Note: *The system's hardware information is displayed in the About pane of the Settings window. The information displayed can be used to determine if the system meets the requirements for installing an application. The displayed system has the following hardware installed:*

System type: *64-bit operating system*
Processor: Intel(R) Xeon (R) CPU E5-2640 v2 @2.00GHz 2.00 GHz
RAM: *8 GB*
After gathering the system information, it can be used to validate it against the application's hardware requirements.

*Note: The amount of **Virtual memory** is displayed in the Performance Options window. Virtual memory is used when the system runs out of physical memory and uses hard drive space. This setting can be adjusted to ensure when an application is installed, it will have sufficient memory to run.*

Note: *Before an application is installed, the amount of drive space available needs to be verified and the amount of drive space the application will need. In this example, 16.6 GB of free space is available on the drive*

. **Note:** *The System Information window is an additional way of gathering information about the System's hardware to validate against the requirements for the installation of the application.*

Note: *Before an application can be installed on a system, it needs to be verified if the application is compatible with the specific version of the Windows operating system. In this example, the operating system installed is Windows 10 PRO.*

Note: *The **DirectX Diagnostic Tool** can be used to determine the Graphical Processing Unit (GPU) that is installed on the system. Depending on the application, it might be needed that a GPU is installed for the application to function correctly. In this example, there is no GPU installed or any available Display Memory (VRAM). The results will be different on a physical device with a GPU installed.*

Note: *The ISO file was attached to the device, which enables the installation of the Office application. Please note that the ISO file is attached as a DVD Drive. The installation will take a couple of minutes to complete.*

Note: *After the application has been installed, the attached ISO can be safely removed from the device.*

Note: *Applications can be installed using different file formats. The PuTTY application can be installed using the MSI file format. The installation file is downloaded from the application's website and installed instead of using physical media. Similar to an ISO installation, the MSI file contains all the data to install the application but does not need to be mounted on the device.*

Application's Impact on the Device

Before the application is installed, the application manufacturer's recommendation for the application needs to be reviewed to ensure the implication on the device. This might include increased memory and storage consumption.

Network Impact of the Application Installation

The installation might impact the network traffic. Depending on the use of the application, it could cause an increase in network traffic, affecting other applications or services on the network.

Business Impact of the Application

Installing a new application might require that staff need additional training to use the application, which could affect productivity. Careful consideration needs to be taken when implementing new applications.

13-1a Useful Settings and Control Panel Applets

- 1.4

Given a scenario, use the appropriate Microsoft 10 Control Panel utility.

- 1.5

Given a scenario, use the appropriate Windows settings.

Here is a handy list of settings in the **Settings app** you can use to access numerous Windows 10/11 settings and a couple of applets in Control Panel. The A+ Core 2 exam expects you to know how to use all these in a given scenario:

- **Accounts.** Find your Windows account information here or link your account to a Microsoft account. The Accounts group also includes email and app accounts, sign-in options, Microsoft account sync settings, options to sign in to work or school networks, and options to add new user accounts to the computer.
- **Apps.** Use this group to uninstall applications, set default applications, and check other application settings. For example, to make Outlook the default app for email, click **Apps**, click **Default apps**, and then change the setting from Mail to Outlook.
- **Devices (Bluetooth & devices in Windows 11).** Find settings here for printers and scanners, connected devices, Bluetooth, mouse and touch pad devices, typing, AutoPlay, and USB.
- **Gaming.** This group contains settings for the Xbox Game bar, Game DVR, broadcasting, and Game Mode. When you turn on Game Mode, Windows improves the gaming experience by prioritizing system resources for the game being played on the computer.
- **Network & Internet.** This group provides network status, data usage information, and settings for different connections, including Wi-Fi, Ethernet, dial-up, VPN, and mobile hotspots. Go here to set up new connections. Airplane mode and proxy settings are also available for mobile devices. The link to the Network and Sharing Center takes you to more advanced connection settings.
- **Personalization.** Find settings here for the background, colors, lock screen, themes, Start menu, and taskbar.
- **Privacy (Privacy & security in Windows 11).** Find the settings here to restrict or allow Windows or apps access to your information and resources, including your location, camera, microphone, notifications, speech, inking, typing, account information, contacts, calendar, call

history, email, messaging, radios, and file system. The Privacy group is also where you adjust settings for feedback, diagnostic, and usage data that is sent to Microsoft. You can also choose which apps are allowed to run in the background.

- **System.** Look here for catchall information and settings that affect functions of your computer, such as those for adjusting display, notifications, power, sleep, storage, and tablet-mode settings. Important information about the Windows system can be seen on the About window in the System group. See [Figure 13-1](#).

