memory. Virtual memory is using a part of a hard drive as if it were random access memory (RAM). A larger paging file may alleviate low memory warnings, but the price is slower performance because the hard drive is slower than RAM. To change the amount of hard drive space reserved for virtual memory, search for Advanced System Settings and select View Advanced System Settings. On the System Properties window, click the Advanced tab. Then, in the Performance box, click Settings. In the Performance Options window, choose the Advanced tab, and in the Virtual memory box, click the Change button. Deselect Automatically Manage Paging File Size for All Drives, then click Custom Size. Adjust the size by typing the appropriate value in the Initial Size (MB) box and Maximum Size (MB) box, then click Set. If you have a magnetic

hard drive (HDD) and a solid-state drive (SSD), the SSD will be faster but using it for virtual memory can shorten its life. If possible, it's better to increase the physical RAM than the virtual memory. A hard drive being too large would not cause this problem.

46. A. In Windows 10 and 11, if the update fails to work properly, search for Windows Update in Windows Settings, then scroll down to Find and Fix Problems with Windows Update. The troubleshooter will search for and attempt to resolve any problems that may prevent updates to your operating system (OS). When it has finished, check for updates again. You might need to run the troubleshooter more than once. It's important that the OS is kept up to date because updates may be patching security holes in the system. You would not want to reinstall the system, because eventually you would need to install the same update, and most likely you would not need to purchase an updated computer.
47. C. You can choose the time server to sync with by going to the Control Panel, selecting Date and Time, and on the Internet Time tab, clicking Change Settings, then the down arrow on the right of the entry box, and choosing the correct server in the Server box. The Date and Time options in Windows Settings will allow you to change time zone settings and set time automatically, but not which server you are using. In the Services app, you can choose how and if the Windows Time service runs but again, not the time server that is being used.
48. B. Services will behave as you tell them to. Services can be set to Automatic so that they'll start automatically when the computer starts, or to Automatic (Delayed Start) so that the computer will start faster. They still start when the computer starts up, just two minutes later. Manual start is what the user is currently doing. Starting of the service would be set up in the Services console, not the application. A service can also be triggered to start by some event or other software, then closed again when it is no longer needed. To access the Services console, click Windows Key + R, then type **services.msc** in the box and press Enter.
49. A, C. When you're getting messages that your computer is low on memory, you can stop some programs that are running in memory. However, more than likely you will need to increase physical memory and/or virtual memory. A rule of thumb is that virtual memory should be 1.5 times the physical memory, but you can change the setting to a larger value if you want. The downside of using more virtual memory instead of physical memory is that virtual memory resides in a page file (**pagefile.sys**) on the hard drive, and hard drives are slower than random access memory (RAM), so having a larger swap file (i.e., virtual memory) may slow the system performance. To change virtual memory, search for Advanced System Settings, and select View Advanced System Settings. On the System Properties window, click the Advanced tab and then in the Performance box, click Settings. Click the Advanced tab, and on the Performance Options window, in the Virtual Memory box, click the Change button. Deselect Automatically Manage Paging File Size for All Drives, then click Custom Size and adjust the size by typing the appropriate value in the Initial Size (MB) box and Maximum Size (MB) box. Then click Set.
50. B, C. There are several places in the operating system (OS) where you can see how much physical random access memory (RAM) is installed in the system. Opening the case and counting the modules is neither necessary nor an accurate measure of how much RAM you have. The System Information utility (**msinfo32.exe**) has this and much more information about your computer. The Performance tab in Task Manager will not only show you

how much physical memory you have, but it will also show you how much is being used. It can give you a better idea of whether you have enough RAM installed, because it is also taking into consideration what is normally being used in your system. Another place you can see installed RAM, not shown in the options for this question, is by searching for System in the Settings app and choosing About. There is no Memory utility in the Control Panel.

51. A, D. Given the description, it might be best to roll back the update, although not all updates can be rolled back. In cases where there are mission-critical applications, it's best to pause the updates and test them in a sandbox before rolling them out. To access the screen for rolling back the update, go to the Control Panel, Programs and Features, and click on View Installed Updates. On the resulting screen, you'll see the updates and an option on the right to uninstall the offending one, if it's possible. Until the business application and update can be proven compatible, the update cannot be installed as is.
52. A, B. The Windows User Profile service detects when there is a slow link between the client computer and the domain controller. The service will then load the user's profile from a copy that is cached on the local machine. If the user has used a different machine since the last time they used the current one, then the profile changes will not be on the local machine. The User Profile service is running, because it is what generates the error message. Screen resolution has nothing to do with this error message.
53. B, C. Universal serial bus (USB) ports provide limited power to the devices connected to them. If that power is exceeded, one or more of the devices attached to the controller may stop working, and the error message "Not enough USB Controller Resources" may be generated. They also have a limited number of endpoints available on each port. Some devices use more endpoints than others, and if the limit is exceeded, the same error message will be generated. A damaged motherboard could cause many things to malfunction but likely would not generate this error message, and it is highly unlikely that the speaker drivers would conflict with the USB hub controller drivers.
54. D. On the graphic, the third icon down on the left, just above Focus, is the screen orientation. Notice that the lock is closed. That means that their smartphone orientation is locked in Portrait mode and will not autorotate. Bluetooth, focus, and the camera have nothing to do with this problem.
55. B, D. Slow data speeds can be caused by too much interference or by a weak signal. If there is too much interference, try changing the channel on Wi-Fi routers to less used channels; performance should increase. Fix weak signals by installing more access points or signal boosters, or by moving closer to an existing access point, or away from physical obstructions.
56. C. A limited connectivity error means that your device is able to connect to Wi-Fi but not to the Internet. Because this is happening with several users in the same area, the issue is likely caused by a problem with the wireless access point (WAP), not an individual device. The users are getting a limited connectivity error, so they're connecting to the WAP but not getting an IP address from the DHCP server or router. Try cycling the WAP off and back on to resolve the issue. If that doesn't work, troubleshoot the connection between the WAP and the router (if the router is acting as the DHCP server). You don't need to boost the signal strength, because the users are able to connect to the WAP. Having all the users reboot their

devices will not solve the issue, and if they're getting a limited connectivity message, then Wi-Fi on their device is already turned on.

57. A, B, C. There are many bootleg, imitation/fake, and malicious apps waiting for unsuspecting users to download them. They often have names very similar to the actual app, but there are ways to identify the spoofed apps. First, check the reviews. If you see negative comments about problems with mobile devices after installing the app, beware. Look at the number of downloads or reviews. If it's a popular app, it will have a high number of both. For example, if you see a Hulu app with fewer than a million reviews, it is probably not the real app. Research the app and the company from which it originates. Check the spelling of not only the app name, but the description and the screenshots as well. Misspelled words are a sign that the app is not legitimate. How long has the app been available? Popular apps will not have been released three days ago. If there is a free version, don't download and install it without first doing your due diligence. Offering something for free is a way to get you to download and install something malicious. If you download an app and it asks for permissions that you don't think it should need, be suspicious.
58. A. This message happens when the User Profile service incorrectly identifies the connection between the client and server as a fast connection, when it is actually slow. These settings can be configured on the domain controller. If the User Profile service detects a slow connection, it will load a cached profile from the local machine instead of the roaming profile on the server. If it's the first time the user has logged in to a particular machine, then the profile will take longer to load because the entire profile is loaded, not just the changes, and it wouldn't generate this error message. It is unlikely that a failure to update Windows would affect this message, and if a user entered an invalid password, they would see a message stating that.
59. A. Plugging a universal serial bus (USB) cable from a power block into a motherboard port will not solve your problem, and it will likely destroy your motherboard. The first thing you should try is rearranging the devices that are using the USB ports. USB hubs have a limit as to how much power they can provide and the number of endpoints that each port can support. A device may have multiple endpoints, and devices that are heavily involved in data transfer may use many more endpoints than other devices. Using a separately powered external hub or docking station means that the port won't be providing power to the devices, so this may resolve the issue. Disabling the XHCI Mode option in the BIOS/UEFI may help with the resource error but will effectively turn off USB 3.0 and your hubs will behave like 2.0 ports. USB 2.0 ports use fewer resources than USB 3.0 ports. Other troubleshooting options could be to update the chipset drivers for the motherboard and check the power options in the basic input/output system/unified extensible firmware interface (BIOS/UEFI). Make sure any USB controller drivers are updated. If you have plugged and unplugged devices, try going to Device Manager to scan for hardware changes and test the devices again. Also in Device Manager, uninstall all USB controllers and restart the computer. Windows will scan for hardware changes and all the USB controllers that were uninstalled should be reinstalled, which will allow the USB controllers to return an unresponsive port to a working condition.
60. C. Either Airplane mode being on or Wi-Fi turned off would keep them from connecting to their Wi-Fi, but in this case, according to the graphic, the Wi-Fi is turned off. Cellular service and Bluetooth should have no effect on their ability to connect to their home Wi-Fi network.

- 61.** A. If your computer is set to an incorrect time and date (I'm talking years off, not just a few minutes), then it can cause invalid certificate errors for the websites you want to visit. Refreshing your certificate is not an option in the Security settings in the Control Panel, and there is no low option for the Internet Zone in Internet Properties. It's never recommended to turn off your security settings for browsing the Internet. Note that if your date and time are way off, it might be that the basic input output system/unified extensible firmware interface (BIOS/UEFI) is not retaining its settings, in which case the CMOS battery needs to be changed.
- 62.** A, B. When authorized users access devices through unintended connections or unauthorized users access absconded devices (such as with root access), they can access the data on the device. Every firm should have a policy for protecting data (i.e., encryption) and dealing with leaks when they occur.
- 63.** C. Going over the limit on your phone's data plan is generally not a major risk, other than to your finances. Data overage charges can be high, depending on your provider and service plan. It is unlikely that your account will be deactivated, made more vulnerable to security breaches, or locked out of the cellular system.
- 64.** A, C. The most likely cause for an Android phone randomly restarting is a poorly written app. Any apps that you're not using should be deleted from the device. Another cause may be that on some Android phones, there is an auto-restart feature as a part of a Device Care option to boost phone performance. If it is on, turn the feature off to avoid automatic restarts. Batteries that are too hot or too cold can cause problems, but room temperature batteries are okay. Typing too fast on the keyboard wouldn't cause a reboot problem. Other problems not listed might be the battery overheating or third-party cases that don't fit just right (causing a button to stick), defective hardware, or corrupted operating system (OS) files.
- 65.** B. A common cause for lack of wireless connectivity is that the device is in Airplane mode, which can easily happen by an unintended touch on that part of the screen. Ensure that the device is not in that mode, then cycle the power if necessary. If the problem persists, you'll need to perform further troubleshooting. There is no Wi-Fi receptivity setting, and you would not reset the device to factory default without exhausting all other options first.
- 66.** D. Multiple users have the same complaint, so it's not likely a problem with their devices. Your first step should be to use a Wi-Fi analyzer to see signal strength, channels used, and various other network metrics. Any company with a wireless network should have one for troubleshooting purposes. A Wi-Fi analyzer could be as simple as an app on your phone, to a very sophisticated and expensive device. Based on what you find, you might need to install a new wireless access point (WAP) that uses a different channel to avoid congestion or move physical obstructions to your network.
- 67.** B, C. The specific behavior exhibited most likely means that their device is the victim of an adware attack, or that their browser's pop-up blocker has been turned off. Adware tracks your movements and targets you with advertisements, trying to get you to click on them and spend your money.
- 68.** C. While all of the options are possible, the most likely in this scenario is that the devices need to be paired. If the Bluetooth devices have not been used together previously, they must

be paired so they can work together. Pairing is usually a simple process. CompTIA's steps to configure Bluetooth devices (from Exam 220-1201) are:

1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.
 4. Enter the appropriate PIN code.
 5. Test connectivity.
- 69.** C. Even most unlimited plans aren't truly unlimited. Most mobile or even home Internet providers will slow down your transmission rate when you exceed a specified data threshold. It is highly unlikely that your account will be deactivated, become vulnerable to security breaches, or be locked out.
- 70.** A, B. If everything is up to date and your battery is healthy but the problem continues, you need to contact Apple Support. Most batteries are not user replaceable. Be sure to back up your data before contacting Apple Support. If you reset the phone to the factory default, you will lose everything on the phone.
- 71.** A. This is a typical fake security warning. If you click the message, or anywhere on the message, it will likely install the malware that it is mentioning. To ensure that your device is clean, update your anti-malware software and run a scan. It's important to keep your operating system (OS) and all software updated with the latest versions. Use reliable anti-malware software, strong passwords, or a password manager; avoid using public Wi-Fi (just because it says it's Starbucks Wi-Fi doesn't necessarily mean that it is); and do your due diligence when choosing new apps to download and install, even from places like the Google Play app.
- 72.** A, B. Smartphones are susceptible to malware, just like any other computer device. Some malware can be configured to perform unauthorized location tracking. To help prevent this, always patch and update the operating system (OS) as soon as updates are available and install anti-malware software. Some services such as maps require that location services are enabled, but if the user chooses to, location services can be disabled. Exactly how to do that depends on the device, but the option is most likely in the Settings menu. Enabling sync with a cloud provider will make a backup of their data, but it does nothing to protect it from being leaked.
- 73.** B, C. To use near-field communication (NFC) services like Apple Pay and Google Pay, you need to ensure that Airplane mode is off and NFC is enabled. Wi-Fi and Bluetooth have no effect on the NFC reader. NFC has a very short transmission range, measured in centimeters or inches.
- 74.** A, B. For AirDrop to work, both of you must have Wi-Fi and Bluetooth enabled, and you need to be within Wi-Fi and Bluetooth range. If either party has a hotspot on, it must be turned off. If you are not in the receiver's contact list and they have their AirDrop Receiving setting set to Contacts Only, then you will not be able to send them information. If you are in their contacts list, then your Apple ID email or your phone number must be in the contact card. If they change their AirDrop Receiving setting to Everyone, then they can receive the file even if you are not in their contacts list.

- 75.** B. Often times when a third-party app is installed, you also unknowingly give it permission to bombard you with “helpful” pop-up messages. While it could be malware, that doesn’t happen as often. Firewalls and proxy servers provide a layer of protection, but they are not causing pop-ups. Some other issues could be that browser settings need to be updated, or the browser cache cleared. Most devices will also enable the user to block pop-ups and redirects through the Settings app.
- 76.** A. If the update fails once because of a lost or insufficient network connection, retry the update using the same network connection. If it fails again, connect the iPhone to your computer to perform the update. This error message has nothing to do with insufficient room on your iPhone, and connecting to a different network might solve the problem, but that isn’t what you would do first.
- 77.** B, D. Regardless of the operating system (OS), if there is insufficient space on a smartphone or a weak Internet connection, an application is unlikely to update. Allowing the power to go too low or the device to turn off during an update may cause problems, so it’s perfectly fine to have the phone plugged in while doing updates. Generally speaking, mobile devices use Wi-Fi instead of Ethernet, and you will want a strong Wi-Fi signal.
- 78.** A, C. Higher than normal resource utilization can be a telltale sign that a device is running more than it should be—perhaps the drives are being searched, or the camera is recording your every move. Or it could be that the user has too many apps open, and the device is struggling with available resources. The latter tends to happen more on Android smartphones than iPhones. Unauthorized root access on an Android or jailbreaking an iPhone cause the phone to be susceptible to malware attacks but don’t by themselves cause more resources to be used. A stuck sync operation would not likely cause high resource utilization.
- 79.** D. Weak signals are a common culprit behind dropped signals. Before you engage in communication, the device’s signal strength should be evaluated. If the signal is low (e.g., no bars), then change location. For example, step outside, drive out of the tunnel, or exit the elevator and try for a better signal. A low battery can affect signal strength, so keep the battery charged as much as possible. Waiting a few minutes won’t help if something is blocking the signal. And cycling the power off and on probably won’t help either. You certainly wouldn’t reset your phone to factory defaults any time that your signal was weak!
- 80.** B. You don’t need to force-stop the application because it isn’t unresponsive. What you should do is suspect that your phone is infected with malware. Most Android phones have a method to restart in safe mode. Once there, perform a malware scan and uninstall the offending app. Make sure your operating system (OS) and other apps are updated. If you identify any other suspicious apps (i.e., apps that are acting strangely), then they might have been infected as well and should be removed and a clean copy downloaded and installed.
- 81.** B. While apps, usage, and so on can contribute to power drain, one of the biggest offenders is the search for a cellular signal. It’s unlikely that the battery needs to be replaced, power cycled off and on, or the phone replaced. Simply recharge the battery. The phone will also use battery power if it’s searching for a Wi-Fi signal, so when you’re traveling and not using Wi-Fi, turn the Wi-Fi off to conserve battery resources.

- 82.** C, D. If Developer mode and the Debugging feature are left on, then whenever the PC is connected to any computer, the Android device is essentially wide open, meaning that passwords, bank accounts, photos, and so on are visible to anyone who accesses it. There are many features that can be manipulated in Debugging mode, such as Show Touches, Pointer Location, Transition Animation Scale, and so on. Just ensure that Developer mode and Debugging are turned off when you are done with them.
- 83.** A, B. To update the iOS, you need to have sufficient room on your iPhone. You might be able to use your computer to do the update, because files can be temporarily stored on the computer by the update while it is working. If it still won't update using your computer, then you need to make space on your iPhone by removing apps or data that you aren't using. Adding internal storage to an iPhone is not possible, and while it is possible to use an adapter and a secure digital (SD) memory card for extra storage, the card can't be used to hold the iOS.
- 84.** C, D. The Play Store sometimes won't install updates or apps if your date or time is incorrect, so ensure that they are correct. Having updates pending in the Play Store queue could also be a problem, so you'll need to cancel those updates before installing the new software. You'll also need a good Wi-Fi connection and sufficient space on your device for the new app. The other two options are irrelevant.
- 85.** B. These are push notifications, not pop-ups, because they are coming up on the desktop, not in a browser. You can definitely do something about them. In order for them to show, you would have had to innocently agreed to them at some point. And yes, you can disable or block all or some of them. You might want some notifications and not others. In Windows Settings, search for Notifications, and on the Notifications screen you'll find options for allowing or blocking notifications. Choosing which ones to allow can also be done through your browser and how depends on the browser being used. Each browser (i.e., Safari, Firefox, Opera, etc.) has its own path to the specific settings that need to be changed, and they may change over time, but all will allow you to choose which notifications to see and which to block.
- 86.** A, C. An Android device won't perform an operating system (OS) update under the following conditions: If the Wi-Fi connection is not strong enough, the battery power or storage space is too low, or the device is no longer supported. If there is insufficient storage, remove apps or data that are no longer needed to make room for the update. Ensure that there is a good Wi-Fi connection. If the battery power is insufficient, plug the device in until it is fully charged.
- 87.** B, D. It's possible that you've already signed up for desktop alerts. If you receive weather warnings on your computer or phone, or school closings, power outages, or other notifications, these are desktop alerts. Desktop alerts can be displayed on wall-mounted displays, desktops, mobile devices, and phones, and they are an excellent way to provide mass notifications to affected people. They can include text and graphics, and they can be made full screen and interactive so that the receiver can respond. But like many other useful features in computer systems, they can be abused by those with malicious intent. For example, an interactive button on a desktop alert could be used to deploy malware when the user clicks it. There are many third-party vendors for desktop alert systems.

- 88.** C. Jailbreaking does let you do more with your device, but it isn't necessarily safe or legal. Jailbreaking is most commonly done with Apple devices because they are more locked down (i.e., closed source) than Android (i.e., open-source). Jailbreaking an iPhone, for instance, allows the user to install apps that are not approved by Apple. When you open the device up for you by cracking software or gaining root access, it also opens your device up more for cybercriminals to perpetrate an attack on it. Jailbreaking also voids the warranty on your device. The device may become unstable, and with the warranty voided, you are not likely to receive support in fixing problems. Jailbreaking may even be illegal depending on where you are in the world.
- 89.** A, D. Apps from the Google Play app store are required to be signed by the developer, and any updates won't be installed unless the signatures for the update and the original software match. This is a security feature for Android devices. If the signatures don't match, an error message like "Signatures do not match previously installed version" will appear. If you've downloaded the update from somewhere other than the Google Play store and received this error, there is a good chance that the website is a spoof of the actual developer's site, and a criminal is trying to get you to install malware. Android package (APK) source is the format for Android apps on the Google Play store prior to August 2021. Updates for existing apps may still be in this format, but any newly developed apps after August 2021 on the Google Play store will be in an Android App Bundle (AAB) format.
- 90.** B. The most likely reason for a sudden high increase in network traffic is that there is malware on the system and that malware is using your network to do something. Luckily, the mobile devices are on a virtual local area network (VLAN), so it isn't directly affecting your main network. You need to immediately identify the source of the network traffic and perform malware removal procedures. A malfunctioning mobile device is not likely to be the source of the problem. Limited connectivity would not present as an increase in network traffic, and it is unlikely that your monitoring software being infected is the problem. High network traffic is precisely the sort of incident that your monitoring software should be designed to detect.
- 91.** A. Desktop alerts perform a valuable function, but they can be subject to misuse by cybercriminals. The best protection for this type of attack is user education. You would not want to block all desktop alerts because they serve a purpose, and you certainly don't want to log on as an administrator unless absolutely necessary to avoid an attacker gaining administrator access and to avoid accidentally doing something as an administrator that could damage a system, because administrators can do anything in a system. Anti-malware should be updated daily.
- 92.** B. If a computer's boot order is set to boot only to a universal serial bus (USB) drive, then leaving a non-bootable media in that drive will give the error that the operating system (OS) is not found, when in fact it may be perfectly fine and residing on the hard drive. Your first course of action is to verify that there is no media inserted into USB ports. If you find it there, remove the non-bootable media and restart the computer. If it starts normally, the issue is resolved, but you shouldn't stop there. Enter the basic input/output system/unified extensible firmware interface (BIOS/UEFI) and verify the boot options. For a secure environment, you will want to disable booting to drives other than the intended boot drive, usually a hard drive. It's true that booting to alternate drives may be necessary when troubleshooting, but leaving that option always available opens the system up to potential attack.

93. C. A seemingly unstable Windows installation may be repaired by using a system restore point from a time when the system was working well. If that doesn't resolve the issue, a more involved step would be to boot into Windows Recovery Environment (WinRE), navigate to Reset this PC, and choose to keep your personal files, performing an in-place update that will reinstall the Windows 11 operating system (OS) files. There is no need to reformat the drive and reinstall the OS or delete the Registry.
94. D. Whenever a device will leave your possession, whether it is being donated or recycled, you need to ensure that all data is removed from the device. The simplest way to do this is by restoring the device to its factory settings, if a restore image is available. The process for a factory image restore on phones and mobile devices will be different depending on the device. With Windows OS, boot to the Windows Recovery Environment (WinRE) and navigate to Factory Image Restore. If you are in a government or industry where data security is an absolutely essential matter, you may be required to use other means such as physically destroying the device or performing multiple zero-writes to the storage media.
95. B. If the computer is behaving strangely, the simplest fix is to reinstall the company's PC image. This will delete any files that exist on the computer and install any software and settings that are necessary for the company. The user can then log in to the domain. There is no need to back up their files, because on the domain their files will be saved in a home directory on a server. Booting into Windows Recovery Environment (WinRE) to reset or perform a factory restore is not the best way to resolve the problem.

Chapter 9: Operational Procedures

1. C. Artificial intelligence (AI) has many appropriate uses, but it's also important to know when not to use it. For example, AI should not be used to prescribe medicine; however, it could be used to give a doctor a list of new medications for a condition, leading the doctor to research them and choose the best one for a patient. AI excels at generating ideas and performing repetitive tasks. It can quickly analyze historical data, but a human needs to make decisions based on that data, not AI. AI is a tool to enhance human work, to streamline processes, but not to replace the human element or critical thinking.
2. B. A splash screen appears on a computer before a user logs in. It can contain information related to the acceptable use policy (AUP) or regulatory information to which the user must agree and adhere. This information is accepted by clicking a button, indicating agreement to it before they can log in. The act of logging in alone does not prove acceptance of the conditions unless there is a statement telling the user that they must either accept the conditions or not continue. An incident report is filed when someone identifies a breach of company policies. A signature on an AUP should always be obtained as a part of employee onboarding, but it won't include any changes to the policy.
3. B. One component that people frequently overlook is the case itself. Cases are generally made of metal, and some have sharp edges inside, so be careful when handling them. You can, for example, cut yourself by jamming your fingers between the case and the frame when

you try to force the case back on. Motherboards and expansion cards have sharp solder projections on the bottom that can cut as can a moving fan (which would only be on if troubleshooting a power issue). Less often injuries can occur from the power supply and processor. The power supply could provide a lethal shock because it contains capacitors that hold a charge for a time after the power is turned off. You could be burned by a processor if removing it before it has had adequate time to cool off. Flying debris inside the case are very unlikely.

4. A, B, C. Three ways to make the custom installation of software easier are to create an image and install it via a network share, create your own installer package for the software (in a Windows environment, it would have a Microsoft installer [.msi] extension), or use a third-party software tool that can automate the process for you. Installing each package individually is what you want to avoid because it can be very time consuming and is subject to human error in installation.
5. C, D. One way to keep dust and debris out of your computer is to use an enclosure, which is basically an extra case. But if dust and debris do get inside your case, the best way to remove it is to use compressed air. Compressed air can be easily directed to exactly where it is needed. If the compressed air doesn't get the dust out, or you're concerned about the dust causing health problems to someone nearby, you can use a vacuum cleaner made specifically for computers. Never use a regular vacuum cleaner with electronics because it will introduce static that can damage components. Simply blow the dust from inside the computer to the outside by using a stream of compressed air. However, ensure that you don't blow dust all over your work area or yourself, and place a pen or pencil in the fan so it won't spin while you're dusting it off. Denatured isopropyl alcohol is used to clean contacts because it dries quickly, and demineralized water would not be used inside the case, except perhaps in a liquid cooling system.
6. D. Third-party software that includes a screen-sharing feature would allow the technician to demonstrate a task using the user's own local desktop. File-sharing software facilitates the sharing of files, Secure Shell (SSH) is an encryption protocol and set of utilities for managing systems remotely, and browsing is not a type of screen-sharing.
7. B. The Remote Desktop Protocol (RDP), Hypertext Transfer Protocol Secure (HTTPS), and File Transfer Protocol (FTP) provide confidentiality of network traffic, but Secure Shell (SSH) provides that and a suite of utilities commonly used by network administrators to remotely control and manage networks.
8. B. An end-user license agreement (EULA) is a contract between you and the entity providing the software. When you buy an application, you aren't actually buying the application. Instead, you're buying the right to use the application in a limited way, as prescribed by the licensing agreement that comes with it. Don't like the terms? Too bad. No negotiation is allowed. If you don't accept the EULA, your only recourse is to return the software for a refund.
9. B. Tracking where seized equipment or data is stored, and who has access to it, is documenting the chain of custody. After the device or data has been preserved, someone needs to keep track of it before it's handed over to the proper authorities. The next specific

step depends on your documented chain of custody policy. Depending on the situation, materials may be held in a safe locked location at the office, or they may need to be turned over to local authorities. Have a documented procedure in place to follow, given a situation. Always document the findings, who has custody of the illegal materials, and if/when the custody is transferred to someone else. No one should be using the equipment or data, so you're not documenting use and storage. Change management is a specific process for approving and implementing changes in a business environment. Asset management is tracking software, hardware, and data that belongs to or is licensed to an organization.

10. D. One of the golden rules of customer service is to be professional and use discretion when talking about a customer or work experience. Don't vent about customers on social media. You never know who will read it, and regardless, it's unprofessional to air dirty laundry. Depending on the situation, it may be advisable to discuss it with your manager or simply document it and move on with your day.
11. C. IT professionals often deal with confidential, private, or restricted information. Other users trust that IT professionals will treat the sensitive material as such and not spread information. Ignore the paychecks and focus on doing the job professionally.
12. B. Avoid distraction and/or interruptions when talking with customers. You need to make them feel that their problem is important and that it has your full attention. Distractions can include personal calls, texting, social media, talking to coworkers, and other personal interruptions. Listening, taking notes, and asking appropriate questions is part of good customer service.
13. D. Putting yourself at the same electrical potential is not as effective as using proper anti-electrostatic discharge (anti-ESD) gear, but it makes up for that with its simplicity. Make sure the computer is turned off and unplugged. Then touch an exposed (but not hot or sharp!) metal part of the case. That will drain electrical charge from you. Better yet is if you can maintain constant contact with that metal part. That should keep you at the same electrical potential as the case.
14. A. The Remote Desktop Protocol (RDP) lets you establish a connection to a remote client, showing the remote system's desktop. Secure Shell (SSH) lets administrators securely manage networks remotely, File Transfer Protocol (FTP) is for moving large files efficiently, and a virtual private network (VPN) uses encryption to create a private connection across a public network.
15. C. It is important for an IT technician to be culturally sensitive. Some people may have a language barrier, making it difficult to explain their issue. Others may have different habits or practices in their workplace. Be respectful of their world. In some cases, using appropriate professional titles is a sign of respect and not using them is an insult. You would never stare at their personal items, imitate their accent, or laugh at their clothing.
16. A, D. To use the electrostatic discharge (ESD) strap, you attach one end to an Earth ground, which provides a path for electricity to flow safely away (or more typically, the computer case), and wrap the other end around your wrist. The ESD strap dissipates static electricity from your body and has a resistor to offer some protection against electrical shock, although ESD straps are designed to protect the equipment, not the user. Never wear an ESD strap if

you're working inside a laser printer or power supply. If you wear one while working on the inside of these components, you increase the chance of receiving a lethal shock.

17. D. When batteries are thrown away and deposited into landfills, the heavy metals inside them will find their way into the ground. From there, they can pollute water sources and eventually find their way into the supply of drinking water. The best way to dispose of old batteries is to recycle them.
18. B, C. If you have your incident policy in place, then your incident response plan should be relatively scripted. Your first priority as the first responder is to identify the improper activity or content and preserve the data or device, which often means removing the offender's access to it. It's desirable to get someone else to verify the material or action so that it doesn't turn into a situation of your word against someone else's. You'll want to document the incident and the chain of custody, but those are not the first priority. You would never ask the user to delete the prohibited material.
19. C. When dealing with a customer, always display professionalism. That means avoiding slang, jargon, and acronyms; not interrupting; and clarifying what the customer wants and needs.
20. A. Static-shielding bags are important to have at your disposal when servicing electronic components, because they protect the sensitive electronic devices from stray static charges. This is in contrast to the familiar pink antistatic bags, which only prohibit static buildup found in other plastic bags, but do not shield from electrostatic discharge (ESD). By design, the static charges collect on the outside of these silver or pink bags rather than on the electronic components. Unlike antistatic mats, antistatic bags do not "drain" the charges away, and they should never be used in place of an antistatic mat. Components should never be placed on top of an antistatic bag. While mats are designed to be stationary on a bench, bags are built for portability.
21. B. After the device or data has been properly secured and preserved, because this is a matter of law, someone will need to notify the proper authorities. Whether you do or your superior does is a matter of company policy and should be part of your incident response plan. You will also need to document everything that could be relevant to the situation. Many organizations will walk an offender out of the building to prevent them from trying to cover up what they've done. The chain of custody is a document you'll create to track where the evidence is, who has access to it, and when it changes hands. You should never delete illegal material. In fact, you'll want to make a copy of it if possible.
22. C. Part of excellent customer service is setting and meeting—or exceeding—expectations. Be sure to communicate timelines and status with the customer. If you say you'll call them in three days, call them even if the part didn't come in. Customers want to know what's going on. In addition, offering different repair or replacement options will usually make the customer feel better because you are giving them an option in choosing a solution.
23. B. When dealing with customers, it's important to maintain a positive attitude and project confidence. Remember that if they have called you, they're already having a bad day, and they are counting on you to resolve the problem. Saying, "I'm not sure yet, but I'm

confident that we will have you up and running soon” is the only option that projects both a positive attitude and confidence. Be honest but gentle when forming answers to your customers.

24. B. The Payment Card Industry Data Security Standard (PCI DSS) applies to any organization that handles credit card data or processes or stores payment transactions from bank cards. PII is personally identifiable information, VPN stands for virtual private network, and Secure Shell (SSH) is an encryption protocol.
25. A. Software that you only pay for one time and are allowed to use forever has a perpetual license. Contrast this with most licenses, which are subscription in nature, where you pay an annual or monthly fee for the privilege of using the software. Open-source software gives the licensee permission to change the source code of the software. Many Linux distributions are open-source. A personal use license means just that—you can use it for your personal use, usually just on one computer, although some personal use licenses permit you to install five copies, but the license does not permit you to use the software in a company environment. For that, you would need a corporate-use license.
26. D. This is a standard change. A standard change is something that happens frequently and can be planned for. Companies can create a list of preapproved/predefined changes that are considered standard, like replacing pickup rollers in a printer. A normal change is one that goes through the entire change process. It isn’t standard, but it’s also not an emergency. It may be a suggestion to streamline processes. An incremental change is not a term used in change management. An emergency change will go straight to the change approval board (CAB), because it needs to be fixed now and waiting negatively impacts the organization.
27. B. Opening a power supply is not safe! Unless you have special training to work inside one, take the power supply to an electronics recycler. Power supplies contain several capacitors that can hold lethal charges long after they have been unplugged! It is extremely dangerous to open the case of a power supply. Besides, power supplies are relatively inexpensive. It would probably cost less to replace one than the cost of time to try to fix it and replacing it would be much safer. Only open a power supply if you have been specifically trained to repair them safely. You would not be testing capacitors inside the power supply.
28. B. Creating an acceptable use policy (AUP) is the most important part of dealing with prohibited content or actions. Without a policy set in place that specifically defines what is and what isn’t allowed, and what actions will be taken when a violation of the policy occurs, you don’t really have legal grounds to take action when a situation happens. What is in the policy depends on the company for which you work. A good policy will also contain the action steps to be taken if prohibited content or activity is spotted. Those actions may involve disciplinary action, terminating employment, or contacting law enforcement.
29. A, C. Both complete power losses and undervoltage events can damage computers and other electronic devices. Even when an undervoltage event goes unnoticed because your display doesn’t flicker or room lights dim, it can still be enough to shut down, restart, or damage a computer system.

- 30.** A. The Simple Protocol for Independent Computing Environments (SPICE) uses token authentication rather than passwords. If the token is lost or stolen, or programming is inadequate, then the system may be vulnerable. The Virtual Network Computing (VNC) method of remote access uses port 5900 and a display number, making it difficult to secure with firewalls that only allow a port number. Secure shell (SSH) and remote monitoring and management (RMM) are vulnerable when they are not patched and updated, or due to human errors like misconfiguration and inadequate passwords.
- 31.** A, B. Open-source software is usually free, but what makes it open-source is that the source code (i.e., code used by programmers) is also shared to encourage others to contribute to the future development and improvement of the application. Open-source software can't be sold, although it can be bundled with commercial products that are sold. Contrast open-source with commercial licenses, where you pay per user and can't modify the program except as allowed by the developer.
- 32.** D. Devices that attempt to keep power surges at bay are called surge suppressors. They often look like a power strip, so it's easy to mistake one for the other, but suppressors are more expensive. They have a fuse inside them that is designed to blow if it receives too much current and not to transfer the current to the devices plugged into it. Surge suppressors may also have receptacles for Registered Jack-45 (RJ-45, Ethernet), coaxial, and universal serial bus (USB), or other connectors. Uninterruptable power supplies (UPS) contain a battery backup to keep equipment running. Power strips are only used to turn multiple devices on or off together, and a battery backup is what people sometimes call a UPS, although UPSs often have many more features.
- 33.** A, B. Active listening means paying attention to your customers (eye contact is good) and taking notes. Allow them to complete their statements and avoid interrupting them. Don't do something else like texting or walking away while they are talking to you. People like to know that they are being heard and understood, and as simple an act as it is, paying attention to your customers can make all the difference in making them feel at ease with your work.
- 34.** C. Denatured isopropyl alcohol works well for cleaning connectors. Compressed air won't likely blow grime away. Electronic connectors of computer equipment should never touch water. Instead, use a lint-free swab moistened in distilled, denatured isopropyl alcohol (also known as electronics or contact cleaner and found in electronics stores) to clean contacts. You might have heard people say they use an eraser, but that could remove some of the soft gold from the contacts and damage the component, so don't use an eraser.
- 35.** A. The best device for power protection is called an uninterruptible power supply (UPS), also known as a battery backup. These devices can be as small as a brick or as large as an entire server rack. Inside the UPS is one or more batteries and fuses. Much like a surge suppressor, a UPS is designed to protect everything that's plugged into it from power surges. They are also designed to protect against undervoltage events and even complete power failures. Energy is stored in the batteries, and if the power fails, the batteries can power the computer for a period of time long enough, so that the administrator can then safely power it down. Voltage regulators are an electronic component found on some circuit boards. Surge suppressors and

power strips will not keep equipment running until it can be safely shut down or switched to an alternate power source.

36. C. Whenever working inside the case, always turn off the power and unplug the unit from the power source. The only exception to this rule is when troubleshooting a power issue and you need to leave the computer on to figure out the problem.
37. A, C. The muscles in the lower back aren't nearly as strong as those in the legs or other parts of the body. Whenever lifting, you want to reduce the strain on those lower-back muscles as much as possible. To do so, bend at the knees and lift with your legs. Also observe weight limitations and lift with a partner if needed. Better yet, lift with partner and use a cart to move items. Also, keep objects close to your body and at waist level to minimize bodily stress.
38. B. To use the electrostatic discharge (ESD) strap, you attach one end to your wrist with the supplied bracelet and the other to an Earth ground. Some ESD mats have a connector for the ESD strap. This strap and mat connection provides a safe path to ground for stray electrons (static). If you don't have an ESD mat handy, connecting the strap to a metal part of the case keeps you and the case at the same electrical potential, which will help to prevent you from accidentally damaging components with a jolt of static electricity. Never connect an ESD strap to the power supply, because it contains capacitors that can discharge and injure you. Some plastics develop a static charge, so connecting your ESD strap to a plastic table would more likely cause a static discharge than prevent one.
39. A, C. When supporting a large group of users, you're going to need either a corporate license or a concurrent license that permits at least the number of people you'll have accessing the software. A single-user license is good for only one user. You could buy a lot of single-user licenses, but that is generally more expensive than buying a corporate or concurrent license. Shareware generally does not require licensing, and payment may be handled via the honor system. But shareware is generally not a good choice for a corporate environment where you depend on the software. Some shareware will also specify that it is only free if used for personal use, but in a corporate environment, a fee must be paid.
40. B, C. If you can't find a way to reuse the equipment, be sure to dispose of it in compliance with government regulations. Most computers contain small amounts of hazardous substances, so they should be recycled by professionals who know how to deal with those dangers. Many municipalities, states, and countries have regulations in place specifying appropriate measures to enforce their proper disposal. Search the Internet for certified recycling programs near you. To donate equipment, overwrite or physically destroy the drive to ensure that the data remains private. Never put them on the curb for free, as you don't know where they (or any stray data on them) will end up.
41. A, C. You should always set expectations with the customer and then meet or exceed them. After resolving a customer's issue, follow up with them to ensure that they are satisfied with the services you provided. Your follow-up shows professionalism and may earn you future business. Never post online about a customer unless you have their permission first and calling them to ask if they have additional work for you makes you appear less professional.