Figure 13-1

Use the About window to find out important information about hardware and the Windows installation
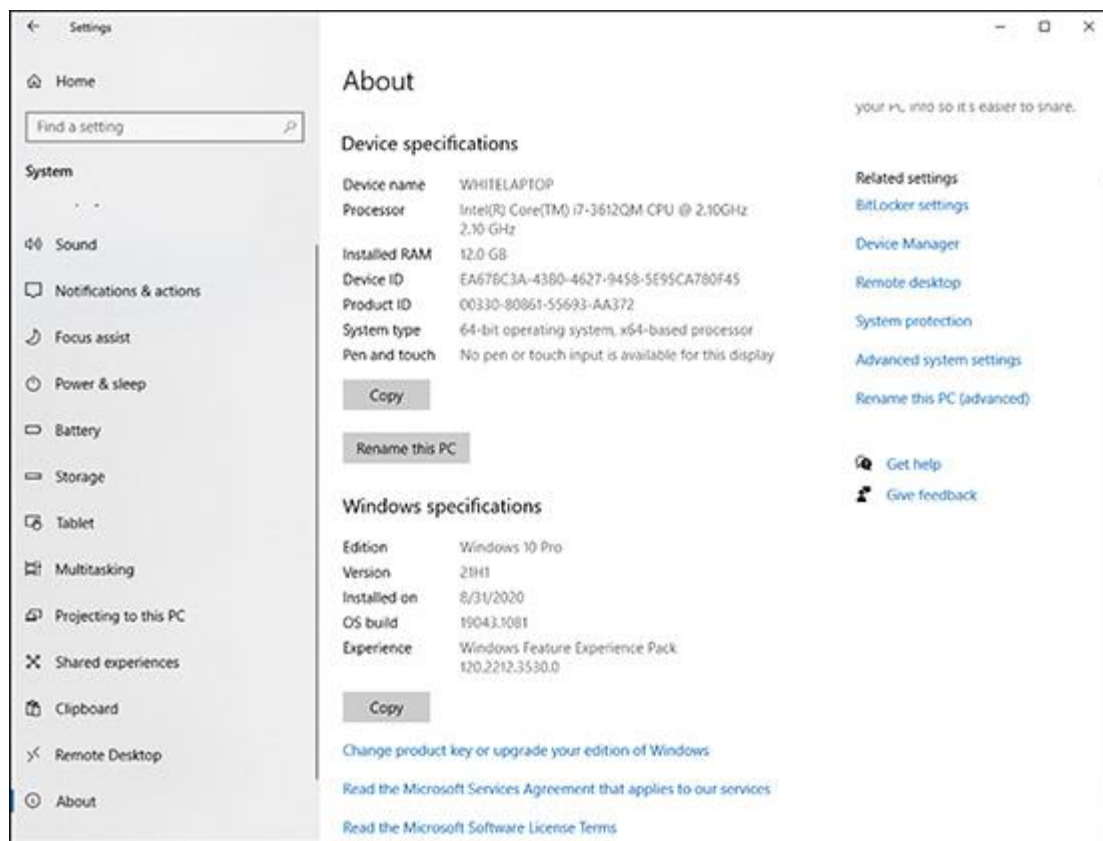
The About window in the System group gives information similar to what you find in the System Information window, including processor, RAM, Windows edition, architecture, and version. You can also get to several troubleshooting tools from this window. The About window can also be accessed by clicking **System** in Control Panel.

- **Time & Language.** The Time & Language group provides settings for date and time, region and language, and speech.
- **Update & Security.** Tools and settings found here include Windows updates, backups, recovery, activation, links to Find My Device, and

settings for power users, such as device discovery, Remote Desktop, and PowerShell.

Some items in the Settings app may be unavailable if you are logged in with a standard account. Use an account with administrative privileges to view all available settings.

Here are two applets in Control Panel that users find handy:

- The **Sound applet** is used to select a default speaker and microphone and to adjust how Windows handles sounds. To control volume, you can use the volume icon in the taskbar.
- Use the **Mail applet** in Control Panel to set up Outlook email. You can also configure Outlook from within the Outlook app.

Now let's turn our attention to maintenance chores. We begin with power options for laptops.

3-1b Power Options

Core 2 Objective

- 1.4

  Given a scenario, use the appropriate Microsoft 10 Control Panel utility.

  One maintenance chore for laptops is to verify that power options are set to conserve power and increase the amount of time before a battery pack on a laptop needs recharging. Power is managed by putting the computer into varying degrees of suspend or sleep modes. Use the **Power Options applet** of Control Panel to change these settings.

✔ Exam Tip

The A+ Core 2 exam might give you a scenario and expect you to know which power options to change to solve a problem, including using power plans and sleep (suspend), hibernate, and standby modes.

Here are the different power-saving states:

- **Sleep mode.** Using Windows, you can put the computer into **sleep mode**, also called **standby mode** or **suspend mode**, to save power when you're not using the computer. If applications are open or other work is in progress, Windows first saves the current state, including open files, to memory and saves some of the work to the hard drive. Then everything is shut down except memory and enough of the system to respond to a wake-up. In sleep mode, the power light on the laptop might blink from time to time. (A laptop generally uses about 1% to 2% of battery power for each hour in sleep mode.) To wake up

the computer, press the power button; for some computers, you press a key or touch the touch pad. Windows wakes up in about two seconds. When Windows is in sleep mode, it can still perform Windows updates and scheduled tasks. Windows can be configured to go to sleep after a period of inactivity, or you can manually put it to sleep. To put the system to sleep manually, click **Start**, then click the power icon and select **Sleep**. See Figure 13-2. A laptop might also be configured to go to sleep when you close the lid.

Figure 13-2

Put Windows to sleep using the Start menu
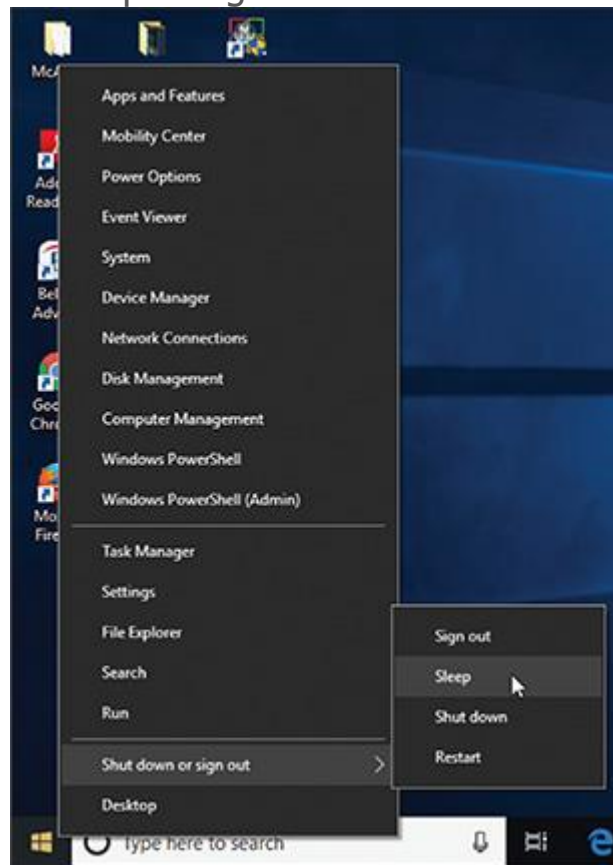
- **Hibernation. Hibernation** saves all work to the hard drive and powers down the system. When you press the power button, Windows reloads its state, including all open applications and documents. When Windows is in sleep mode on a laptop and senses the battery is critically low, it will put the system into hibernation.

Note 5

Recall that hard drives are permanent or nonvolatile storage, and memory is temporary or volatile storage. A hard drive does not require power to hold its contents. Memory, on the other hand, is volatile and loses its contents when it has no power. In hibernation, the computer has no power; therefore, everything must be stored on the hard drive.