- 42.** A. In difficult situations, it can be challenging to keep a level head. It's important to do so and to avoid arguing and becoming defensive. Remember that if a client had to call you, they're likely already having a bad day and may be frustrated. Sometimes, they will take their frustration out on you. Keep a level head and work to resolve the problem. Do not engage in an argument with them. Don't leave unless you feel in danger or your company policy states to do so. Don't tell the client to fix it themselves. If they could have, they would have done so.
- 43.** A. If you have your policy in place, then your incident response plan should be relatively scripted. Your first priority as the first responder is to identify the improper activity or content (which you have done). Then you should always get someone else to verify the material or action so that it doesn't turn into a situation of your word against someone else's. Remove the evidence from the offending person's possession, take steps to preserve the data or device, and immediately report the situation through proper channels, whether that's management or law enforcement. You would not shut down the computer or ask the user to delete the offending content, because doing so might destroy evidence. You certainly do want to preserve the data or device by locking it in a separate location, while being conscious of the order of volatility. Documenting the chain of custody and what happened is also required, but it's not what needs to be done next.
- 44.** D. When humidity gets to be very low, around 20 percent or lower, the risk of electrostatic discharge (ESD) increases. Remember that computer components can be damaged with very little voltage, even less than the shock you feel when you touch a metal doorknob after walking across a carpet. Always use ESD protection to prevent damage to components.
- 45.** D. If you have your policy in place, then your incident response plan should be relatively scripted. After identifying illegal content, you need to preserve that content. The method of preserving the data depends on exactly what format that data is in. For example, if the data is held in random access memory (RAM), you can't turn the computer off, because without power, it will no longer exist in RAM. If it is files on the storage drive, you could turn the PC off and remove the drive. In any case, the data or device should immediately be removed from the possession of the offending party and preserved. This will ensure that the data doesn't mysteriously disappear before the proper parties are notified.
- 46.** D. Personally identifiable information (PII) is anything that can be used to identify an individual person on its own or in context with other information. This includes someone's full name, address, and other contact information; the names of family members; and other details that people would consider private. PII should always be kept confidential and secure. Government-issued information includes data such as Social Security numbers, license numbers, passport data, and other government identifications. Be sure that this information is properly secured and can be accessed only by authorized personnel. There are rules and regulations for how this data can be stored, accessed, and used. This is known as regulated data.
- 47.** B, D. Freeware is an easy choice, because it's free. Open-source software is often also free, and you can modify the code free of charge as well (if you have the skills to do so). Some shareware is free, but it depends on the program. Single-user and corporate licenses generally cost money. The downside of freeware or open-source software is that there might not be sufficient support for it if you run into any difficulties.

- 48.** B, C. It is possible to damage a device by simply laying it on a benchtop. For this reason, you should have an electrostatic discharge (ESD) mat in addition to an ESD strap. The mat drains excess charge away from any item coming into contact with it. ESD mats are also sold as mouse/keyboard pads to prevent ESD charges from interfering with the operation of the computer. Many ESD wrist straps can be connected to the mat, thus causing the technician and any equipment in contact with the mat to be at the same electrical potential and eliminating ESD. Magnetic screwdrivers are not a good idea, because they could damage a computer chip if they inadvertently come into contact with it. A dehumidifier removes excess moisture from the air. The correct air moisture content for working on computer equipment is about 50 percent. In cold climates, you're more likely to need a humidifier, to add moisture to air, because too little moisture creates more static electricity. Too much moisture can cause components to corrode.
- 49.** A. When compressed air is used, particles of dirt and debris can become airborne, and be inhaled or get into your eyes. Always wear proper safety gear, such as safety goggles and an air filtration mask. In most situations, the other options would be unnecessary.
- 50.** B. A person's medical records and health information is classified as protected health information (PHI) (listed as Healthcare data on the CompTIA A+ objectives) and must be protected according to regulatory requirements such as the Health Insurance Portability and Accountability Act (HIPAA). A driver's license number and place of employment may be considered personally identifiable information (PII).
- 51.** A. A safety data sheet (SDS) is required for any chemicals that are sold and include information such as the physical product data (e.g., boiling point, melting point, flash point, etc.), potential health risks, storage and disposal recommendations, and spill/leak procedures. With this information, technicians and emergency personnel know how to handle the product as well as respond in the event of an emergency. The term material safety data sheet (MSDS) was replaced with the term safety data sheet in 2015, but you still see MSDS used on the CompTIA A+ exam and objectives. The Occupational Safety and Health Administration (OSHA) is a U.S. government agency that enforces safe working practices. Warning labels can be found on chemicals and equipment and may be required by local or national governments. It's unlikely that instructions can be found on the bottom of containers.
- 52.** B, C. Computers generally tolerate temperature and humidity levels about the same as humans do, except electronic devices do like it a bit colder. The general rule of thumb is room temperature or cooler, average humidity, and good ventilation.
- 53.** D. The first option should be a few quick blasts of compressed air to immediately blow out the crumbs and debris. If that first option does not work, then demineralized water should clean anything spilled on a keyboard. Bear in mind that when you use demineralized water, it will then take a few days to dry out the keyboard, and it shouldn't be used until it's completely dry. Isopropyl alcohol is used to clean electrical contacts, not keyboards, and a regular vacuum cleaner can introduce static, which can damage computer components, so don't use it!
- 54.** C. Four major classes of fire extinguishers are available, one for each type of flammable substance: Class A for wood and paper fires, Class B for flammable liquids, Class C for

electrical fires, and Class D (for metal powder or NaCl [salt]) for flammable metals such as phosphorus and sodium. The most popular type of fire extinguisher today is the multipurpose, or ABC-rated, extinguisher. It contains a dry chemical powder that smothers the fire and cools it at the same time. For electrical fires (which may be related to a shortened-out wire in a power supply), make sure the fire extinguisher will work for Class C fires.

55. D. Be on time, or five minutes early. If you're going to be late, be sure to contact your customer. Not doing so indicates that you think their problem isn't important. Don't simply show up late and assume that's okay. They may have other things scheduled. If they've been waiting around for you and you don't call them until later, they may have already called someone else for help.
56. D. Providing good customer service involves proper communication and professionalism. Clarifying the scope of the issue and verifying that you understand what isn't working are ways to show the customer that you're listening to them. Dismissing customer problems is never a good tactic. Neither is asking accusatory questions or telling them there are other things that are more important. Clarify the scope of the problem and ask clarifying questions to ensure that you understand what isn't working properly.
57. A, D. Both tablet computers and cell phones contain toxic chemicals such as beryllium, arsenic, and lead as well as rare-Earth metals that could be recycled. None of what is inside most electronic devices belongs in a landfill. The other two options arguably belong elsewhere as well, but may not be considered toxic, and are not devices.
58. C. One unique challenge when cleaning printers is spilled toner. Getting it wet by using mild soap and water or denatured isopropyl alcohol will make an inky mess. It sticks to everything and should not be blown into the air and inhaled—it's a carcinogen. Use an electronics vacuum that is designed specifically to pick up toner. A normal vacuum cleaner's filter isn't fine enough to catch all the particles, so the toner may be circulated into the air. Normal electronic vacuums may melt the toner instead of picking it up.
59. A. Extreme temperatures, either hot or cold, will negatively impact battery life. Batteries store best in cool (not frigid) temperatures. You might think that you should store it in a freezer, but that isn't good either because the freezer is likely a bit too cold, and they tend to have too much moisture. A closet is at room temperature, but someplace a few degrees cooler than room temperature and dry is the perfect storage area for a battery. You'll also want it to be about half charged when you store it, and bring it out periodically to charge and discharge, then store it again.
60. B. Enough electricity can hurt people, but tiny amounts can pose safety issues for computer components. One of the biggest concerns for components is electrostatic discharge (ESD). For the most part, ESD won't do serious damage to a person other than provide a little shock, like scuffing across a carpet then touching something metal. But little amounts of ESD, smaller than you could see a spark or feel a zap, can cause serious damage to computer components, and that damage can manifest itself by causing computers or components to hang, reboot repeatedly, or fail completely.

61. A. PowerShell uses the .ps1 filename extension. Linux-based Bash scripts use .sh, JavaScript uses .js, and Python uses .py.
62. B. Visual Basic scripts, which have a .vbs extension, are run on Windows platforms, so Notepad or WordPad would work to edit them, but the Linux/UNIX editors vi and nano would not be used to view a VB script. CoffeeCup is for editing HTML files.
63. D. Batch scripting, which uses the filename extension .bat, is typically a series of command-line commands. Such a script file would run on the Windows systems' command line. The other filename extensions—.js, .sh, and .py—are JavaScript, shell, and Python, respectively. They each require special additional software to be able to interpret the script.
64. A. JavaScript uses the .js filename extension. Java is a programming language. Juice is software to schedule the downloading of podcasts, and Joomla is a web development platform. Of the four choices, only JavaScript is on the CompTIA A+ exam, so focus on that programming language's file extension.
65. A. An internal service level agreement (SLA) is an agreement between different departments or locations of the same organization. An external/third-party SLA, for example, could exist between the IT department and another company that supplies computer hardware. A standard operating procedure (SOP) defines what actions will be taken when various incidents occur, such as a security incident, new hires, and procuring equipment. A knowledgebase (KB) is a repository of known issues with equipment or software and how to resolve them. A knowledgebase can be either a database or consist of articles, like the Microsoft KB.
66. B. Asset tagging hardware, like desktops and laptops, can help an administrator quickly know the details of a particular asset. Inventory management is more easily accomplished with asset tagging. Knowledgebase (KB)/articles are a repository of information about known issues and how to resolve them. A password policy defines requirements for passwords, such as complexity and how often they can/must be changed. They are enforced through group policies. Incident reporting should be part of a standard operating procedure (SOP) that defines what to do when something undesirable occurs.
67. B. Many software and hardware companies have extensive knowledgebases/articles to document issues that have occurred and how to resolve them. Chances are that if you're having an issue with hardware or software, someone else has encountered the same issue and documented it for you. Just ensure that the knowledgebase/article you use is from a reliable source. Individual organizations sometimes keep their own knowledgebases (KBs) as a part of their systems information management procedures. A change board is usually a group that approves of proposed changes as a part of project management. Change management policy describes the procedures to be followed if a major system change is needed. Brown bagging means bringing lunch from home.
68. D. Sandbox testing is setting up a system that mimics a production system to try the change in a safe environment *before* implementing it. The scope of the change identifies what it will and will not affect. A change board approval is the last step before a kickoff meeting to

initiate the change. Risk analysis should be a part of every project, with an identified risk level for each possible negative (or positive) event that might affect the project. The risk is assigned a score, and the risk level and response plans are identified so that if the risk is realized, there is a clear plan of action to handle it.

69. C. Every documented change should include the reason or purpose of the change. The reason can explain the justification to those unfamiliar with the situation before the change. The scope of the change documents what is affected by the change. The change board approval, arguably the most important part, documents the management's support of the change. Documenting what applications are not affected by the change is an unnecessary step.
70. B. A change freeze means that no new changes, or even excellent suggestions or solutions, will be implemented in a project. It often happens near the end of the project, or when systems must be stable, such as entering a busy season. The rollback plan documents the actions to take, in the event that the change must be stopped for some reason, once the process has begun. A risk analysis is performed to assess any deviations to a plan, whether good or bad, and assign them a risk number. Some risks will have contingency plans created as a part of the risk analysis. End-user acceptance isn't necessarily documented, but it means that the change is welcomed, agreed upon, and supported by end-users. End-user acceptance is important to the success of any major change that affects how the end-users do their job, and there are actions that can be taken to help ensure end-user acceptance, such as including end-users in the planning process and explaining in detail why a change affecting them must be made.
71. A. The greatest backup procedures in the world will not help if your backups are not reliable. Backups must be tested on a regular basis to ensure that they can be restored if the need ever arises. You will most certainly want a documented checklist to follow in the backup and recovery process. End-user acceptance is not what you would do next. Approval of the policy/procedure may be required, but again, it isn't the next thing you would do.
72. C. Depending on the disaster, the question of off-site cloud storage versus local storage backups can significantly affect the success of recovery. For example, for a server hardware failure or a recent malware incident, local storage provides adequate security of backups. However, a catastrophic collapse of the building could mean local storage is not accessible.
73. D. Inventory lists are a feature of asset management, not ticketing systems. On the initial call, a user would typically gather information about the user, such as their name and contact information, the device that has an issue, and a description of the issue.
74. B. Whenever you're planning a change to a business system, you need to have a plan set in place to return to the old system if the planned change doesn't work out as expected. The plan to revert to the old system is known as a rollback plan. Sandbox testing is done before implementing changes to ensure that the changes will work. Request forms happen at the beginning of change management, and risk analysis examines whether to proceed with the change.
75. C. A full backup creates a copy of all files whether or not their archive bit is set. An incremental backup will back up files that have changed since the last backup was made.

Incremental backups and full backups reset the archive bit. Differential backups will back up all changes since the last full or incremental backup was performed. Differential backups do not reset the archive bit.

76. B. When using full backups and differential backups to restore a system, you'll need the last one of each to recover all the data. Each differential backup is larger than the one before, because it includes the cumulative backup of all the changes that have happened since the last full backup. The differential backups are slower to create than incremental backups but restoring them is easier because there are fewer datasets to restore.
77. A, D. Incremental backups are created faster over time than differential backups. If each weekday the same number of files were changed, an incremental backup on Wednesday would only take one-third as long as a differential backup, because the differential backup would have Monday, Tuesday, and Wednesday's changes. The Wednesday incremental backup would only have Wednesday's changes. Differential backups are easier to restore, because you would only restore the last full backup and the most recent differential backup. Incremental backups are less fault tolerant than differential, because there are more possible points of failure in the form of a greater number of backups, which would need to be restored to achieve the same result as a differential backup. Say your procedure is to perform a full backup each Sunday, and daily backups each night, then you discover on Thursday morning that your system crashed. If you needed to restore from incremental backups, you would have four backups to restore (i.e., Sunday, Monday, Tuesday, and Wednesday), whereas using differential backups would only require restoring two (i.e., Sunday and Wednesday).
78. A. Static sensitive components should be stored in (not on) antistatic bags. If possible, use protective packaging that came with them. They should not be stored in plastic bags or on plastic shelves because most plastics gather static. The exception would be shelves that are specifically made to be static-free. Expansion cards should never be stacked on top of each other, because doing so could damage or dislodge chips on the card. If you must store several of them, put each in its own box or a divided box made for that purpose. Antistatic bags are made to keep static on the outside of the bag, like a mini-Faraday cage, so placing sensitive components on an antistatic bag is like asking for trouble.
79. C. If you were moving a laser printer more than from one room to another, you would certainly want to check the manufacturer's recommendations for moving the equipment. But whenever you are moving a laser printer, it's important to remove the toner cartridges first. The cartridge may get jostled during the move and toner spilled inside the machine, which would create a hazardous situation for both you and the machine. Laser printers don't have printheads like inkjet printers do. The stapler assembly should be fine but again check the manufacturer's documentation. Removing the paper is likely not necessary.
80. B, C. Computers will shut down when the central processing unit (CPU) has exceeded an acceptable heat level. Components may start acting strangely as well if they are too warm. Not only is the ambient temperature too warm, but by wrapping it in plastic, the computer lacks the necessary airflow to keep the components from overheating. They may need to move this computer to a cooled, protective enclosure.

- 81.** A, C. When retiring equipment, there should be a checklist of things to do. First and foremost, ensure that there is no confidential data on the equipment, then remove it from the asset management inventory list. You could then donate or recycle it. A sandbox is a testing area that is set up like your production systems but separate from them and used when testing a new configuration, software, or process. You would not install the new software update on this machine. If anything, this machine would be restored to the factory default.
- 82.** A, D. If you're in a lead role where you meet with clients in larger businesses, you will likely want to dress in business formal attire, which would include matching suit coat and pants or skirt and a tie, if appropriate. Business casual attire for many techs is the familiar khaki pants and polo shirt, but it's not what you would wear to impress a potential new client.
- 83.** A, C. You need to provide the customer with the proper documentation according to your company, but usually this will include a description of the problem, when and how long you were there, and a "big picture" description of what was done. You also need to call them a few days later, to ensure that they are still happy with the service they received. You would not tell them to call you directly and you'll charge less, or you probably wouldn't have a job for long. You also would not leave without talking to the customer. Ideally, have them test the changes that you've made to ensure things are working well for them.
- 84.** A. As a technician you'll probably come into contact with all sorts of confidential or privileged information, whether it is the business files on someone's computer or their personal photographs and documents. You do your best to mind your own business, but sometimes you're going to see things. Unless it's illegal or you're bound by company policy to report it, ignore it. Forget that you saw it and don't talk to anyone about it. You're there to do a job. That's all.
- 85.** C. A full backup that is created from a prior full backup and one or more incremental backups is known as a synthetic full backup. The advantages are that it takes much less time to create a backup because you only need to perform incremental backups, and if you must restore from a backup, it takes less time because you can always have a full backup. Incremental only backs up what has changed since the last incremental or full backup, and differential backs up whatever has changed since the last full backup. Differential backups don't reset the archive bit, but full backups and incremental backups do. A grandfather-father-son (GFS) backup is a long-term backup where there are father and son backups between the times that the grandfather backups are made. The GFS strategy is often used where a daily backup is called the "son," the weekly backup is the "father," and the monthly backup is the "grandfather." Consider, for example, that you lost all your data on the second Tuesday of the month. If the "father" and "son" backups were incremental, and the "grandfather" is a full backup, to recover all of the data, you would restore the grandfather for the end of the prior month, the first "father" backup, and the "son" backups up to the day the data was lost.
- 86.** B. In an ideal world, it would be great to test the backup for integrity after every backup, but that would be prohibitive in terms of the time it would take. They should be tested often, at least once a month but more often if you are able, and certainly after something significant has changed in a system. You would also want to ensure that you have a good backup before you make those big changes.

- 87.** D. You would not want to wear business formal, which is a suit and dress shoes, if you're running wires. You also don't want to be so casual that you look unprofessional. Here, business casual is more appropriate. For some companies, it's a polo shirt with a company logo and casual pants, but exactly what business casual means will depend on the policies of your company. For many technicians, it's nice jeans or casual pants and a button-up shirt or a sweater, not a dress shirt, but also not a T-shirt or hoodie. Many companies will have attire with their logo that they prefer you wear. Sometimes, IT techs get dirty.
- 88.** A. In the United States, the Occupational Safety and Health Administration, which is known as OSHA, oversees workplace safety and enacts rules that companies must abide by, including training workers on working safely. If the company fails to make changes after an OSHA inspection, OSHA has the option to close them down. The National Electrical Code (NEC) is a document that was developed by the National Fire Protection Association (NFPA) for wiring and building buildings that are safe. Their rules have been adopted by all 50 U.S. states as a part of their building code. FEMA, which is the Federal Emergency Management Agency, helps in the event of natural disasters, and the IRS, or Internal Revenue Service, is responsible for collecting income taxes.
- 89.** D. The 3-2-1 backup rule states that you need three copies of data, on two different media, with one of them being off-site. Grandfather-father-son (GFS) is a rotation scheme for backup media. The rule of 78 is an accounting rule used to calculate interest payments, and there is no common rule called the on-site/off-site backup rule.
- 90.** C. A virtual network computer (VNC) allows a user to manipulate a computer remotely. Some VNC systems allow a smartphone to control a computer remotely, and some allow for file transfer but not all. Windows Remote Desktop, which uses the Remote Desktop Protocol (RDP), is a type of VNC that is part of the Windows operating system (OS). Remote monitoring and management (RMM) is a category of software used by managed service providers to remotely manage, configure, and control the resources of many different networks. A VPN allows a user to be away from their office, such as a remote worker or traveling salesperson, and connect to the company server or other resources with their laptop or other mobile computer as if they were in the company offices. Microsoft Remote Assistance (MSRA) could not be used, as it would require someone at the home computer to send the invitation.
- 91.** D. Until (or unless) they invite you to wear casual attire, you should dress in business formal attire. Even though they are a casual company, you still need to project a professional image, especially for a first meeting.
- 92.** B. Regulatory compliance means that you're following all the laws that pertain to your company and its locations. These laws can be local, state or provincial, federal, or even international laws. Being out of compliance with government regulations can result in fines, company closure, or even jail time. Disobedience would be the opposite of compliance. Information technology governance means that the structures, processes, and actions of a company's IT department are in line with the overall goals and objectives of the company. Information security is ensuring the confidentiality, integrity, and availability (CIA) of an organization's information.