Applying Concepts

Configuring Windows Power Plans

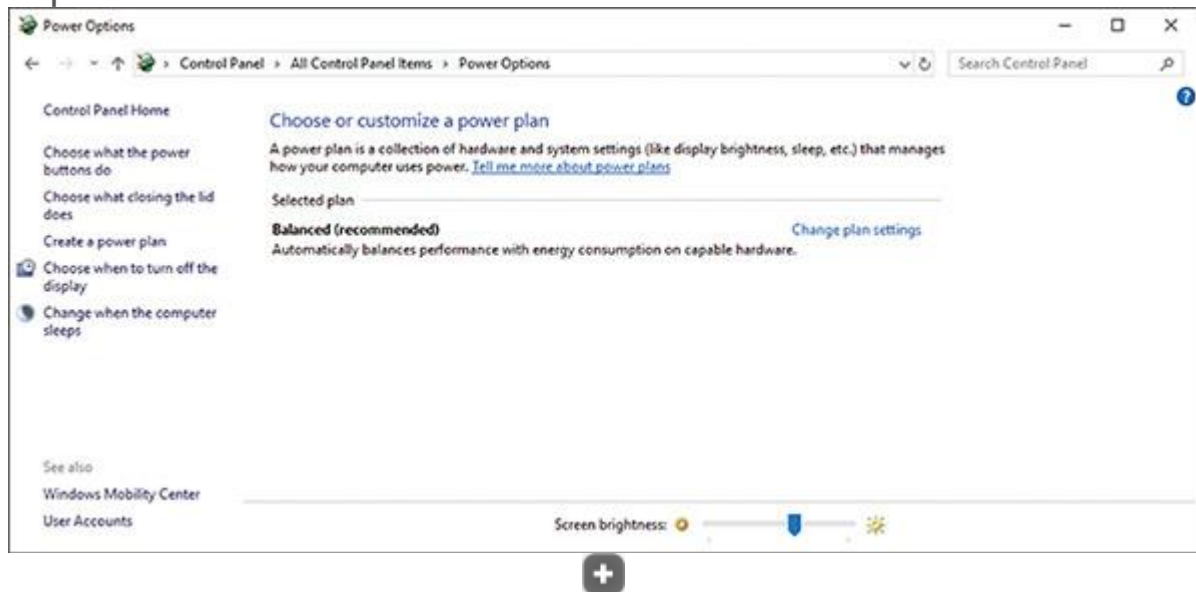- **Est. Time:** 15 minutes
- **Core 2 Objective:** 1.4

Follow these steps to configure power plans in Windows 10:

1. **1**

   Open **Control Panel** in Classic view, and click **Power Options**. The Power Options window opens. Figure 13-3 shows the window for one laptop. The plans might be different for other laptops.

   ## Figure 13-3

   Power plans in Windows 10

2. **2**

   Use links in the left pane to choose what happens when you click a power button and close the lid. When you click **Choose what closing the lid does**, you can turn on fast startup to improve performance.

3. **3**

   You can create and customize a power plan. For example, under Balanced (recommended), click **Change plan settings**. The Edit Plan Settings window appears (see the left side of Figure 13-4). Notice in the figure the various times of inactivity required before the computer goes into sleep mode; these are called **sleep timers**.

   ## Figure 13-4

   Customize a power plan
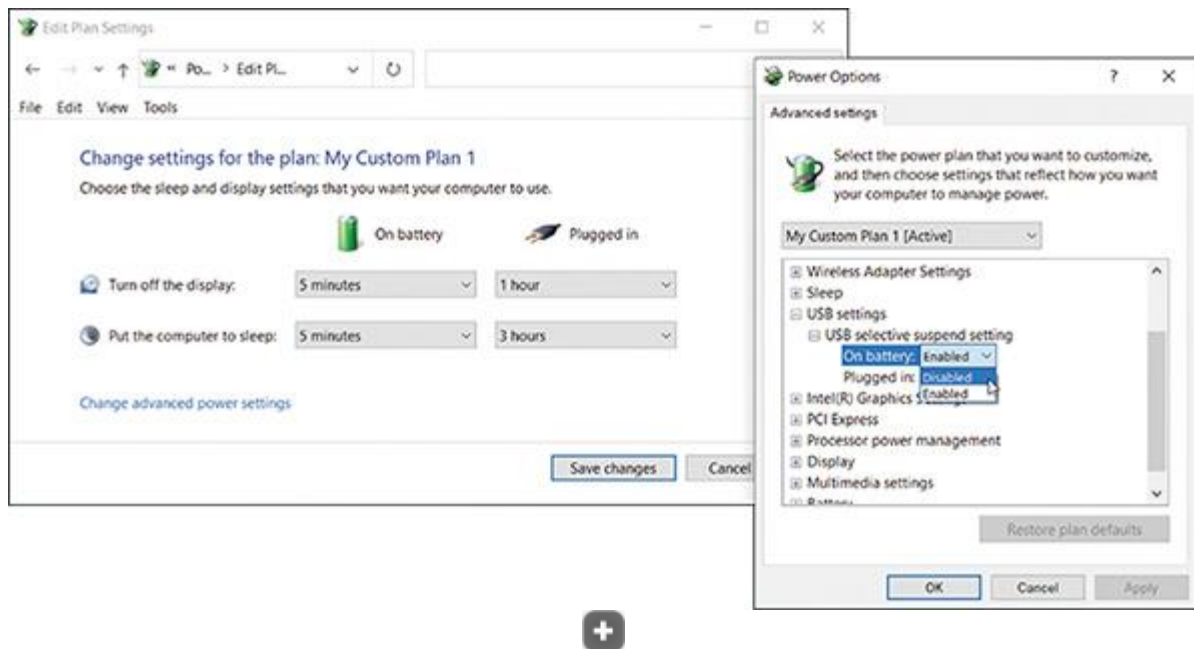
4. **4**

    To see several other changes you can make, click **Change advanced power settings**. The Power Options dialog box opens. Check out the **USB selective suspend setting** shown on the right side of <u>Figure 13-4</u>. By default, Windows puts USB ports in a very low power state when they are not in use. If USB ports are not behaving reliably, one thing you can try is to disable selective suspend, as shown in the figure. Make your changes and click **OK** to close the box.

5. **5**

    If you made changes, click **Save changes** in the Edit Plan Settings window. Close the Power Options window.

✔ Exam Tip

The A+ Core 2 exam expects you to know how to use Power Options in Control Panel to create a power plan, including choosing what to do when closing the lid, turning on fast startup, and disabling USB selective suspend.

13-1c Plan for Disaster Recovery

Core 2 Objective

- 4.3

    Given a scenario, implement workstation backup and recovery methods.

    In this part of the module, you learn how to make a disaster recovery plan and then learn how to use Windows to back up user data, entire volumes, and critical Windows system files.

Applying Concepts

Backups Pay Off

- **Est. Time:** 5 minutes
- **Core 2 Objective:** 4.3

Dave was well on his way to building a successful career as an IT support technician. His IT tech support shop was doing well, and he was excited about his future. But one bad decision changed everything. He was called to repair a server at a small accounting firm. The call was on the weekend when he was normally off, so he was in a hurry to get the job done. He arrived at the accounting firm and saw that the problem was an easy one to fix, so he decided not to do a backup before working on the system. During his repairs, the hard drive crashed, and all data on the drive was lost—four million dollars' worth! The firm sued, Dave's business license was stripped, and he was ordered to pay the money the company lost. A little extra time to back up the system would have saved his whole future. True story!

Note 6

With data and software, here's a good rule of thumb: If you can't get along without it, back it up.

> The time to prepare for disaster is before it occurs. If you have not prepared, the damage from a disaster will most likely be greater than if you had made and followed disaster recovery plans. Suppose the hard drive on your computer or a particular USB flash drive stopped working and you lost all its data. What would be the impact? Are you prepared for this to happen? The following sections discuss some of the decisions you need to make for your backup and recovery plans.

Where to Keep Data and Backups

An overview of six options as to where to keep data and backups is shown in [Figure 13-5](#). Here are the options if you keep your data on your local computer, as shown on the left side of [Figure 13-5](#):

Figure 13-5

Where to keep data and backups
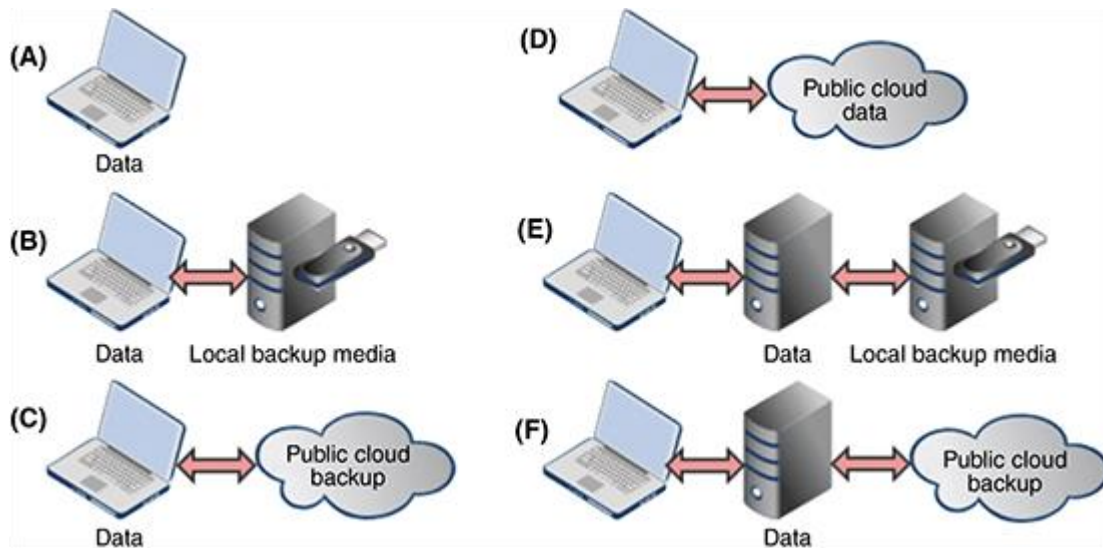
- **Option A: Use no backup.** When you have no backups and your hard drive fails, you have no other choice than to reenter your data.
- **Option B: Create and maintain your own backups.** Windows File History and Windows Backup and Restore are two Windows utilities designed to work in this type of scenario. An advantage of this option is that you have complete control over the data and the backups. The primary disadvantage is you're responsible for all backup and recovery operations. If you use this option, consider what would happen if a catastrophic event, such as a fire or flood, destroys the building where your original data and backups are all located. For this reason, always keep some backups at an off-site location.
- **Option C: Back up to the cloud.** Cloud services such as Carbonite (carbonite.com) and iDrive (idrive.com) are designed for this solution. They automatically copy your data to the cloud when you're connected to the Internet and in real time.