- 93.** A. Grandfather-father-son (GFS) is a rotation scheme for backup media. For a typical small business, the “son” backups would be labeled Monday, Tuesday, Wednesday, and Thursday. Seven days later, they are then overwritten. Each Friday a “father” backup is made, so there would always be four or five father backups, which would be overwritten a month later. The grandfather backups are made only once a month, so they won’t be overwritten for a year. The 3-2-1 backup rule states that you need three copies of data, on two different media, with one of them being off-site. Moore’s law says that technology doubles every two years, and there is no common rule called the on-site/off-site backup rule.
- 94.** B. The Health Insurance Portability and Accountability Act (HIPAA) is a U.S. law protecting personal health information (PHI) privacy, and there are similar laws in many other countries. The requirement to keep information for a period of time is called a data retention requirement. PHI is only one of the many types of regulated data that may affect an IT department, their processes, and the data that they are responsible for. IT governance has to do with keeping the objectives of the IT department in alignment with the goals and objectives of the organization as a whole. Grandfather-father-son (GFS) is a popular backup media rotation scheme, and a license agreement is a contract between you and the software company that is granting you a license to use their software.
- 95.** A. Remote monitoring and management (RMM) is a category of software used by managed service providers (MSPs) to remotely manage, configure, and control the resources of many different IT networks. A virtual private network (VPN) allows a user to be away from their office, such as a remote worker or traveling salesperson, and connect to the company server or other resources with their laptop or other mobile computer as if they were in the company offices. A virtual network computer (VNC) allows a user to manipulate a computer remotely. Some VNC systems allow a smartphone to control a computer remotely, and Remote Desktop, which uses the Remote Desktop Protocol (RDP), is a type of VNC that is part of the Windows operating system (OS).
- 96.** D. Personal-use software is sometimes distributed free to individuals in the hope that they will like it so much, that they will be willing to pay for premium features or purchase corporate licenses for their place of business. Some of these licenses allow users to make and distribute free copies of the software to their friends so that they can try it too. Most will not allow them to bring it into their company without paying for it, nor allow them to sell it. Exactly what you can do with any software that is licensed to you as an individual is covered in the end-user license agreement (EULA) that you agreed to when installing or downloading the software.
- 97.** B. Digital rights management (DRM) means using technology to protect the copyrighted material created by artists and others from being stolen. Musicians, programmers, movie makers, authors, and so on sometimes put immeasurable hours and great expense into creating their work. To keep others from stealing it, they can use technology to control the number of people who can access content, or sharing, printing, saving, and so on. Some DRM software can limit access to information based on IP addresses or even cause watermarks to appear when someone tries to print a document or image that they don’t have the right to print.

- 98.** A, C, D. Occasionally scripts have unintended results when they run. They can include, but are not limited to, unintentionally introducing malware, inadvertently changing system settings, or causing browser or system crashes because they are using too many resources. These occasional mistakes are far outweighed by their uses, such as remotely installing applications, installing updates, automating backups, and restarting machines, just to name a few.
- 99.** A, B, C. Windows Remote Management (WinRM) enables a network administrator to manage remote systems over port 5985, using hypertext Transfer Protocol (HTTP), or port 5986, using Hypertext Transfer Protocol Secure (HTTPS). They can configure, manage, and gather management information using WinRM. Remote Desktop, which uses the Remote Desktop Protocol (RDP), is used to control a remote computer as if you were sitting at it. It can be used on the same network or over the Internet. Secure Shell (SSH) is both a protocol and suite of tools for an administrator for the secure remote management of networked resources. Remote monitoring and management (RMM) is a category of software used by managed service providers to remotely manage, configure, and control the resources of many different networks.
- 100.** B. Creating a private artificial intelligence (AI) system instead of publicly available AI will likely cost a company more, in terms of time and cost to implement. The advantages to developing a private AI are all related to the data. A private AI system lets you choose what data will be included, control the data's security, and choose who has access to the data, keeping the data private rather than publicly available. This may even include maintaining regulatory compliance when the information includes personally identifiable information (PII) or medical information.
- 101.** C. If you fail to comply with government regulations, there are usually severe consequences. Not only fines and fees, business shutdown, or possible jail time, but if a failure to comply with rules meant that someone's health data was hacked, for example, the cost could be measured in lives lost.
- 102.** B. While it is important to maintain records of your software licenses, the way that licensing data set is stored, moved, and used is not regulated. Credit card payment information, healthcare data, and personally identifiable information (PII) all have industry and/or governmental rules about what happens to that data. Said data is worth far more than the hardware that it resides on, so ensuring the confidentiality, integrity, and availability (CIA) of that information is a primary concern of any IT department. Often regulated data will be concerned with not only how it is used, but also how it is stored (data-at-rest), and how long it is stored, how it is moved (data-in-transit) and how it is protected.
- 103.** D. Videoconferencing software has been around for a long time. It enables people who might be on the other side of the world to take part in the same meeting, seeing the other attendees and participating in discussions. Some types of videoconferencing software allow screen sharing as well. Screen-sharing software enables you to show others a window, your entire desktop, or a section of it (such as an application window). File transfer software enables the secure and quick transfer of large files from one system to another remote system. Desktop management software is any software that allows you to manage multiple desktops remotely, often on different platforms.

- 104.** A. A filename with an `.sh` extension indicates that this is a script for Bash, which stands for Bourne-Again Shell. The other file extensions—`.py`, `.vbs`, and `.ps1`—are used in Python, Visual Basic, and PowerShell, respectively.
- 105.** C. Tracking valid licenses is a part of asset management, not a ticketing system. It is very important that the issue's description, progress notes, and resolution be written in clear concise language so that anyone who reads them in the future will be able to understand what transpired.
- 106.** B. A request form is used to initiate the change management process. Risk analysis and a report of the affected systems and the impact on them is part of the document that is presented to the change board for their approval before the change can be implemented.
- 107.** A. End-user acceptance is a desirable result of meeting with and including end-users in the decision-making process of change management. It is a desired result, not necessarily a part of the documentation. The responsible staff member(s) needs to be listed in the documentation, along with a person who will be a champion for the project, meaning someone in a position of power who supports the change and who may or may not be listed as a responsible party. A careful analysis of the affected systems and the impact the change will have on them must be included. The change document also must include the scope of the change, which is an explanation of what will and will not be changed and how far-reaching the project is.
- 108.** C. Batch files, Visual Basic, and PowerShell are all examples of scripting programs. They have many uses and are used daily by network administrators to facilitate network management. Remote monitoring and management (RMM) is a type of remote access technology. Screen-sharing software lets the user show their screen to people who are working with them remotely. Remote access technologies is a general term that encompasses any software that enables someone to access a computer system located in another place.
- 109.** D. Every ticket in a Help Desk ticketing system should include the category of the issue, its severity, and any escalation levels that were used. The procurement lifecycle is a part of asset management.
- 110.** B. The aim of change management is to control change in such a way that it continues to move the organization forward with as little disruption as possible to the employees and IT processes of the organization—to affect change without causing any adverse results or negative effects to the company's bottom line. Asset management is maintaining documentation on a company's IT assets. Ticketing systems allow for tracking of support issues and results, and knowledgebases and articles provide a wealth of information for resolving IT problems that have been previously encountered.
- 111.** C. A configuration management database (CMDB) system, assigned users, and warranty and licensing, are all a part of asset management records. The procurement lifecycle is also a part of asset management, and it starts with identifying a business need for what is being purchased. The exact steps might vary by company and be different for government entities, but they often include vendor analysis, request for information (RFI), request for proposal (RFP), and request for quote (RFQ) before a decision is made regarding what vendor to use and what specific products to purchase.

- 112.** C. A part of every project should be a risk analysis with an identified risk level for each possible negative (or positive) event that might affect the project. The risk is assigned a score, known as the risk level, and response plans are identified so that in the event that the risk is realized, there is a clear plan of action on how to handle it. The scope of the change identifies what it will and will not affect. A change board approval is the last step before a kickoff meeting to initiate the change. Sandbox testing is setting up a system that mimics the production system in order to try the change in a safe environment before implementing it.
- 113.** B, C. It's easiest to onboard and offboard employees if you have a checklist to follow. The checklist can include items such as adding the employee to security groups based on their department or job title and ensuring that their user account is disabled when they leave. An incident report should be filed whenever an IT employee observes a breach of protocol regarding acceptable use, or whenever someone is injured. Splash screens are a way to ensure nonrepudiation (i.e., the idea that someone cannot deny the authenticity of a message or signature) of agreement to company policies each time a user logs on to a company computer system.
- 114.** A, C, D. Avoid distraction and/or interruptions when talking with customers. You need to make them feel that their problem is important and that it has your full attention. Distractions can include personal calls, texting, social media, talking to coworkers, and other personal interruptions. Listening, taking notes, and asking appropriate questions are all part of good customer service.
- 115.** D. Procedures for custom installation of software packages should be spelled out in a standard operating procedures (SOP) document. This should also be a part of an acceptable use policy (AUP). The checklists for new-user onboarding and user offboarding will help ensure that all necessary steps take place, and a configuration management database (CMDB) provides a record of how devices are configured and relate to each other and is used in proving compliance and making management decisions.
- 116.** C. Keeping track of technical jargon used by your company is not a part of inventory management or compliance, and most likely not done. Valid licenses are those that are not void for any reason, such as using a personal license for corporate use, having more users than are allowed by the license, or using a software with a license that has expired. Software licensing can be so complicated that there are companies who make their living ensuring that other companies are compliant with licensing agreements. Even open-source licenses that are used by a company should be documented, and a periodic accounting of all software on all computers should be performed to ensure that the company is compliant with licensing laws and agreements. Inventorying the software used by your company is just as important as keeping an inventory of the hardware.
- 117.** D. One of the great features of open-source software is that you are allowed to modify the software code to meet your needs. The other three options for this question—using software licensed for personal use in a corporate setting, using more copies or having more users than the license allows, and using software whose license has expired—are all invalid uses of software and may subject you or your company to fines or even jail time. It's very important to keep an inventory of your software and valid nonexpired licenses and where

they are being used. You should do at least an annual accounting of all the software being used on all the computers in your organization.

- 118.** A. An incident report should be filed whenever an IT employee observes a breach of protocol regarding acceptable use, or when someone is injured and should be a part of the organization's standard operating procedures (SOPs). It's easiest to onboard and offboard employees if you have a checklist to follow. The checklist can include items such as adding the employee to security groups based on their department or job title and ensuring that their user account is disabled when they leave. Splash screens are a way to ensure nonrepudiation of agreement to company policies each time a user logs on to a company computer system.
- 119.** C. A standard operating procedure (SOP) defines what actions will be taken when various incidents occur such as a security incident, new hires, and procuring equipment. A configuration management database (CMDB) keeps track of how devices and user accounts are configured, can serve as a part of proving compliance, and can be used as a tool in managing computer purchases and such. IT asset management (ITAM) is the process of keeping track of assets, such as tagging them and keeping inventory and where each asset is located. A knowledgebase (KB) is a repository of known issues with equipment or software and how to resolve them.
- 120.** C. This is an emergency change and will go straight to the change approval board (CAB) because it needs to be fixed now and waiting negatively impacts the organization. A standard change is something that happens frequently and can be planned for. Companies can create a list of preapproved/predefined changes that are considered standard, like replacing pickup rollers in a printer. A normal change is one that goes through the entire change process. It isn't standard, but it's also not an emergency. It may be a suggestion to streamline processes. An incremental change is not a term used in change management.
- 121.** B. The plan described is a backout plan, which is listed as a backup plan in the CompTIA objectives. A backout plan is a step-by-step list for IT departments to follow, so they can restore a system to the state it was in before a change, whether planned or unplanned, occurred. While rollback and backout plans are similar, the difference is that a rollback is considered, planned, and tested ahead of time for a specific planned change, while a backup/backout plan can encompass a rollback plan but also has steps to recover from unexpected issues/changes.
- 122.** D. The toner itself is a carcinogen, and toner cartridges can contain heavy metals that are bad for the environment. PC recycling centers will take old toner cartridges and properly dispose of them. Most toner cartridge manufacturers will also take them back for recycling.
- 123.** A. This is a normal change. A normal change is one that goes through the entire change process. It isn't standard, but it's also not an emergency. It may be a suggestion to streamline processes. Incremental change is not the type of change used in change management; it is a type of backup. An emergency change will go straight to the change approval board (CAB) because it needs to be fixed now, and waiting negatively impacts the organization. A standard change is something that happens frequently and can be planned for. Companies can create a list of preapproved/predefined changes that are considered standard, like replacing pickup rollers in a printer.

- 124.** A, D. Parts of a typical change management plan include a rollback plan, which is part of a backout/backup plan, sandbox testing, responsible staff member, request forms, purpose of the change, scope of the change, data and time of the change, affected systems/impact, risk analysis, peer review, implementation schedule, and change board approval. Incremental change isn't a type of change management and neither is backstage testing. Hopefully when all is said and done, your change will have end-user acceptance.
- 125.** B. Parts of a typical change management plan include a rollback plan, which is part of a backout/backup plan, sandbox testing, responsible staff member, request forms, purpose of the change, scope of the change, data and time of the change, affected systems/impact, risk analysis, peer review, implementation schedule, and change board approval. Incremental change isn't a type of change management and neither is backstage testing. Hopefully when all is said and done, your change will have end-user acceptance.
- 126.** D. End-user acceptance is when people who will actually be using the changed systems give their stamp of approval. Usually, a small implementation of a change is used to test the change among users. Getting end-user acceptance of a change is critical to ensure that the change will be followed and work as expected. Risk analysis lists all the issues, good or bad, that could occur during a change and assigns a risk level for each and a contingency plan for the risks that need them. Peer review happens early in a plan when the change is examined by another technical person at the same level, to ensure that the plan will meet the established goals and is in alignment with company goals, as well as whether the plan will work. Sandbox testing is creating a mockup of the system changes in an isolated setting and testing them before the changes go live to ensure that they will work as expected.
- 127.** B. A maintenance window is a scheduled time when changes can be made to a system, without affecting the system's users. Often for standard changes, this is during the evening or weekend hours. Risk analysis lists all the issues, good or bad, that could occur during a change and assigns a risk level for each and a contingency plan for the risks that need them. Sandbox testing is creating a mockup of the system changes in an isolated setting and then testing them before the changes go live, to ensure that they will work as expected. Peer review happens early in a plan, when the change is examined by another technical person at the same level, to ensure that the plan will meet the established goals and is in alignment with company goals as well as whether the plan will work.
- 128.** C. When you're restoring files from a backup to a place that they didn't come from, this is restoring them to an alternative location. The other type of restore from a backup is an in-place/overwrite location, which means that you're placing the files back where they originally were. Incremental and differential are types of backups, not restores.
- 129.** C, D. Working safely should always be your priority. Using an approved power strip to temporarily add an outlet to an area is the best of the options given, but you could also run an extension cord across the floor if it's covered with a pedestrian cable cover designed to prevent people from tripping on the wire. This is good cable management. Cables should never be run across a walkway, even for a minute. That presents a tripping hazard. Likewise, they should never be run through the air where someone walking through could run into them and get hurt.

- 130.** A. Although you want to move the computer to a secure place, it's important not to turn it off until evidence has been gathered from it, because some of that information will disappear as soon as the computer is turned off. (It's volatile.) Always gather evidence from most volatile to least. Following is the order of volatility, from most to least.
1. Cache, Central Processing Unit (CPU) registers
 2. Routing and process tables, Address Resolution Protocol (ARP) cache, and kernel statistics
 3. Random access memory (RAM)
 4. Swap file or other temporary file systems
 5. Storage drives (i.e., Hard Disk Drives (HDD), Solid-State Drives (SSDs), M.2 drives, flash drives, and so on
 6. Remote data such as logging and monitoring systems
 7. Archival media (such as backup drives and tapes), physical configuration and network topology information, and your notes on the incident
- 131.** C. A mutual non-disclosure agreement (MNTA) is used when both parties want legally protect their confidential or proprietary information from being shared by the other party. An acceptable use policy (AUP) states what you may and may not do with company equipment. A non-disclosure agreement (NDA) is a signed document stating what you may not reveal about your partner companies and their business dealings. A bring your own device (BYOD) policy states whether you may use your personal device for business purposes and under what conditions.
- 132.** C. Open-ended questions are those that allow the end-user to explain what's happening, and they're a great way to determine the next question to ask, or where to start looking for the offending issue. Close-ended questions require yes or no answers and are helpful in certain situations, after you've let the user explain the issue. Going directly to the computer without asking the user anything is not only rude, but not the most productive way to solve a problem. Even if the user caused the problem, they probably don't know how or they might have been able to fix it without calling you.
- 133.** B. Python uses a .py extension. Batch scripting, which uses the filename extension .bat, is typically a series of command-line commands. Such a script file would run on the Windows systems' command line. JavaScript uses a .js file extension, and Shell uses a .sh extension.
- 134.** D. Simple Protocol for Independent Computing Environments (SPICE) is open-source and free, designed specifically for remote access on a local area network (LAN) or wide area network (WAN). JavaScript is a programming language. Linux is the basis for many open-source operating systems (OSs), and macOS is a commercial OS that is most definitely not open-source.
- 135.** A, B. The most common problems that come up when researching the Remote Desktop Protocol (RDP), virtual network computing (VNC), remote monitoring and management (RMM), Windows Remote Management (WinRM), and virtual private networks (VPNs) are misconfiguration and inadequate passwords. Requiring multifactor authentication (MFA) and enforcing strong passwords can help, along with role-based access control (RBAC), monitoring logs, and encrypting data.

- 136.** B. The virtual network computing (VNC) method of remote access uses port 5900 and a display number, which makes it difficult to secure with firewalls that only allow a port number. The Remote Desktop Protocol (RDP) has been compromised with dynamic link library (DLL) hijacking, and Secure Shell (SSH) and remote monitoring and management (RMM) are vulnerable when they are not patched and updated, or due to human errors like misconfiguration and inadequate passwords.
- 137.** D. When talking with customers, it's important to remember that they don't have the training that you do, so they won't understand all the terminology that technicians use. Describe the situation in terms that the user will understand, but don't be condescending. Never use jargon, acronyms, or slang terms, even if they are commonly used with your peers. It takes practice to put complex concepts in simple terms, but your customers will appreciate it. More tech-savvy customers will usually let you know that they understand and you can use more advanced terms with them as needed.
- 138.** A. Application integration occurs when artificial intelligence (AI) capabilities are added to an existing application. The other three terms are not related.
- 139.** A, B, D. Common limitations of artificial intelligence (AI) are bias, hallucinations, and accuracy. Manifestations is not a limitation of AI. Bias can occur due to the data that is used to train an AI system or poor programming. Once learned, a bias can be exacerbated by an AI system. Hallucinations are when AI output seems factual, but in fact, is not. They can be caused by limited or outdated data sets or programming error, which causes an AI system to interpret (i.e., put together) information inaccurately, providing an incorrect output. Accuracy is one of several metrics used to determine an AI system's performance. It's a measure of how often the AI returns correct answers.
- 140.** A, B, D. A configuration management database (CMDB) system stores information about the relationships between key components of an IT infrastructure and how they are configured. This can include router configuration information, networks and interrelationships, and warranty and licensing information. It can even include people. It is not asset management, which is more concerned with acquiring, monitoring, and disposing of assets. The size of the database depends on the size of the company and what the company determines should be included. In general, it helps to track compliance and make management decisions.
- 141.** C, D. Plagiarism occurs when you take credit for someone else's work. This is true even if the "someone else" is an artificial intelligence (AI) program. Using an AI rephrasing tool to rephrase what AI or someone else has generated is also plagiarism. There are ways to use AI that are perfectly acceptable, such as using AI to check your grammar or to point you to websites about what you're looking for. Remember to cite any sources whose ideas you use.
- 142.** B. A virtual private network (VPN) allows a user to be away from their office, such as a remote worker or traveling salesperson, and connect to the company server or other resources with their laptop or other mobile computer as if they were in the company offices. This is accomplished using tunneling protocols. It differs from a virtual network computer (VNC) in that the VNC allows a user to manipulate a computer remotely. Some VNC

systems allow a smartphone to control a computer remotely. Remote monitoring and management (RMM) is a category of software used by managed service providers to remotely manage, configure, and control the resources of many different IT networks, and Remote Desktop, which uses the Remote Desktop Protocol (RDP), is a type of VNC that is part of the Windows operating system (OS).

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1. D. Solid-state drives (SSDs) have many advantages over hard disk drives (HDDs), including producing less heat, retrieving data faster, and being less susceptible to damage from shock or overheating. However, they are more expensive per gigabyte.
2. B. There are many benefits to using a stylus with your touchscreen computer. Using a stylus can aid artists in being more precise in their art than is possible using fingertips. Styli are more sanitary than fingers and don't leave behind the oils that your skin would on the touchscreen. Their use makes it easier to create handwritten notes than simply using your fingers. Not every stylus is compatible with every touchscreen, so you must know what kind of touchscreen you have to ensure that your stylus is compatible with it. Most touchscreens are capacitive, which means that the stylus must be constructed so that it will interrupt an electrostatic field. Resistive screens only register pressure and are better for uses such as making lines darker in a drawing program. Almost any material can be used to make a stylus. A stylus can connect via a USB port or wirelessly using Bluetooth.
3. A. Fluorescent lighting, and liquid crystal display (LCD) backlights in particular, require fairly high-voltage, high-frequency energy. The component that provides the right kind of energy is the inverter, which is a small circuit board installed behind the LCD panel that takes direct current (DC) and inverts it to alternating current (AC) for the backlight. An inverter is not needed in a display that uses LED backlighting because LEDs use DC just like motherboards do.
4. C. The CompTIA A+ exam objectives list these steps for connecting Bluetooth devices as follows:
 1. Enable Bluetooth.
 2. Enable pairing.
 3. Find a device for pairing.
 4. Enter the appropriate personal identification number (PIN) code.
 5. Test connectivity.
5. D. Location services on your device may use the global positioning system (GPS), which relies on satellites, Bluetooth, Wi-Fi, or cellular location services to determine your approximate location. Location services can be enabled, disabled, or conditionally enabled for different apps on your phone that need the service to function properly. Airplane mode turns off all network connectivity.

6. A, D. Protocols are either connection-oriented, meaning they will guarantee delivery, or connectionless, meaning they will not guarantee delivery. Connectionless protocols are used for activities such as streaming, where a missing packet here and there is less important than continuing to send the information. Connection-oriented protocols are used when it is important that each packet arrives. Some connection-oriented protocols are Transmission Control Protocol (TCP), Hypertext Transfer Protocol Secure (HTTPS), and Secure Shell (SSH) Protocol, whereas User Datagram Protocol (UDP), Dynamic Host Configuration Protocol (DHCP), and Trivial File Transfer Protocol (TFTP) are examples of connectionless protocols.
7. A. File Transfer Protocol (FTP) uses ports 20 and 21. Port 22 is used by Secure Shell (SSH), port 23 is/was used by Telnet, and port 25 is used by Simple Mail Transfer Protocol (SMTP). Note that Telnet is insecure and has been deprecated.
8. B, D. A unified threat management (UTM) appliance is a single device on your network that provides multiple security functions. It is usually placed between the outside world and the local area network (LAN), so it can function as a gateway as well as a security appliance. A proxy server can be a very powerful force for good on your network. Proxy servers can be a firewall blocking traffic based on port number. They can also inspect packets for objectionable content or malware. They can even work as a cache for frequently visited websites, and because all traffic goes through the proxy server into and out of your network, they are the default gateway. A spam gateway is software that is used for filtering spam out of email. A load balancer appliance is used in an environment where there are multiple servers to distribute the workload across those servers instead of it all going to one.
9. D. The FF00::/8 range in IPv6 is for multicasts. Remember that IPv6 does not use broadcasts. The closest IPv6 gets is the use of multicast addresses. The ::1 is the loopback address for IPv6. IP addresses that begin with 2001 are in the global unicast range, meaning that they are routable on the Internet, and the first 64 bits identify the network. Any number that starts with FE80 is non-routable and is called a link-local address.
10. C. A personal area network (PAN) is a small-scale network designed around one person within a limited boundary area. The term generally refers to networks that use Bluetooth technology. A local area network (LAN) connects devices in a small area, such as a house or business or a single floor in an office building. A wide area network (WAN) covers a very large geographic area, traversing many roads or areas not owned by the entity, and it may use leased lines. The Internet is a worldwide WAN, but a WAN can also connect a single company with offices in New York, Chicago, and D.C., for example. A metropolitan area network (MAN) connects devices in a smaller geographic area, such as a city or community.
11. A. A wireless locator or a Wi-Fi analyzer can be either a handheld hardware device or specialized software that is installed on a laptop or smartphone, and its purpose is to detect and analyze Wi-Fi signals. A loopback plug is used to test a network interface card (NIC). A toner probe (or tone generator and probe) is used to find a wire out of a bunch of wires or to figure out where the wire runs. A multimeter has many uses, among them is testing for continuity, checking power supplies, and checking electrical wall outlets.

- 12.** C. The image shown is a high-definition multimedia interface (HDMI) cable. HDMI carries audio and video signals in a digital format. A DisplayPort connector is angled on one side, not both. DisplayPort connectors are intended for video only but can also carry audio signals. DisplayPorts provide a digital connection. A digital video interface (DVI) connector is rectangular with 24 pins on the left side in eight rows of three, and four pins on the right, arranged in a square. By definition, a DVI is digital, but there are DVI-A connectors that are analog, and integrated DVI (DVI-I) connectors that are both analog and digital, whereas DVI-D connectors are strictly digital. The number and arrangement of pins changes, depending on which type of DVI connector is being used. A video graphics array (VGA) connector has a total of 15 pins arranged in three rows. VGA is strictly video and transmits only an analog signal.
- 13.** A, C. There are several reasons that paper might jam in a laser printer: if you buy the least expensive paper and it's the wrong weight or coating for the printer, debris in the paper path such as dust and pieces of paper, paper with wrinkles or bent corners, too much humidity causing sheets to stick together, and worn paper feed rollers. Ink cartridges are used in inkjet printers, not laser printers, and printheads are found in impact and thermal printers, not laser printers.
- 14.** B. The best option to try first is changing the channel that the wireless access point (WAP) uses to connect. The intermittent connections could be caused by interference with the neighboring Wi-Fi. Turning up the power on your WAP would only make the crossover more between your Wi-Fi and the neighbor's Wi-Fi, increasing the interference and slowing the connection even more. Adding another WAP might help if the problem was too many users, but with only four users in that area, it's not that. You could check the cable connecting the WAP to the router, if changing the channel doesn't resolve the issue.
- 15.** B. An registered jack 45 (RJ45) connector is used to terminate Ethernet cables used in local area networks (LANs). It has eight wires. An RJ11 connector is narrower than an RJ45 because it only has four wires. RJ11 is used for landline telephones. An F-type connector is used for cable television transmission, satellite television connections, and cable modems. It has a twist-on connector with a solid pin in the middle and is used with coaxial cables. A straight tip (ST) connector has a bayonet-type plug and socket. It is used with fiber-optic cable, and if bidirectional signals are needed, two cables and two connectors are needed.
- 16.** A. Double data rate 3 dual in-line memory modules (DDR3 DIMMs) have 240 pins, double data rate 4 (DDR4) and double data rate 5 (DDR5) both have 288 pins, and a small outline dual in-line memory module (SODIMM) is not a type of desktop random access memory (RAM); it is used in laptops.
- 17.** A. One simple way to add ports is to use a port replicator, sometimes sold as a "hub." It usually plugs into one USB-C port and supplies multiple USB-C ports. A trackpad is a surface, usually on a laptop, that enables the user to move their finger(s) either across it or in pinch-and-spread fashion, to control the mouse. A stylus looks like a pen but has a special tip and is used with a touchscreen to control a mouse. A docking station is a bit different than a port replicator, although the terms are often used interchangeably. A docking station replicates the functions of the ports on the back of a laptop, so that peripherals, such as displays, keyboards, printers, and so on, that don't travel with the

laptop can remain connected to the dock and don't all have to be unplugged physically whenever the laptop is removed. Docking stations effectively turn a laptop computer into a desktop computer, and the docking station may offer its own devices, such as an optical drive and speakers. It may have a generic connector such as a universal serial bus (USB) USB-C or a proprietary connector. Docking station can also refer to a charging cradle for a smartphone or tablet to plug in vertically that provides other functions such as built-in speakers for music playback or a clock. This differs from a port replicator, whose main function is to let the user connect several devices at once and doesn't require the laptop to be connected to offer that connectivity between the devices.

18. D. If the device does not produce sound, first ensure that it's not set to silent operation. Most mobile devices will have a switch on the side that users can set to silent or vibrate mode, which will mute the device and keep it from making noises. Also check settings for volume as well as the possible redirection of sound, such as an active Bluetooth pairing. If the speakers have failed on a mobile device, it's time for a new device. You could try cycling the power on the phone, or the other options listed as possible answers, but they likely won't work.
19. A, D. A groove or scratch in the EP drum can cause the problem of vertical black lines running down all or part of the page. Because a scratch is lower than the surface, it doesn't receive as much (if any) of a charge as the other areas. The result is that toner sticks to it as though it were discharged. The groove may go around the circumference of the drum, so the line may go all the way down the page. Another possible cause of vertical black lines is a dirty charging corona wire, which prevents a sufficient charge from being placed on the EP drum. Because the charge on the EP drum is almost zero, toner sticks to the areas that correspond to the dirty areas on the charging corona. The symptom displayed when a fusing assembly isn't heating properly is toner sliding off the page when the paper is removed from the printer. Worn exit rollers might cause a paper jam, but not lines down every page.
20. C. Some motherboards support accessing more than one random access memory (RAM) module at a time. When that is the case, we say that the motherboard has multiple channels. Typically, you will purchase identical RAM modules in quantities that match the number of channels there are. In this case, the documentation says to purchase RAM in identical sets of four, so you can assume it is a quad-channel motherboard. Dual would require identical sets of two, and triple would require identical sets of three, although triple channel motherboards were only popular for a brief period of time.
21. B. An 802.11ac network operates in the 5 GHz band, and can be 20, 40, or 80 MHz wide. With the 80 MHz channel width, there are effectively two channels: channel 36–48 and channel 149–161. Because you have three access points, you should use the 40 MHz channel width, which provides four possible channels: 36–40, 44–48, 149–153, and 157–161. The 20 MHz channel width provides nine channels, but you don't need that many, and the narrower channel width would decrease the performance per client. The 20 MHz channels are 36, 40, 44, 48, 149, 153, 157, 161, and 165.
22. A. Memory problems can cause system lockups, unexpected shutdowns or reboots, or errors such as the dreaded blue screen of death (BSOD) in Windows or the rotating/spinning pinwheel in macOS. Issues with a central processing unit (CPU) can also cause intermittent

rebooting, BIOS/UEFI, network adapters, and storage drives would produce different symptoms than those in the question.

23. C. When troubleshooting, always start with simple things first. It would not be the first time that a display had been inadvertently turned off. If that doesn't resolve it, check the cabling to ensure that nothing is loose, check display settings to ensure that the brightness isn't turned all the way down, and whether the display is using the correct input if it has more than one.
24. D. Displays may have their own internal power supply, and they all have internal circuitry, which means they can overheat. Ensure that the air vents on the back of the display are free of both dust and debris. In this case, removing the display from the cabinet might help to increase cooling air flow to the display. If the problem persists, it's best to replace the display. The other options would exhibit different symptoms.
25. B. Radio frequency identification (RFID) tags have numerous uses, including tagging pets to locate the owners when the pet is lost. Near-field communication (NFC) technology is also used to transfer data over a small distance, but that technology is not used in animal tags. Hard disk drives (HDDs) and graphics processing units (GPUs) are found inside computers, not inside a pet, unless of course the pet is a robot.
26. A. The micro-advanced technology extended (ATX) form factor is designed to work in standard ATX cases as well as its own smaller cases, with no adapter or special cards required.
27. C. Splitters generally have two effects on a coaxial cable: They degrade the signal and limit the distance the signal will travel. Avoid using them whenever possible.
28. C. If a computer is a few years old, the basic input/output system/unified extensible firmware interface (BIOS/UEFI) may fail to retain your computer's settings, such as time and date and hard drive configuration. The BIOS/UEFI uses a small, flat, 3-volt battery (much like a watch battery) on the motherboard to help it retain settings when the system power is off. If this battery fails, the BIOS/UEFI won't retain its settings. Simply replace the battery with the same type to solve the problem. There is usually a number printed on top of the battery, such as CR2032 or 2035 so you know which one to get. You would not flash the BIOS to fix this problem, and BIOS/UEFI chips are not user replaceable. Resetting the BIOS/UEFI jumper on the motherboard will clear the settings, which is what you're trying to avoid.
29. D. When the power-on self-test (POST) completes successfully, most motherboards will emit a single beep to let you know. If it doesn't turn on normally after one beep, or multiple beeps, refer to the motherboard manufacturer's documentation, but continuous beeps are usually a RAM issue, and a series of long and short beeps are usually a video issue. Some motherboards have status indicator lights on the motherboard instead of beep codes. If it's the CPU, it usually just won't start.
30. C. If you have a swollen battery, turn the device off immediately and ensure that it's not plugged into a charger. It might be possible to remove the battery, but swollen batteries are more prone to explosions than normal ones because the casing is already compromised, and most batteries in small devices are not user replaceable. The best course of action is to

purchase a new device. Take the battery or device to a proper recycling center to dispose of it. Never just throw it in the trash because it can explode and harm sanitation workers as well as cause significant environmental damage.

31. C. A load balancer distributes requests among different servers. One of the main reasons for using a load balancer is to improve server response times, whether the servers support a website or internal data. Not surprisingly, spam gateways detect and block spam. A proxy server usually serves as the gateway between networks or a network and the Internet and will filter traffic based on various user specified criteria. Unified threat management (UTM) combines multiple security features such as a firewall, anti-malware, packet filtering, intrusion detection services (IDS), and intrusion protection services (IPS) all in a single network appliance or software.
32. C. The x8 card won't completely fill the x16 slot, but it will work at x8 speeds if up-plugging is supported by the motherboard. Otherwise, the specification requires up-plugged devices to operate at only the x1 rate.
33. D. An optical network terminal (ONT) is usually a box on the outside of a building where a fiber-optic line connects to a network. The ONT will have fiber-optic connections, Ethernet (RJ45) connections, and perhaps others. It also contains a transducer that converts the flashes of light from the fiber-optic cable to pulses of electricity needed by the Ethernet cable.
34. B. Currently there are three form factors for secure digital (SD) cards; they are SD, MiniSD, and MicroSD. The cards also come in different capacities and filesystems as follows:
 - Secure Digital (SD): 2 GB or less, FAT12 or FAT16
 - Secure Digital High Capacity (SDHC): 2 GB to 32 GB, FAT32
 - Secure Digital Extended Capacity (SDXC): 32 GB to 2 TB, exFAT
 - Secure Digital Ultra Capacity (SDUC): 2 TB to 128 TB, exFAT
35. D. If a key on the laptop keyboard is stuck, you need to determine whether the contact is having problems or whether the key itself is stuck. If the key is not physically stuck but the laptop thinks it is, rebooting generally solves the problem.
36. B. The hotspot feature available on virtually all smartphones will enable you to connect other devices to the Internet via the cellular tower system. Typically, you turn the hotspot feature on in the phone's settings. It will display a wireless password and allow you to connect wirelessly via Wi-Fi or Bluetooth or connect physically via universal serial bus (USB) by connecting a cable between your laptop and phone. The downside of using your smartphone as a hotspot is that it eats up data quickly and could be expensive if you don't have unlimited data on your cellular plan.
37. A. Most laptop antennas connect to the main board and have wires that run up the sides of the display. Occasionally, you might find one on the mainboard. Modern laptops typically don't have removable areas on the bottom/back like legacy laptops do. If a laptop's antenna quits working, one option is to purchase a Wi-Fi network card that plugs into an external port, such as a universal serial bus (USB) port.

- 38.** A, B, C. Calendar, Contacts, Mail, and storage are common components of cloud applications that enable you to synchronize information across your devices. Microsoft 365 Copilot, Google, and other companies provide cloud application services.
- 39.** A. Most Internet Service Providers (ISPs) offer faster Internet access for a premium price, but they also put a cap on that service, and although they won't turn your service off, they may slow it down when you reach that cap.
- 40.** C. To segregate a local area network (LAN) into two virtual LANs (VLANs), you would need a managed switch. Managed switches contain software that allows for port configuration, diagnostics, and monitoring situations, such as port flapping. An unmanaged switch is simply a connectivity device. It can't be used to segregate ports into separate VLANs. A bridge is used to aggregate two or more networks into one. A hub is simply a connectivity device that is a single collision domain, whereas each port on a switch (managed or not) is its own collision domain. Hubs are seldom found on networks now, but they are often used to provide multiple ports for a single connection on a computer, such as a USB port. Note that some routers have the ability to create a VLAN by using different IP address ranges, but more often a switch is used.
- 41.** A. A Type 1 hypervisor is also called a bare metal hypervisor, because it is installed directly on the hardware and not within an operating system (OS) such as Microsoft Windows. Type 2 requires an operating system for installation. Virtual machines (VMs) can be used to create a sandbox, which is a network or system for testing software or configuration changes, or even malware, without compromising the live network. Storage is simply space in RAM or on a drive where data is kept.
- 42.** B. Private IP addresses are not routable on the Internet. The following are the IPv4 private address ranges and non-routable number ranges, with the $/n$ indicating the bits in the subnet mask that identify the network portion of each group:
- 10.0.0.0–10.255.255.255/8 (Class A)
 - 172.16.0.0/16–172.31.255.255/12 (Class B)
 - 192.168.0.0–192.168.255.255/16 (Class C)
 - 169.254.0.0–169.254.255.255 (APIPA)
 - 127.0.0.1 (Loopback address)
- 43.** C. The range of numbers that can be assigned by a Dynamic Host Configuration Protocol (DHCP) server to client computers is called the DHCP scope. Each of those numbers can be leased to the client for a period of time that you choose in the server settings. Reservations are numbers that you set aside for specific devices on the network whose IP address you don't want to change, like a server or IP printer. Automatic Private IP Addressing (APIPA) addresses are self-assigned by a computer that is set for dynamic IP addressing but that is unable to reach a DHCP server.
- 44.** D. There are advantages and disadvantages to using the unlicensed frequency bands. Advantages include equipment is widely available and inexpensive, there are no fees for using the unlicensed spectrum, and its use is widespread, so information is available to

help set one up. The disadvantages of using the unlicensed frequency spectrum are that it is congested (because it's free) and many places regulate how powerful the signal can be.