If you don't want to keep data on your local computer, you have these options, shown on the right side of Figure 13-5.

- **Option D: Keep your data in the public cloud.** Examples of cloud services designed to hold your original data and work with your applications are Microsoft OneDrive (onedrive.live.com), which works well with Microsoft Office, and Google Drive (drive.google.com), which integrates well with Google Docs. Using this method, you are trusting the cloud service with the only copy of your data unless you download files.
- **Option E: Data is kept on a local file server and backed up to private media.** Keeping data on a file server rather than the local computer gives more control of the data to the network administrator and makes it easier to share the data among users. The disadvantage of this method is that the user must be on the local network to access the data, which makes it more complicated to access data when

traveling or working from home. With this option, the organization is responsible for maintaining backups.

- **Option F: Data is kept on a local file server and backed up to the cloud.** The main advantage of keeping the backups of an organization's data in a public cloud is the cloud service is responsible for all backup routines and supporting recovery operations when your data is lost.

Note 7

Even though it's easy to do, don't make the mistake of backing up your data to another volume or folder on the same hard drive. When a hard drive crashes, all volumes most likely will go down together, and you will lose your data and your backup. Back up to another device, and for extra safety, store it at an off-site location.

Many organizations trust all their data to a public cloud so the organization is not responsible for maintaining backup software and routines and testing the backups. However, experienced IT technicians agree that you should maintain two backups, one of which is kept off site. These operations standards follow the **3-2-1 backup rule**:

- **Three** copies of your data (the original data and two backups)
- **Two** media (for example, an external hard drive and in the cloud)
- **One** copy off site (for example, in the cloud)

Note 8

This author keeps two backups of data, both in the cloud. I use Carbonite for real-time backups to the cloud, and I back up data on my computer to Dropbox daily.

Many organizations maintain one or more backup routines, and you need to understand how backups and data recovery work and what you are expected to do when maintaining backups for your organization.

Backup Types

Generally, you should back up data for about every 4 to 6 hours of data entry. When you think about it, that's a lot of storage and procedures used for backups. To make backing up the most efficient, three types of backups are used:

- A **full backup** backs up all data designated for backup.
- An **incremental backup** backs up only files that have changed or been created since the last backup, whether that backup is itself an incremental or a full backup.
- A **differential backup** backs up files that have changed or been created since the last full backup. A differential backup does not consider if other differential backups have been performed.

A backup routine always begins with a full backup and then uses either an incremental or differential backup several times, with an additional full

backup made occasionally. When a file, folder, or volume is recovered, the recovery process must reconstruct the lost or corrupted items from the latest full backup and then apply any changes reflected in all the incremental backups since the last full backup—or in the latest differential backup—to create the **synthetic** (reconstructed) file, folder, or volume.

Rotating Backup Media

Backup routines might use the **grandfather-father-son (GFS)** plan for rotating and reusing backup media. The plan is explained in . A **backup operator** would be responsible for putting the plan in writing and keeping a log of backups performed.

Table 13-1

The Grandfather-Father-Son Backup Rotation Plan

Name of Backup	How Often Performed	Storage Location	Description
Son backup	Daily	On site	Make six backups each week, rotated (reused) each week. A Friday backup is made. Label the media Saturday, Sunday, Monday, and so forth. When you rotate the backup media each week, the backup for a given day is overwritten each week.
Father backup	Weekly	Off site	On Friday, perform a weekly full backup, and rotate or reuse the media each month. Label the media Friday1, Friday2, Friday3, and Friday4. Store the media off site.
Grandfather backup	Monthly	Off site, in a fireproof vault	Perform the monthly full backup on the last Friday of the month. Keep 12 media, one for each month, and label them January, February, March, and so forth. Store the media in a vault off site.