45. A. The port shown in the graphic is a universal serial bus Type C (USB-C) port. It is identical in shape to a lightning port. A Molex connector is a type of 4-pin power connector used for legacy hard drives and some motherboard and expansion card power connections. The subscriber connector (SC) and Lucent connector (LC) are used for fiber-optic connections. An SC is about twice the size of the LC connector. Both have square housing. The SC uses a small locking tab, and the LC uses a locking latch to hold it in place.
46. D. Nonvolatile memory express (NVMe) is a driver and communication interface for Peripheral component interconnect express (PCIe)-based solid-state drives (SSDs). It uses the PCIe bus but can be in PCIe, M.2, and U.2 form factors. It transfers data much faster than the advanced host controller interface (AHCI) that was used for serial advanced technology attachment (SATA). Both AHCI and NVMe SSDs can use the PCIe slot and M.2 connectors on motherboards, so it's important to know whether the M.2 connector supports AHCI, NVMe, or both. U.2 is only NVMe, but it isn't on the CompTIA A+ objectives. SATA will use the AHCI interface, even if it's connected to an M.2 slot on the motherboard. Mini SATA (mSATA) is a different form factor and can't be used in an M.2 slot.
47. C. Redundant array of independent disks (RAID) level 0 is disk striping and provides improved performance but no fault tolerance. RAID 1, mirroring, provides fault tolerance but no improvement in performance. Both RAID 0 and RAID 1 require two drives. RAID 5 provides both fault tolerance and enhanced performance and requires a minimum of three drives. RAID 10 (or 1+0) is a stripe of mirrored drives and provides both fault tolerance and enhanced performance but requires a minimum of four drives.
48. B. Mini PCIe cards running in PCIe 1.0 x1 mode have a maximum speed of 2.5 Gbps per lane. Each send and receive pair in Peripheral Component Interconnect Express (PCIe) is a lane, and PCIe can have 1, 2, 4, 8, 12, or 16 lanes. PCIe that uses one lane is noted as PCIe x1, two lanes are x2, and so on. Successive versions of PCIe have increased the speed per lane. PCIe 2.0 speed per lane is 5 Gbps, 3.x is 8 Gbps, and 4.x is 16 Gbps per lane. Those speeds are the bandwidth, the theoretical speeds, but the actual throughput will be slightly less.
49. C. If you have scorch marks on a component, say a video card or a motherboard, it could be that the specific component has gone bad. It could also be a sign of a problem with the power supply. If you see a component with a burn mark, it would be a good idea to test the power supply as well. Not all power supply problems will show up by using a tester, so if you replace the component and a similar problem occurs, definitely replace the power supply as well as the damaged component.
50. A. Power supplies convert the volts of alternating current (VAC) from a wall outlet into volts of direct current (VDC) that computers can use. ATX12V power supplies provide the following voltages for the computer: +3.3 VDC, +5 VDC, +12 VDC, and -12 VDC. Older (ATX) power supplies that have a 20-pin main power connector also supply -5 VDC. Power supplies use shapes as keys so connectors can't be plugged in incorrectly. Many

companies also have proprietary power supplies, meaning that you must replace their power supply with an identical one, because they don't match the standard.

51. B, C. A local printer can easily be shared with other people in your workgroup. Simply navigate to the Printer properties, which can be accomplished in various ways, and choose the Sharing tab.
52. C. Platform-as-a-Service (PaaS) adds a layer to Infrastructure-as-a-Service (IaaS) that includes software development tools, such as runtime environments. Because of this, it can be helpful to software developers; the vendor manages the various hardware platforms. This frees up the software developers to focus on building their application and scaling it. The best PaaS solutions allow for the client to export its developed programs and run them in an environment other than where they were developed. Software-as-a-Service (SaaS) provides access to applications online, and Network-as-a-Service (NaaS) provides a scalable network infrastructure.
53. B, D. If your redundant array of independent disks (RAID) system is beeping steadily, it's warning you that there is a problem with the array. It might be the controller, but it's more likely that the problem is a failed drive. You might have to replace a drive or rebuild the array, depending on how the RAID is configured.
54. C. Elasticity is one of the greatest benefits of cloud computing. You can add servers or network components as needed, on the fly. Shared resources are what makes rapid elasticity possible. Metered utilization means you pay for what you use, and file synchronization keeps your files up to date across different devices.
55. B. The creation of virtual machines (VMs) would alleviate the issue of space, power, and most of the hardware costs associated with maintaining individual computer systems. VMs can provide the same functionality at a fraction of the cost by enabling a single set of hardware to provide much of the computing power needed. Control and management of the machines would remain with the company.
56. A. Grinding noise is a telltale sign of a hard disk drive (HDD) that is failing. Unlike solid-state drives (SSDs), HDDs have moving parts that sometimes wear out. If you hear a grinding noise, back up the data and replace the HDD as soon as possible!
57. B. This configuration is a mirrored drive, Redundant Array of Independent Disks 1 (RAID 1). If one drive fails, you have an exact duplicate on the other. It provides fault tolerance, but it doesn't protect your system against human error, so you still need backups! RAID 0 is disk striping, which enhances performance but doesn't help at all with fault tolerance. RAID 5 is disk striping with parity, so it offers fault tolerance and performance improvement. Data is written on two drives, and the third is striped with recovery data. The recovery data is put on each drive in turn. If one drive fails, there is enough recovery data on the other two to rebuild it. RAID 10 is a striped set of mirrors, so like RAID 5 it offers fault tolerance and performance improvement but does so in a different way.
58. D. Nearly every hard drive is built with Self-Monitoring, Analysis, and Reporting Technology (S.M.A.R.T.) software installed on it, which monitors hard drive reliability and theoretically

can warn you in the event of an imminent failure. The error ID makes no difference. If it is a S.M.A.R.T. error, it's the hard drive.

59. D. It is normal that a display may have a dead (i.e., black) pixel or two. This is not considered a big flaw; there is nothing you, as a tech, can do to fix it. If there are many dead pixels or you're just not happy with your display, your only recourse is to return it for another one, if the vendor will take it back.
60. A. This is a typical symptom of a loose cable. You need to check both ends of the cable and ensure that they are properly seated. Turning the display or the PC off and back on may also fix it and checking that someone hasn't bumped or changed the display's settings is a quick fix too. If none of those work, the next step would be to try a known good display on the computer. If the problem still exists, it's not the display. It might be time to get a new graphics card.
61. C. If the phone will charge wirelessly, then it should be fine. If it's not covered by a warranty, the store isn't going to fix or replace it for free. Charging ports aren't normally considered a user-replaceable part. Components like charging ports can be replaced by a service center where there are people trained to work on smartphones. In any case, make sure that person is backing up the data on their phone to the cloud.
62. A. In troubleshooting, try the simple things first. If it wasn't grinding before, and it is since you installed a new toner cartridge, then the problem is most likely the toner cartridge. Take it out and put a new one in. If that doesn't fix it, then look for loose rollers or gears and jammed paper. Thoroughly cleaning it would be the next step. Chances are that reloading the paper won't help.
63. B. When a Wi-Fi user is getting limited connectivity messages, it means that they are able to connect to the wireless access point (WAP) but not the Internet. Because others are also receiving this error message, you can assume it's the connection between the WAP they're connecting to and the wired network where the router resides. The router connects the WAP to the wired network and the Internet.
64. A, C. Biometrics are any device that uses a part of your body to identify you. It's common on modern laptops to have the availability of a face scanner or fingerprint reader to log in to the computer. Other biometrics are retina scanners, palm scanners, and voice recognition.
65. B, C. It is likely that the ink on your print nozzles is dried out, or if there is something stuck in the printer, like a piece of sticky label, it could be blocking the ink from going where you want it on the paper. The first step would be to do the nozzle-cleaning routine, which cleans the printheads, and you may have to do it more than once. If the nozzle-cleaning check printout looks good, but you're still having the issue, look inside for something blocking the ink. You might need to replace the ink cartridges. Inkjet printers don't use toner cartridges, and the wrong paper would present different problems.
66. B, C. The most likely problem is overheating. DO NOT unplug the projector, as this will stop the fan from cooling down the system and could result in a blown bulb. You can use canned air or a small anti-static brush to remove dust from the vents to promote better air flow. Allow the fan to run and cool down the projector. If an incorrect input source is chosen, it

could shut the projector down because it doesn't sense any input, but then you would have received a call that it simply "doesn't work."

- 67.** A, C. Configuring quality of service (QoS) to give priority to the voice over IP (VoIP) phones would likely help the situation, but not as much as putting them on their own virtual local area network (VLAN). Upgrading the cabling to something with more bandwidth might help, but that isn't a quick solution. If you have a managed switch, setting up a VLAN could be done fairly quickly and would segregate your VoIP traffic on its own network, so that it isn't competing with computer traffic. A virtual private network (VPN) enables a remote user to connect to a network as if they were in the same physical location.
- 68.** B. First, if it is plugged in, unplug it. A swollen smartphone is usually a sign of a battery problem, and compromised batteries may explode or burst into flame. Most modern smartphones don't have replaceable batteries, so your friend should replace the smartphone.
- 69.** A, C. Virtualization has many benefits. If you need, for example, Windows 10, Windows 11, and a Linux distro, instead of having three computers you would only need one. Windows 11 could be the host operating system (OS) and the other two could reside in a virtual machine (VM). This saves power, space, and hardware expense. You would need the same number of licenses whether or not you have the OSs installed on a VM, and managing the OSs is simple because they are all in one box.
- 70.** B. If everyone is receiving a limited connectivity message, then no one is connecting to the Internet. The place to start troubleshooting is the default gateway, which on many networks could be a router, but it could also be a proxy server, so the default gateway is the best answer here. It's not the wireless access point (WAP) because wired users are having trouble too. It's not the switch because switches connect devices on a LAN; they don't connect the LAN to the Internet.
- 71.** C. The vast majority of consumer Bluetooth mobile devices are Class 2 devices, which have a maximum communication distance of 10 meters (i.e., about 30 feet). The maximum communicating distance for near-field communication (NFC) is only about four inches, infrared (IR) requires line of sight, and Wi-Fi has a much greater distance depending on the Wi-Fi standard being used.
- 72.** B. Organic light-emitting diode (OLED) displays have many advantages over liquid-crystal displays (LCDs). In-plane switching (IPS) and vertical alignment (VA) are both types of LCDs, and some displays use light-emitting diode (LED) backlighting. OLEDs don't need backlighting because the carbon-based material they are created from provides light and color. Fewer layers are needed so OLED displays can be made thinner than LED displays. The color contrast is better than LED displays, and they have faster refresh rates and the unique characteristic of being foldable.
- 73.** A. Mobile device management (MDM) systems can be used to ensure the security of your company information on employees' personal devices. They can be used to block downloading or printing of certain information and can be used to lock or wipe lost or stolen devices or remove company data from mobile devices when an employee has left the

company. A bring your own device (BYOD) policy is agreed to by an employee at onboarding and defines how BYOD devices will be used and secured, but the policy doesn't actually do the securing. A preferred roaming list (PRL) will be updated as needed on a mobile device, to ensure that you can roam and connect to the proper cell towers. The Global System for Mobile Communications (GSM) defines how 2G cellular networks work. GSM is used in Europe and in much of the world. Code Division Multiple Access (CDMA) is mainly used in the United States and was used on 2G and 3G phone systems. The current standard is 5G in many places.

74. C. Your username is identification—telling a system who you are. Authentication means proving to a system that you are who you say you are, and that is done by providing something you know, something you have, something you are (i.e., biometrics), or somewhere you are. These are the factors used to authenticate you. In a multifactor authentication (MFA) system, you first identify yourself to the system (i.e., by providing your username), and provide your first authentication, usually a password (i.e., something you know), then you need another authentication factor. A key fob is a small device, about the size of a key chain, that uses algorithms to generate a numeric key that lasts for only a few seconds and is unique to the application and the user. An authenticator app is software on a device, which does the same thing, and is a type of soft token. A key fob is considered a hard token.
75. B, C. Post Office Protocol version 3 (POP3) and Internet Message Access Protocol (IMAP) are used for downloading email messages from a server. The difference between the two is that IMAP allows the messages to remain on the server so they can be accessed from different devices, whereas with POP3 the email messages will only exist on the device on which they were downloaded. Simple Mail Transfer Protocol (SMTP) is used for sending an email. A good way to remember which is for sending and receiving is to remember that S (as in SMTP) is for sending. Server Message Block (SMB) is a protocol for sharing files across a network.
76. D. Address Resolution Protocol (ARP) is responsible for resolving Internet Protocol (IP) addresses to media access control (MAC) addresses. IP is used in routing information packets from one Internet location to another. Secure Shell (SSH) is a connection-oriented protocol used to securely manage a network and its devices remotely. Dynamic Host Configuration Protocol (DHCP) is a connectionless protocol used to dynamically assign network configuration information to clients that request it on a network.
77. B. If your wireless access point (WAP) is Power-over-Ethernet (PoE) compliant but your switch is not, then you can purchase a PoE injector to send power (along with the data) to a PoE device with a single Ethernet cable. The distance is limited by the cable category and Ethernet standard being used.
78. B, D. Only the 802.11n, 802.11ax, and 802.11be standards can use both the 2.4 GHz and 5 GHz frequencies, which makes them backward compatible with all the other standards. Standards 802.11a and 802.11ac use only the 5 GHz frequency. Standards 802.11b and 802.11g use only the 2.4 GHz frequency.

- 79.** D. A Dynamic Host Configuration Protocol (DHCP) server can be configured to provide all required and optional Transmission Control Protocol/Internet Protocol (TCP/IP) configuration information to clients. This includes an IP address, subnet mask (for IPv4), default gateway, and Domain Name System (DNS) server address.
- 80.** A, C. Because this computer is not able to reach the Dynamic Host Configuration Protocol (DHCP) server, it will self-assign an Automatic Private Internet Protocol Addressing (APIPA) address. The APIPA address range is 169.254.0.0–169.254.255.255. (In the last octet, 0 and 255 would not be assigned, because the last number of a range is the broadcast number and the first number of a range identifies the network.)
- 81.** A. Domain Name Service (DNS) servers reconcile human friendly names like Sybex.com to Internet Protocol (IP) addresses so that a browser can find them (not IP address to domain name). A Domain Name System (DNS) server setting can be configured on a client computer automatically by a Dynamic Host Configuration Protocol (DHCP) server, or manually on the Networking tab of a network connection by clicking on either IPv4 or IPv6 properties. DNS differentiates between IPv4 and IPv6 by identifying IPv6 addresses as AAAA records and IPv4 addresses as A records.
- 82.** D. A crimper is a handy tool for helping you put connectors on the ends of a cable. Most crimpers will be a combination tool that strips and snips wires, as well as crimps the connector onto the end. A toner probe helps a technician locate a particular wire in a bunch that look the same. A punchdown tool is used to attach wires to a punchdown block on a wiring rack in a telecommunications closet. A multimeter has many uses, among them testing continuity, checking power supplies, and checking wall outlets. UTP is unshielded twisted pair.
- 83.** C. Unshielded twisted pair (UTP) wire has eight wires. The colors are orange, green, blue, and brown, with a solid and striped wire of each color. The American National Standards Institute/Telecommunications Industry Association (ANSI/TIA) 568A Standard is green stripe, green, orange stripe, blue, blue stripe, orange, brown stripe, brown. The ANSI/TIA 568B standard is orange stripe, orange, green stripe, blue, blue stripe, green, brown stripe, brown. To make it easier to remember, notice that only the green and orange change positions. Blue and brown stay in the same positions.
- 84.** C. Both Cat 6 and Cat 6a will support up to 10 Gbps, but for Cat 6 the maximum distance for 10 Gbps is about 55 meters (i.e., 165 feet). Cat 6a can support a frequency that is twice as fast, so it can support 10 Gbps up to 328 feet (i.e., 100 meters). Because the distance in the question is 200 feet, you would need to use Cat 6a cable. Cat 5e has a maximum bandwidth of 1 Gbps. Plenum simply means that the cable has a coating that doesn't produce toxic fumes when burned. It is required by certain building codes.
- 85.** D. This isn't memory at all. It is an M.2, which is a solid-state drive (SSD) used for storage. It may look similar to a dual inline memory module (DIMM), but it's smaller and the connectors are on one (short) end, not on the long edge. Error correcting code (ECC) is a feature of some random access memory (RAM) modules that will detect and attempt to correct errors in storing or retrieving information. ECC is usually found on servers rather than desktop

computers and is more expensive. Small outline DIMMs (SODIMMs), the memory used in laptops, will have a notch and connectors on the long side as will regular DIMMs, which are used in desktop computers. DIMMs are larger than SODIMMs.

86. A. Duplexing is automatically printing on both sides of the paper—no need to stand at the printer and flip the copies over. Orientation refers to whether a paper is wider than it is tall (i.e., landscape), or taller than it is wide (i.e., portrait). Tray settings refer to configuration settings, such as if a print job is 11 14 inches instead of 8.5 11, then you must select tray two which is filled with the larger paper. It's just one of many settings. Most printers will have a fast print mode or a quality print mode.
87. D. Thermal printers require a special thermal paper that will turn black when subjected to heat. Inkjet printers use paper that resists colors bleeding into other areas; impact printers often use no carbon required (NCR) forms to make multiple copies of a form when they print; and laser printers use toner, electricity, and heat to transfer an image to paper.
88. C. Cleaning the screen should be your first step. Dirty screens can cause problems because even clean hands can leave oil from your skin on the screen's surface. Although any or all of the options could be a part of your troubleshooting, cleaning the screen should be your first step.
89. B. There are many reasons why a drive might be working more slowly, but you don't necessarily need to replace it. My first thought would be to check for malware in the system. Then, you should defragment it if it is a hard disk drive (HDD). Solid-state drives (SSDs) should not be defragmented. Ensure that the drive has ample available space, look for physical problems, suspect that the HDD may be failing, and replace it with an SSD for improved performance.
90. A. The connectors shown are straight tip (ST) connectors for fiber-optic cable. They connect with a Bayonet Neill-Concelman (BNC)-type locking mechanism. The subscriber connector (SC) and Lucent connector (LC) are used for fiber-optic connections. SC is about twice the size of the LC connector. Both have square housing. The SC uses a small locking tab, and the LC uses a locking latch to hold it in place.
91. B. RAID 0 is called disk striping. Data can be written to or read from multiple devices at the same time, increasing data access speed. However, if one drive fails, all data is lost. (Back up early and often!) RAID 1 is a mirror set, which does not increase data access but provides fault tolerance. RAID 5 is disk striping with parity, which provides both speed and fault tolerance but requires three drives. RAID 6 is disk striping with double parity, so two drives can fail, and the array's data is still safe, but it requires a minimum of four drives to implement.
92. C. Generally speaking, you will need a license for each instance of an operating system (OS) that is running in your virtual machine (VM), plus the host OS.
93. A, C, D. While Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS), and Infrastructure-as-a-Service (IaaS) are widely considered to be the major categories of cloud computing, RaaS is not an acronym for a specific type of cloud computing.