The plan shown in the table allows you to rotate media daily, weekly, and monthly. However, if an organization is required to retain data for a longer period, rotations happen less often.

Testing Your Backup Plan

After you have a backup plan working, test the recovery plan. Operations standards should state the frequency that the backup plan is tested to make sure all is still working as you expect and you know how to recover data. Do the following:

- **Test the recovery process.** Erase a file on the hard drive, and use the recovery procedures to verify that you can recreate the file from the backup. This test verifies that the backup media works, that the recovery software is effective, and that you know how to use it. After you are convinced that the recovery procedure works, document how to perform it. Write the documentation so others can follow it in the event you are not present when it's needed.

- **Keep backups in a safe place and routinely test them.** Don't leave a backup DVD, external hard drive, flash drive, or other media lying around for someone to steal. Backups of important and sensitive data should be kept under lock and key at an off-site location. Keep enough backups off-site so that you can recover data even if the entire building is destroyed.

Now let's see how to use Windows tools to back up user data, the entire Windows volume, and important Windows system files. How to back up in macOS and Linux is covered in later modules.

13-1d Back Up User Data and the System Image

- 4.3

Given a scenario, implement workstation backup and recovery methods.

Windows 10 offers File History and Backup and Restore to back up user data and create a system image. A **system image** is a backup of the entire Windows volume, including the Windows installation, applications, user settings, and data. The best time to create the image is right after you've installed Windows, hardware, applications, and user accounts and customized Windows settings. The image is stored in a single file with a .wim file extension. The WIM file uses the Windows Imaging File (WIM) format and is a compressed file that contains many related files.

Note 9

Windows uses only one backup tool at a time, either File History or Backup and Restore. One must be turned off to use the other. In addition, both tools allow only one backup routine. Therefore, if you want to use two backup routines (such as when you want to keep one backup on a local device and a second backup in the cloud), you must use third-party backup software that allows for multiple backup routines.
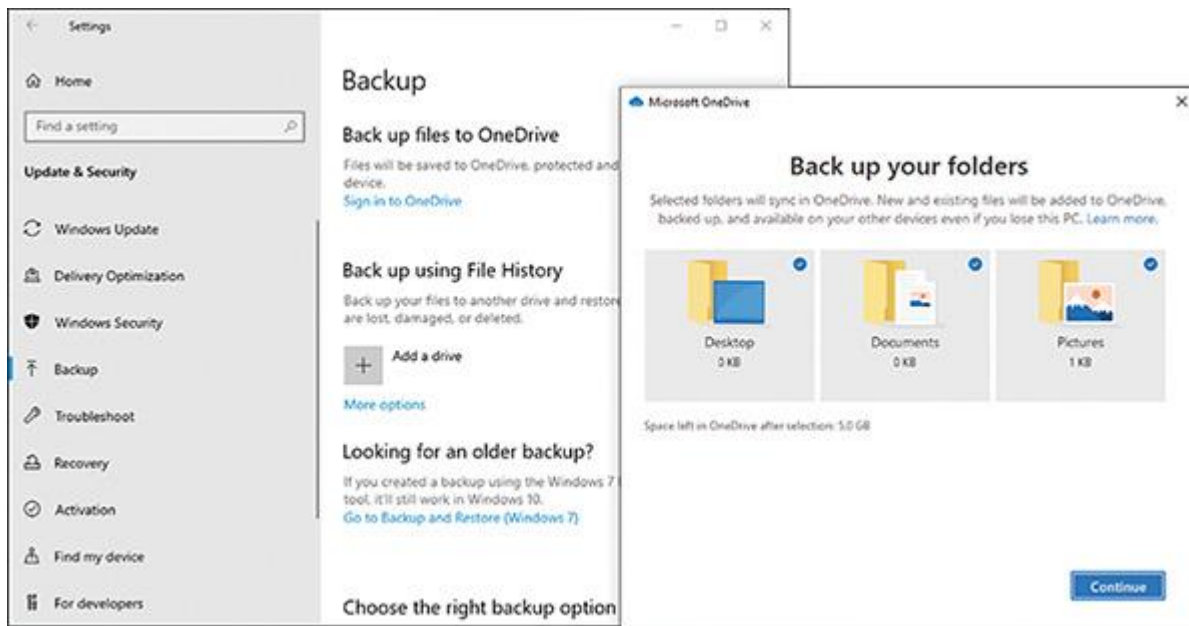
Windows File History

Windows **File History** is a simple backup utility that is easy for users but gives you limited control over backups. When the backup is enabled, it first makes a full backup to another medium. By default, it scans for file and folder changes every hour and keeps as many generations of backups as free space allows on the storage device.