- 94.** B. The least likely problem in this scenario is the paper. If the paper is too thin, too heavy, or too humid, then they would hear the printer attempt to pick up the paper, and there may be a paper jam. They said, “nothing happens,” so look for an issue that happens *before* the printer tries to pick up the paper. Some common issues are that they have chosen the wrong printer, the print queue is frozen for some reason, or they have a connectivity issue with the printer. If it prints from another application, then they have a software issue.
- 95.** D. Garbled print is a classic sign of a corrupted printer driver. Update or replace the printer driver.
- 96.** A. Infrastructure-as-a-Service (IaaS) enables companies to scale their environments without purchasing new hardware and running network wires. IaaS services are typically “pay as you go” and work well for companies experiencing rapid expansion. Software-as-a-Service (SaaS) means that software is being provided online, such as accounting and tax preparation software, sales management, and data backup services. Platform-as-a-Service (PaaS) provides developers all that they need to develop software such as the infrastructure and development software. Network-as-a-Service (NaaS) provides network infrastructure and management. Examples of NaaS providers are Palo Alto Networks and CISCO.
- 97.** B. When wanting to maintain confidentiality, integrity, and availability, security requirements and regulations must first be defined. A company can then consider if an Internet cloud solution would be appropriate. Scalability is the ability to purchase more services over time. Elasticity is similar but is on-demand scaling up or down in service levels automatically. Emulation is when one hardware or software is able to act as if it were another. It is especially helpful when, for example, a piece of hardware that a manufacturing process uses is no longer viable, so more modern hardware is used but software is written to interface between the manufacturing process and the newer hardware. The manufacturing process acts as if it is still running on the older hardware because it can't detect the difference.
- 98.** C. For a company needing additional cloud resources on demand, they should request metered utilization, in which a cloud service will bill much like a utility would, as resources are used. Elasticity means that the cloud service can provide additional or fewer resources as the company needs them, on demand. Infrastructure-as-a-Service (IaaS) refers to hardware and networking in the cloud. Multitenancy means that resources are pooled and delivered as needed to many clients.
- 99.** A. A community cloud is the solution for such situations. It enables a limited group of people or companies to share cloud resources. The group can benefit from economies of scale, but each keep their information separate from the other organizations in the community. They could even share in joint projects. Their servers could be in a data center or stored locally by one of the members. The group will have more control than they would over a public cloud but could share the maintenance costs of their cloud. A community cloud is similar to a private cloud but with multiple members. A private cloud is owned by a single entity, although it may be accessed by several locations owned by that entity. A public cloud service is one that anyone can purchase shared resources or services from, such

as Amazon Web Service (AWS), Google cloud, and IBM cloud. A hybrid cloud is a combination of public and private cloud features, such as having a private data center but leasing management services from a cloud provider.

- 100.** B. A virtual desktop infrastructure (VDI) moves the desktop icons, files, and folders to a server instead of the desktop originating from the local machine. When the desktop experience is hosted on a centralized server location, the icons, files, and folders are the same. With this user working from different offices, the best solution for them is VDI in the cloud. On-demand desktop streaming is a Dell streaming service where the desktops and files are stored on a server that provides them to thin clients without drives over gigabit Ethernet. Desktop emulation is software that imitates a desktop. Synchronized folders means that your documents will be the same whether you log in to a desktop, laptop, or other mobile device. Changes on one are synchronized to the other devices.

Chapter 11: Practice Exam 2 (220-1202)

1. D. The system is most likely overheating. This is a tough question, because there are so many reasons that a computer will shut down on its own. The five-minute interval here is significant. The computer is running long enough to heat up, and when the central processing unit (CPU) gets too hot, it will shut the system down to avoid damage. If it isn't overheating, your next course of action is to check for malware. System File Checker (SFC) will attempt to fix problems with operating system (OS) files. Reinstalling the OS would be a last resort.
2. A, B. When working with customers, it's important to avoid distractions, such as personal phone calls, texting, or social media sites. Exceptions can be made if it's an emergency, but in those cases notify the client that you might get a call or text, and explain that you will deal with it only if it's an emergency. Otherwise, ignore the personal interruption until you are not working with a client.
3. B, C. The New Technology File System (NTFS) is available with all current versions of Windows. NTFS is an advanced filesystem that includes such features as file and folder encryption, compression, and RAID support, as well as support for extremely large file and partition sizes and disk transaction monitoring.
4. B. The `sudo` (“substitute user do” or “superuser do”) command is used to run a command with a different privilege level than the current user logged in. Typically, this means running a command with superuser or `root` permissions. The `su` command switches to a different user, again the default is `root`, but with `sudo` you need to enter `sudo` before each command. With `su`, you don't. Considering best practices, you would use `sudo` if you had one command to run, and `su` if you had several. The `grep` command is used to search for patterns in a file, so if you can't remember the filename but know what is in it, you can still find it. The `man` command brings up a manual—for example, `man grep` would show you how to use the `grep` command.

5. C. Biometric devices use physical characteristics to identify the user. Biometric systems include fingerprint/palm/hand scanners, retina scanners, and anything else that uses part of your body to identify you. To gain access to resources, you must pass a physical screening process. While it's true that guards are humans, they are not biometric devices. Radio frequency identification (RFID) badges have information on them that is read by an RFID scanner, and key fobs generate a new code every few seconds to allow access.
6. B. Many companies rely on digital rights management (DRM) to protect digital assets such as online photos or videos. Unlike an end-user license agreement (EULA), which legally protects software and other objects, DRM physically protects the information by not allowing copies to be made, printing a watermark on the face of an image or document, or incorporating similar measures to prevent the use, modification, and distribution of copyrighted materials. DRM is not as established as licensing agreements are, but you should still respect the property of the owners of digital content.
7. D. Tailgating refers to being so close to someone when they enter a building that you can enter right behind them, without needing to use a key, card, or any other security device. Using access control vestibules, which are devices like small rooms that limit access to one or a few individuals, is a great way to stop tailgating. A brute-force attack attempts to repeatedly guess a password. Shoulder surfing is just like it sounds—someone is looking over your shoulder to gain passwords and logins, and an evil twin is an unauthorized wireless access point that has the same service set identifier (SSID) as a legitimate one.
8. A. The msinfo32 tool displays a thorough list of machine settings on the local computer. You cannot change any values from here, but you can search, export, and save reports. When run from a command prompt, the /computer option allows you to specify a remote computer on which to run the utility, and the /report option saves the report as a text file. Another option while in the msinfo32 graphical user interface (GUI) is clicking the View menu then Remote Computer to collect information related to the chosen remote PC. The compmgmt command opens the Computer Management console, mmc opens the Microsoft Management Console, and perfmon opens Performance Monitor.
9. C. Forensic install is not an option. The easiest way to install Windows 11 on a Windows 10 computer is through Windows Update in the Settings app. If you have a situation where that's not possible, you can create Windows 11 installation media and use it to install the operating system (OS). When you launch the installation from within Windows 10, you have three options. The first is Full Upgrade, which will keep Windows settings, drivers, personal files, and apps. The second, Keep Data Only, will keep drivers and personal files but no installed apps or Windows Settings. The third option is a Clean Install, which will wipe out everything on the drive and install a fresh copy of Windows 11.
10. B. Even if you disable the service set identifier (SSID) broadcast, potential attackers still have many simple tools available to see your wireless network traffic and get the SSID anyway. It is a weak form of security that will keep out only the most casual intruders. Disabling guest access limits who can connect to your network, but if you must have guest access, look for a setting that will isolate the guest network from your network. WPA3 is the best commonly available form of encryption for wireless routers. WPA2 is usually available alongside of WPA3 for networks that are transitioning between WPA2 and WPA3. The router may have

an option that says WPA2/WPA3 or WPA3 transitional, which will allow newer devices to connect using WPA3 and older devices to connect using WPA2. Changing the wireless router default username and password is always recommended, because those are often easy to find online.

11. B, C. To ensure your personal safety, always remember some important techniques before moving equipment. The first thing is to always ensure that the equipment is unplugged. There's nothing worse (and potentially more dangerous) than getting yanked because you're still tethered to the wall. Remove any loose jewelry and secure long hair or neckties. Lift with your legs, not your back (i.e., bend at your knees when picking something up, not at the waist).
12. C. In troubleshooting, it's often best to check the simple things first. Ask them if there is a drive in the universal serial bus (USB) port. If the system is set to check there before the hard drive for boot media, then non-bootable media in the port might prevent the system from booting. (Disabling the ability to boot from a USB port is considered a security best practice.) If it wasn't working yesterday, they likely would have called you yesterday. Never ask an end-user what they did to a system. Even if it is a user error, they probably won't know they did something wrong, and that question will make them more upset; what you want instead is to make them feel that you're professional and confident in your ability. An end-user should not be entering the Unified Extensible Firmware Interface (UEFI).
13. A. BitLocker allows the user to use drive encryption to protect files, including those needed for startup and log-on. BitLocker can be turned on or off only by administrators, and it's enabled by default in Windows 11. It is only available in Pro or higher editions of both Windows 10 and Windows 11. The encrypting file system (EFS) can encrypt data at the volume, file, or folder level but not an entire hard drive. OneDrive is Microsoft's online cloud storage service, and ShadowDrive is not a valid computer term.
14. D. The best way to remove data from a device is to perform a remote wipe. Ideally, you have backed up or synced the device before then, or you will lose data. Full-device encryption is a good security practice, but it should have been completed prior to the phone being stolen. BitLocker is a Microsoft Windows feature for full-drive encryption.
15. D. When you create a partition in Windows 10, it will ask if you want to create a master boot record (MBR) or globally unique identifier (GUID) partition table (GPT) partition. GPT is newer and has far more features than MBR. One of those features is that you can create an unlimited number of logical partitions on it. Only the operating system (OS) will limit you; Windows 10 will only allow 128 partitions on one drive. Windows 11 supports only the GPT partition type. In older computer systems, there were primary and extended partitions. There could be a maximum of four partitions, and only one could be extended. Logical drives could be created in an extended partition and were limited to the remaining letters of the alphabet. If there were three primary partitions, they would likely be labeled C, D, and E. An extended partition could hold logical partitions F through Z. Dynamic drives are unique to Windows and support software RAID.
16. A. Removing all data on a drive by repeatedly replacing it with binary bits, 0s or 1s, is commonly done using drive-wiping software. Government or other highly secure

environments may have specific rules regarding data destruction. Drive wiping can make the data unrecoverable and make it safe to donate the drives. The `format` command will erase the file allocation table or master file table, but the files may still be able to be recovered. It is not a secure way to ensure that your data can't be read. Degaussing and incinerating are ways to physically destroy drives. Degaussing works with only magnetic media.

17. C. An uninterruptible power supply (UPS) is designed to provide enough power to keep systems running until they can be safely shut down or switched to another power source. The UPS must provide adequate wattage for the devices connected to it as well as sufficient battery capacity. Most also offer protected and unprotected outlets; surge suppression, which protects against power surges; and line conditioning, which improves the quality of power delivered to the device, such as boosting the power when there is a sag on the input side. Power strips only give you a place to plug devices in and turn them all off at once. A smart UPS can notify an administrator that there is a power outage.
18. A, B. There are three tools in Windows 10 and Windows 11 that quickly show you the central processing unit (CPU) and random access memory (RAM) usage in Windows. They are Resource Monitor, Performance Monitor, and Task Manager. The easiest way to find Resource Monitor (`resmon.exe`) is to click the search icon on the taskbar and type `res`, then click on Resource Monitor. Performance Monitor (`perfmon.exe`) can be accessed through Computer Management. Task Manager (`taskmgr.exe`) can be opened in several ways, the fastest is by right-clicking the Windows icon on the taskbar and choosing Task Manager. System and Device Manager are accessed in multiple ways but do not provide the information needed.
19. B. A brute-force attack is an attempt to guess passwords until a successful guess occurs. Because of the nature of this attack, it usually occurs over a long time period. To make passwords more difficult to guess, *longer is better*, with eight characters being the minimum that should be required, or 15 for privileged accounts. Limiting the number of unsuccessful login attempts before lockout may also help thwart this type of attack. Password requirements can be set using the Local Group Policy Editor.
20. A. Pop-ups are annoying but not necessarily an indication that your computer is infected with anything. Enabling Chrome's pop-up blocker should prevent them. Antivirus and anti-malware programs don't generally deal with pop-ups unless they're associated with malware and most aren't—they are just coded into the website. A firewall won't help with pop-ups either.
21. D. Acceptable use policies (AUPs) describe how the employees in an organization can use company systems and resources, both software and hardware. This policy should also outline the consequences for misuse. In addition, the policy should address the installation of personal software on company computers and the use of personal hardware such as USB devices. The AUP is often signed during the employee onboarding process and may be part of an employee handbook but is not required to be. An Android package (APK) is a file for installing an Android app, an access control list (ACL) defines who has what permissions on an object, and an automatic document feeder (ADF) sits atop a copier or multifunction device (MFD) to send a stack of papers through, one at a time without user intervention.

- 22.** B. This is a form of ransomware, which can be programmed to take control over a user's webcam. It's just another layer of complexity to scare users. Deleting and reinstalling Windows will work, but it isn't necessary. The system will be locked, so you can't open the anti-malware software. You can, however, boot to a bootable media from the anti-malware software provider and start a remediation that way.
- 23.** D. While it's possible that the disposal information and risks may be on the container somewhere, you will always find it on the product's material safety data sheet (MSDS). It should be stated that, while CompTIA still refers to these sheets as MSDSs as an exam objective, the name has been changed to safety data sheet (SDS). SDSs include information such as physical product data (i.e., boiling, melting, and flash point, etc.), potential health risks, storage and disposal recommendations, and spill/leak procedures. With this information, technicians and emergency personnel know how to handle the product as well as respond in the event of an emergency.
- 24.** A, C. When authorized users access devices through unintended connections or unauthorized users access stolen devices, they can access the data on the device. Disable autoconnection to avoid unintended connections and encrypt data on devices to help protect the data on them in the event they are stolen.
- 25.** A. The `dir` command shows a folder (i.e., directory) listing. The `/p` switch displays only one page at a time. Think of it as the pause switch. The `dir /o:s` command lists the files in order by size, `dir /w` shows a wide format, and `dir /s` includes all the subdirectories. There are many other switches that can be used to modify the output of the `dir` command. Type `dir /?` at a command prompt to see them.
- 26.** C. Inheritance is the default behavior throughout the permission structure, unless a specific setting is created to override it. For example, a user who has Read and Write permissions in one folder will have that in all the subfolders *unless* a change has been made specifically to one of the subfolders. Modify access does not give users permissions to change permissions for others. Only Full Control allows it.
- 27.** D. If you have your policy in place, then your incident response plan should be relatively scripted. Your first priority as the first responder is to identify the improper activity or content. Then you should always get someone else to verify the material or action, so that it doesn't turn into a situation of your word against someone else's. Immediately report the situation through proper channels and secure the drive away from the user.
- 28.** B. Device Manager enables you to manage all your hardware devices, including updating drivers and disabling the device. It is found within the Computer Management console and in the Control Panel, but the quickest way is to right-click the Start button and select it there.
- 29.** D. In macOS, there is a bar of icons that runs along the bottom (or side, if so configured) of your screen. That set of icons is known as the Dock, and it provides easy access to key apps that come with the Mac (such as Safari, Mail, Videos, and Music) or others that you choose to add there. Remote Disc enables Macs without optical drives to use another computer's optical drive across a network. The Finder is similar to Windows File Explorer and enables the user to drill down through files and folders to find what they are seeking. Spotlight is a search tool.

- 30.** D. The purpose of the System File Checker (SFC) utility is to keep the operating system (OS) alive and well. SFC is launched at a command prompt and after the system reboots, it automatically verifies that system files have not been altered or corrupted. If a corrupted or altered file is found, a stored (cached) copy of the system file overwrites it. The check disk utility, chkdsk, is used to verify the integrity of the filesystem and to identify bad sectors of a hard drive. In the graphical user interface (GUI), it is called error checking. The Windows command-line utility diskpart allows you to perform disk partition operations. The tracert utility traces the route a packet takes from one computer to another.
- 31.** B. The user should check to ensure that the phone's Wi-Fi is enabled. A common cause for a lack of wireless connectivity is for a device to be in Airplane mode, but because the user has a cellular signal, the phone definitely isn't in this mode. The other wireless signal types (i.e., Wi-Fi and Bluetooth) can be individually disabled, so check them both. Adjusting receptivity isn't an available option on smartphones, and resetting the phone to factory defaults will wipe out the phone's data.
- 32.** B. The ten steps of the malware removal process are as follows:
1. Investigate and verify malware symptoms.
 2. Quarantine infected systems.
 3. Disable System Restore in Windows Home.
 4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end-user.
- 33.** D. The recommended way to assign permissions on Microsoft systems is to grant them to groups. Then, users can be assigned to groups depending on their access needs. This is far less work than managing permissions on a user-by-user basis.
- 34.** A. The `copy` command makes a copy of a file in a second location. It cannot be used to copy folders. To copy a folder, you need to use the `robocopy` or `xcopy` command. The `robocopy` command is in the CompTIA A+ objectives. The `copy` and `xcopy` commands are not.
- 35.** D. Don't click the buttons! This is a fake security warning. When you click either button, something bad will happen—something like malware being installed on your computer. Attackers are very creative about making their pop-ups look like legitimate security alerts. Shut your computer down, and after you reboot, run a malware scan, or if possible, boot with bootable media from your anti-malware company.

36. A. Keychain is a password management system from Apple. It enables you to store passwords for websites, mail servers, Wi-Fi, and so forth. There is an iCloud variant (i.e., iCloud Keychain) that keeps such information as Safari usernames/passwords and credit card information. Mission Control gives you a look at all the open apps, windows, and desktop spaces on your machine. FileVault provides encryption. Terminal is the command-line interface on macOS and most Linux systems. Windows 11 has the traditional Command Prompt and a new tool called Windows Terminal that opens a PowerShell prompt. Unlike Command Prompt, it enables the user to create multiple tabs. Typing `exit` in Windows Terminal exits the program instead of returning the user to a regular command prompt as it would in the Command Prompt.
37. C. The System Configuration tool (`msconfig.exe`) allows you to force the operating system (OS) to boot into safe mode by clicking the box next to Safe Boot on the Boot tab. The System Configuration utility (`msconfig.exe`) has five tabs: General, Boot, Services, Startup, and Tools. Task Scheduler wouldn't work here because the OS loads before Task Scheduler could run. Computer Management and Task Manager don't have settings for booting.
38. B. The one big advantage of share permissions is that they can be used if the New Technology File System (NTFS) is not in place. Of course, share permissions are in effect only when the user connects to the resource via the network. NTFS permissions can protect at the file level. Share permissions can be applied to the folder level only. NTFS permissions can affect users logged on locally or across the network to the system where the NTFS permissions are applied.
39. A. Personally identifiable information (PII) is anything that can be used to identify an individual person on its own or in context with other information. This includes someone's full name, address, and other contact information; the names of family members; and other details that people would consider private. A first name is considered to be generally common enough that it is not PII. A first name, if not common, would be PII.
40. A. No unintended or unauthorized event is a good thing for mobile users. The one that leaves a user most susceptible to an on-path attack is an unintended Wi-Fi connection. This is because the device at the other end that the user is connecting to could be intercepting data or storing it for a possible attack later.
41. C. The way to protect against this is to implement a basic input output system/unified extensible firmware interface (BIOS/UEFI) password. If a user can get into the BIOS/UEFI settings, they can change the boot sequence, boot to an unauthorized device, and then do some damage to the system. A strong Windows password will help protect Windows but does not protect the computer hardware or information before Windows loads. AutoRun is a feature of Windows and does not affect the boot process. If enabled, AutoRun will initiate any program, even if its malware, found in an `autorun.inf` file on any media that is inserted. User permissions limit what a user can do on a computer system.
42. D. In Hibernate mode, the computer saves all the contents of memory to the hard drive, preserves all data and applications exactly where they are, and allows the computer to power off completely. When the system comes out of hibernation, it returns to its previous state.

Sleep continues to use a small trickle of power until there is none left, then will go into Hibernate mode. Windows 10–11 support a feature called Modern Standby. Modern Standby must also be supported by the hardware. It is not the right answer because it also uses a small amount of power. With Modern Standby, the system will wake from the lowest power to allow short bursts (i.e., milliseconds) of software execution as the system needs them. The system uses just enough power to process background tasks but still preserve battery life. The result is that when in sleep mode, a computer can stay connected to a local area network (LAN) and reacts much like a smartphone with instant on/instant off ability.

43. A, B. Browser redirection is a symptom of a malware attack that has changed settings in the browser. Run anti-malware software and if necessary, change settings in the browser. Desktop alerts provide helpful notices, such as operating system (OS) updates that are needed, dangerous weather alerts, Amber (missing child) alerts, or other events. A browser update failure will either notify you or manifest as different issues.
44. A. Windows 10–11 both incorporate a software firewall called Windows Defender Firewall with Advanced Security, which can be used to stop incoming and outgoing network traffic. Traffic is allowed or denied according to specific rules that are part of an access control list (ACL). By default, Windows Defender Firewall blocks incoming traffic. By creating exceptions, you can configure what incoming traffic you want to allow through. New Technology File System (NTFS) permissions are used to configure user access to files, folders, and volumes. Local Security Policy is used to configure items such as password policy and account lockout policies. Computer Management is a Microsoft Management Console and has several frequently used tools.
45. B. Set and meet, or exceed, customer expectations and communicate timelines and status. Customers want to know what is going on. In addition, giving the customer a choice in repair or replacement options will usually help the customer feel better because they have a choice in the outcome. Remember that if they have called you, their day is already more difficult than normal, so treat customers with kindness and compassion.
46. A, C. If an operating system (OS) update fails, it could be a configuration issue or simply a one-time glitch in the process. Wait until Windows Update reverts the changes, then reboot and try the update again. If that does not work, you can unplug removable media from your computer and try again, or you can try the Windows Update Troubleshooter.
47. B. Check the simple things first. If the Print Spooler service isn't running, then printers will not show. It's unlikely that you will need to reinstall or repair Windows.
48. C. If you can reach a website using an Internet Protocol (IP) address, then the problem has something to do with Domain Name System (DNS) settings. The default DNS server can be configured using Dynamic Host Configuration Protocol (DHCP) settings. But because the other users aren't having this problem, it's not a setting on the DHCP server, which means it must be configured on the local computer. The user is able to reach the file server, and if they're accessing a remote website, the problem wouldn't be your company's web server.
49. D. An acceptable use policy (AUP) describes what users are and are not allowed to do on the company's network. Often, companies will use a splash screen to confirm that the employee

has read and agrees to the AUP or other company policies before they can use the network. In different environments such as a kiosk or app, a splash screen can display while the program is loading, and in those situations, it may be used to reinforce a brand or advertise products. There are ways to track employee time on the network, but that's not the job of the splash screen.

50. B, C, D. Windows 10–11 treat these items the same. The difference lies in whether the Home or Pro edition is being used. All Windows editions support the New Technology File System (NTFS) file compression. Only Windows editions that are Pro or higher support joining a domain, using the Group Policy Editor (`gpedit.msc`), and being a Remote Desktop Protocol (RDP) host. Windows Home editions *can* be a client connecting to an RDP host, but not an RDP host.
51. B. When a client wants to authenticate to a server over a public network, Kerberos works with an authentication server (AS) to ensure that each party to the connection is who they say they are. Multifactor authentication (MFA) requires two or more factors for the user to prove their identity, such as a password and biometric login. The four available factors are what you know, what you have, who you are, and where you are. Remote authentication dial-in user service (RADIUS) is a protocol used specifically between a remote connection and server. It authenticates the remote user, and if the RADIUS server has the remote user configured as a client, it will send configuration information back to the user. RADIUS authenticates the remote user, not both parties. Temporal Key Integrity Protocol (TKIP) was used to encrypt information on wireless networks, but it is no longer considered secure.
52. A. While all four of these options will help to keep a computer system safe, all it takes is one employee who doesn't know how to recognize dangers and a malicious software can be unleashed on a computer system. Regular user education regarding common threats should be a part of your company's security plan.
53. B, C. If you're running low on memory, you have two options. You can modify the virtual memory settings, or you can add more physical memory if the motherboard will support it. Using Task Manager to close unnecessary programs will help in the short term but not in the long term if you often have those programs running. A faster network interface card (NIC) won't help here.
54. D. There are many settings that can be reached through Network & Internet in the Settings app. Of them, Advanced Network Settings, Mobile Hotspot, and Virtual Private Network (VPN) are just a few. The main menu items here include Wi-Fi, VPN, Mobile Hotspot, Airplane Mode, Proxy, Dial-up, Properties (for the connection), and Advanced Network Settings.
55. B. When configuring a static Internet Protocol (IP) address in IPv6 networking, a subnet mask is not needed, but you do need to know the subnet prefix length. That's the only difference between configuring IPv4 and IPv6. In addition to the IPv6 address and default gateway, you'll need to know the address of the preferred Domain Name System (DNS) server.

- 56.** C. If they are able to access the Internet using Microsoft Edge, then the issue is with Google Chrome. The most likely problem is that the firewall isn't allowing it. To resolve the problem, go into Windows Defender Firewall, and in the inbound rules, add Google Chrome and allow it to send information through the firewall.
- 57.** D. If you're planning a change to an IT system, it's important to have a rollback plan, in case the change fails, and to test the change in a sandbox before you go live with it. You'll also want to do a thorough risk analysis and identify the systems that will be affected or impacted by the change. Getting end-user acceptance is also helpful, so be sure to explain to users why the change is necessary and involve them in the changes that will affect them, such as user input screens. A change freeze happens near the end of the project, when no more material changes to the project are allowed.
- 58.** B. The grandfather-father-son (GFS) method of backing up, as described in the question, ensures that there are short-term, medium-term, and long-term backups of a system. You should have backups both on-site and off-site. The 3-2-1 backup rule says you should have three copies of data, using two different types of media, with one of them being off-site. A synthetic backup is a full backup created by combining a recent full backup and the changes since then to create new files. It can be done outside the system, so there is no downtime and it's faster than doing a full backup.
- 59.** C. If a problem is beyond your abilities, of course, you will follow the company policy. However, in most cases, you will escalate the problem to someone else who has appropriate training or experience to resolve the issue. Any of the other options might lose a customer permanently.
- 60.** B. It's easy to pick and choose which notifications you want popping up on your screen. In the Windows 11 Settings application, search for Notifications and click the link. Once there, you can choose the application from which you want to receive notifications.
- 61.** C. FAT32 and exFAT are both compatible with both Windows and macOS systems, but the exFAT filesystem supports files greater than 4 GB; FAT32 does not. New Technology File System (NTFS) is only compatible with Windows, ext4 is used in Linux/UNIX systems, and Apple File System (APFS) is the filesystem for macOS 10.13 and later.
- 62.** A, D. It sounds like the user needs Read, Write, and perhaps Modify permissions to the folder on the C: drive, and they don't need any other access on that drive. The principle of least privilege is one of the most important security rules in computer systems. It says that you give a user only the access that they need to perform their job duties and nothing more. If they have access to the entire C: drive, and an attacker gets in on their account, then the attacker will have complete access too and can cause all sorts of trouble. Limiting them to only the folder they need also limits their exposure. The other two options are simply not true.
- 63.** C. The ten steps of the malware removal process are as follows:
1. Investigate and verify malware symptoms.
 2. Quarantine infected system.
 3. Disable System Restore in Windows Home.

4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end-user.
- 64.** D. If this is the first time the error has occurred, simply reboot and see if it goes away. Windows is quite stable, but occasionally a blue screen of death (BSOD) occurs, and you must reboot. If it doesn't happen again, there likely isn't a problem. If it continues to happen, look for any error message on the screen that will give you a clue about what the problem is, and then troubleshoot from there. If there is no error message, assume the problem is hardware or a corrupted driver and boot into safe mode to fix the issue.
- 65.** B. If a user profile is very large, it may be slow to load but should eventually get there. If there is an error message that it is unable to load, suspect a corrupted profile. To verify that's the problem, create a new user and copy the existing user profile to the new user, then try to log on as the new user. If the same error occurs, the profile is corrupted. You'll need to delete the corrupted profile and when the user logs on again, a new profile will be created.
- 66.** C. The first thing to try for an Android-based device that won't load an app is to restart the device and try the app again. If that doesn't work, try each of the following and restart between them, then see if the app will launch. First, check for Android updates. Next, check for app updates. Finally, clear the app's data and cache. If none of these solutions work, you might need to contact the app developer.
- 67.** C. When you're installing a new component, the safest place for it is inside (not lying on) the antistatic bag in which it arrived. If an antistatic bag isn't available, the next safest place is lying on a grounded antistatic mat. You would never leave a new card teetering on the case's edge, and antistatic bags are essentially a Faraday cage, designed to keep static on the outside, so lying the component on the bag is not a good idea.
- 68.** D. As a managed services provider (MSP), you'll already likely have remote monitoring and management (RMM) software set up to manage your client's computers and infrastructure. Remote Desktop Protocol (RDP) will let you take control of their system but requires user interaction, and a virtual private network (VPN) is used for connecting remotely to a network as if you were sitting in the office. A virtual network connection (VNC) is for connecting to a single client and it may be a part of an RMM product, but RMM is the best answer.
- 69.** B. Script files can be used to make repeated tasks much easier by automating the process. PowerShell is a very popular scripting program among network administrators, and PowerShell files use a .ps1 extension. A batch file has a .bat extension, Visual Basic scripts have a .vbs extension, and Python files have a .py extension. Others are .sh, for Bash (Linux) scripts and .js, for JavaScript.

- 70.** A, C. To add or manage users on a computer with Windows Pro edition installed, use the Local Users & Groups utility, which can be launched by running `lusrmgr.msc`, or search for user in the Settings application, or use the User Accounts applet of the Control Panel. The group policy editor filename is `gpedit.msc`, and Certificate Manager (`certmgr.msc`) stores digital certificates, which verify that websites and other computers have proven who they are and provided a valid certificate.
- 71.** A. Mapping a network drive for this user will make navigating to the resource much easier. A domain name identifies a Windows Active Directory domain. A subnet mask is used in Internet Protocol version 4 (IPv4) networking, and a gateway is the proxy server, router, or other device that connects a user to other networks, including the Internet.
- 72.** A. The computer is running a virus program before the operating system (OS) even boots, which indicates that there is a boot sector virus. The best way to remove this malware is using boot media from your antivirus company to clean the computer. You might need to go into the basic input output system/unified extensible firmware interface (BIOS/UEFI) settings and change the boot order to boot to the anti-malware media. You wouldn't need to repair or replace the operating system (OS) yet, although as part of the remediation you may need to replace it. It is unlikely with this scenario that you would be able to boot into safe mode, and even if you did, the malware could be lurking in the restore point. Part of the best practice procedures for malware removal is to disable System Restore in Windows Home.
- 73.** A, B. Facial recognition and fingerprint readers are common methods of biometric identification on smartphones, tablets, and laptops. A personal identification number (PIN) code is a number, which is not biometric. Swipe to unlock offers virtually no security on a mobile device and is not a biometric method.
- 74.** A. This is a classic symptom of malware. The ten steps of the malware removal process are as follows:
- 1.** Investigate and verify malware symptoms.
 - 2.** Quarantine infected system.
 - 3.** Disable System Restore in Windows Home.
 - 4.** Remediate infected systems.
 - 5.** Update anti-malware software.
 - 6.** Scan and removal techniques (e.g., safe mode, preinstallation environment).
 - 7.** Reimage/reinstall.
 - 8.** Schedule scans and run updates.
 - 9.** Enable System Restore and create a restore point in Windows Home.
 - 10.** Educate the end-user.
- 75.** A, C. Possible undesirable outcomes of running or allowing script files to be run are inadvertently changing system settings, browser or system crashes, and unintentionally introducing malware. The other options listed are advantages of script files.

76. D. Renamed files is a symptom of a malware attack. Isolate the system from the network (i.e., unplug the patch cable or turn off Wi-Fi), and then run anti-malware. Restarting the computer or manually renaming the files won't remove the malware.
77. A. First Aid in the macOS Disk Utility will check and repair the filesystem, similar to Windows Error Checking. From Disk Utility, you can also erase, create, and restore partitions.
78. B, C. For data-at-rest, which means it's on a storage media, your options are Encrypting File System (EFS) and BitLocker. BitLocker is more secure and would be preferred. Kerberos and remote authentication dial-in user service (RADIUS) secure information that is moving (i.e., data-in-transit/motion) between two points.
79. B. Airplane mode disables all wireless communication. Because the user can't make calls or connect to the Internet, ask them to ensure that Airplane mode is off.
80. C. Most laptops, and many commercial desktop computers, have a recovery partition that can be used to restore the computer to factory defaults. Usually, you can get there by pressing a key or group of keys during the bootup. This would be better than using installation media made from the Microsoft website, because it will have the proper drivers and other software that came with the computer. There is no need to buy a new hard drive, unless the drive is physically damaged.
81. A, B. Many routers that don't have a setting for WPA3 can get it by updating the router's firmware. If some of your devices are older, they may not work with WPA3. WPA2/WPA3 Transitional (also known as WPA2/WPA3 mixed mode) is a mode that allows older devices to still work with WPA2, but they should be replaced or updated to WPA3 as soon as practicable. If you choose WPA3 Personal, some devices might not work. If you choose WPA2 Personal, your network is not as secure as it should be.
82. B, D. Creating a screened subnet will protect your network from traffic interacting with the server and can be done with one router, as long as the web server, outside world, and internal network are on different router ports. Incoming requests for HTTPS port 443 should be forwarded to the web server. Universal Plug and Play (UPnP) is considered unsafe, but it is irrelevant to this web server question. You wouldn't forward outgoing requests.
83. A. Always try the simplest things first. An invalid certificate warning can come up if your date and time are incorrect, making them fall outside of the time the certificate is valid. That's the easiest fix.
84. C. Gaining Android root access does let you do more with your device, but it isn't necessarily safe. Jailbreaking is most commonly done with Apple devices because they are more locked down than Android devices are. Jailbreaking an iPhone, for instance, enables the user to install apps that are not approved by Apple. When you open any device up for your own use by cracking software or gaining root access, it also opens your device up more for cybercriminals to perpetrate an attack on it. Jailbreaking and gaining root access often void the warranty on your device. The device may become unstable due to changes made in that mode, and with the warranty voided, you are not likely to receive support in fixing problems. Jailbreaking may be illegal, depending on where you are in the world.

- 85.** D. iPhones tend to have fewer malware incidents than other mobile devices, so it's most likely that the smartphone is too full, resulting in the device appearing to run more slowly just as it would with a desktop drive. Overheating, excessive data use, and pop-ups can be signs of a malware infection.
- 86.** B. A 64-bit operating system (OS) will support both 32-bit and 64-bit applications. A 32-bit application will work on a 64-bit OS, but it won't take advantage of the 64-bit speed. It will essentially run half as fast as a 64-bit application would. A 32-bit OS only supports 32-bit programs; you can't run a 64-bit application on a 32-bit OS. Luckily, there aren't many computers with 32-bit OSs around anymore.
- 87.** C. This is a classic example of multifactor authentication (MFA). The username identifies you; the password (i.e., something you know) and the authenticator app code (i.e., something you have) are multiple ways to prove (i.e., authenticate) who you are. The four types of authentication are something you know, something you have, something you are (i.e., biometrics), and some place you are.
- 88.** D. Educating the end-user on how to recognize malware and avoid it is paramount to preventing infections.

The ten steps of the malware removal process are as follows:

1. Investigate and verify malware symptoms.
 2. Quarantine infected system.
 3. Disable System Restore in Windows Home.
 4. Remediate infected systems.
 5. Update anti-malware software.
 6. Scan and removal techniques (e.g., safe mode, preinstallation environment).
 7. Reimage/reinstall.
 8. Schedule scans and run updates.
 9. Enable System Restore and create a restore point in Windows Home.
 10. Educate the end-user.
- 89.** B, C. No one likes to have changes forced on them, but in IT there are changes every day. When you have a major change, your headaches will be less if you can gain end-user acceptance before the change occurs. One of the best ways to do this is to involve them in the parts of the planning process that affect them, such as user input screens. Have a meeting and listen to input from the people who will actually be using the system. They may have some insight that you don't. Also be sure to thoroughly explain why the change is necessary. The worst thing to do is spring the change on them by not telling them about it and having them discover it when they log in on Monday morning.
- 90.** D. Incremental backups will only back up what has changed since the last full backup or the last incremental backup. An incremental or full backup resets the archive bit, so only Monday's changes will be backed up on Monday, only Tuesday's changed files will be backed

up on Tuesday, and so on. You will need to restore all three backups to get all the changes that have occurred since Sunday.

91. A. Secure shell (SSH) has virtually replaced Telnet as a remote access protocol and program. Telnet is not secure, but SSH is. Videoconferencing software enables users to see and talk to one another as if in the same room while they may be thousands of miles apart. File Transfer Protocol (FTP) is used for efficiently transferring files, but it is not secure.
92. B. When an operating system (OS) has reached end-of-life (EOL) status, not only are there no more feature updates or support, but there are no security updates and patches, and therein lies the danger. Using an EOL OS might open your system up to hackers. When an OS reaches EOL, it's past the time to upgrade.
93. A. Although iPhones and Android smartphones use different icons for autorotate, for most smartphones a swipe from the top will reveal a quick menu showing autorotate and other commonly used features. Simply enable autorotate. Restarting the smartphone won't resolve the issue. The user may not have a desktop computer available and using it won't solve the problem. Clicking the full screen icon on the video won't help because failing to display full screen isn't the problem.
94. C. Following best practices, this user would need two accounts: one is a member of the Administrators group, and another is a standard user. They should be instructed to only log on to the administrator account if they can't do what they need to from their standard user account, using features like Run As Administrator or entering their administrator password in the User Account Control (UAC) window.
95. A. The first step for any unresponsive app on your mobile device is to force-close it. How that is done will be different, depending on whether it is an Apple or an Android device. If the app is still causing problems, you can try restarting your device, and if that doesn't work, uninstall and reinstall the application. Reverting your mobile device to factory default shouldn't be necessary.
96. C. When you tell a client you will do something, you are setting their expectations. The rule is to meet or exceed the expectations that you set. Remember, people like options. Let them know that you're running late, apologize, and give them the option of how to proceed. Be sure to call the other clients scheduled for the day too.
97. A, C. The exact terms of what you can and cannot do with the software will be spelled out in the license. However, it is common that you can use, modify, and share the source code, but not sell it for a profit, and you usually need to credit the original author of the software.
98. B. A case like this is exactly why you have a rollback plan. Occasionally, despite your best efforts, you get into a project and discover that it isn't going to work, or it will take longer than expected. Perhaps if you rework the plan, you could make the changes without a big disruption to the business. Involving management in what is going on is always a good idea. The acceptable use policy (AUP) likely doesn't have any bearing here.

- 99.** A, B. Websites store parts of pages in the cache to make loading them faster the next time. If you clear the browser's cache and cookies, then when you access the website, it must download all of the data that was previously cached, which means that it will be the updated version. It may take a little longer, but it will be up to date. If it's a site where you use cached credentials to log in, you must log in again. Uninstalling and reinstalling your browser isn't necessary. The Ctrl key and F key pressed simultaneously usually brings up a Find dialog box.
- 100.** D. If the battery is very low, the applications can show a slower-than-normal response time. If this continues when the phone is charged, see how full your phone is. If it's slow when you're saving or reading files, then you might need to clear out some space on your phone. Make sure your phone is updated. If it's an Android phone, ensure that your anti-malware is updated. If the problem happens with just one app, try updating the app, clearing the app's cache, or removing and reinstalling the app.

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