To use File History, first connect your backup device. In the Settings app, click **Update & Security**, then click **Backup**. See the left side of Figure 13-6. You have two options for the backup location:

- To back up to OneDrive in the Microsoft cloud, click **Sign in to OneDrive** and follow directions to back up the Desktop, Documents, and/or Pictures to OneDrive. See the right side of Figure 13-6. Later, if you want to see or recover a file from your backups, open your OneDrive folder in Explorer.
- To back up to a local peripheral device or drive on the network, click **Add a drive** and select the location. By default, File History backs up all data folders in your user profile. To view and change what is backed up, click **More options** in the Backup window.

Figure 13-6

Select what to back up to OneDrive

File History can also be accessed through Control Panel, where you can turn File History on or off, change File History settings, and restore files from backup. Using the File History window in Control Panel, you can click System Image Backup (see Figure 13-7) to start the process of creating a system image.

Figure 13-7

Manage File History settings, create a system image, and restore files from backup
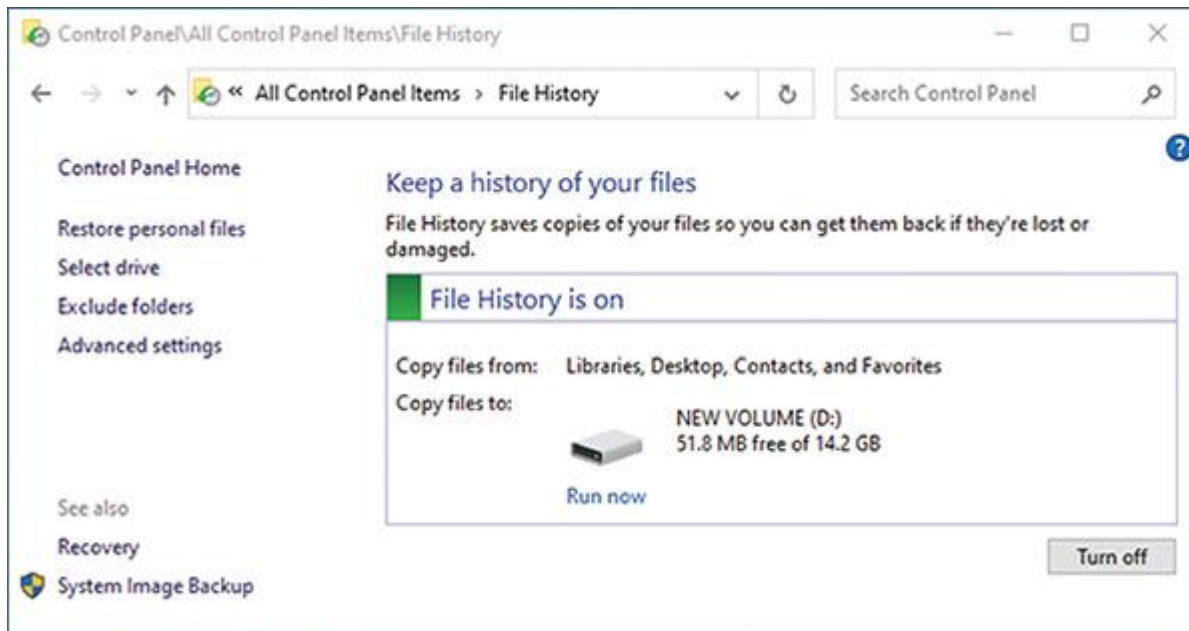
Exam Tip

The A+ Core 2 exam might give you a scenario that expects you to create, use, and test backups.

Windows Backup and Restore

Windows 10 offers **Backup and Restore** to back up any folder on the hard drive and create a system image. While File History is designed to be an easy tool for users to manage their own backups, Backup and Restore is designed for technicians who prefer more granular control of backups.

When you first turn on Backup and Restore, it does a full backup, followed by incremental backups and occasional full backups. If you've established a backup schedule in File History on a Windows 10 machine, those settings will appear in the Backup and Restore window.

Follow these steps to save a full backup and set up an ongoing backup schedule using Backup and Restore in Windows 10:

1. **1**
   Open **Control Panel** in Classic view, and click **Backup and Restore**. If no backup has ever been scheduled on the system, the window will look like the one shown in . Click **Set up backup**.

Figure 13-8

Use the Backup and Restore window to schedule backups
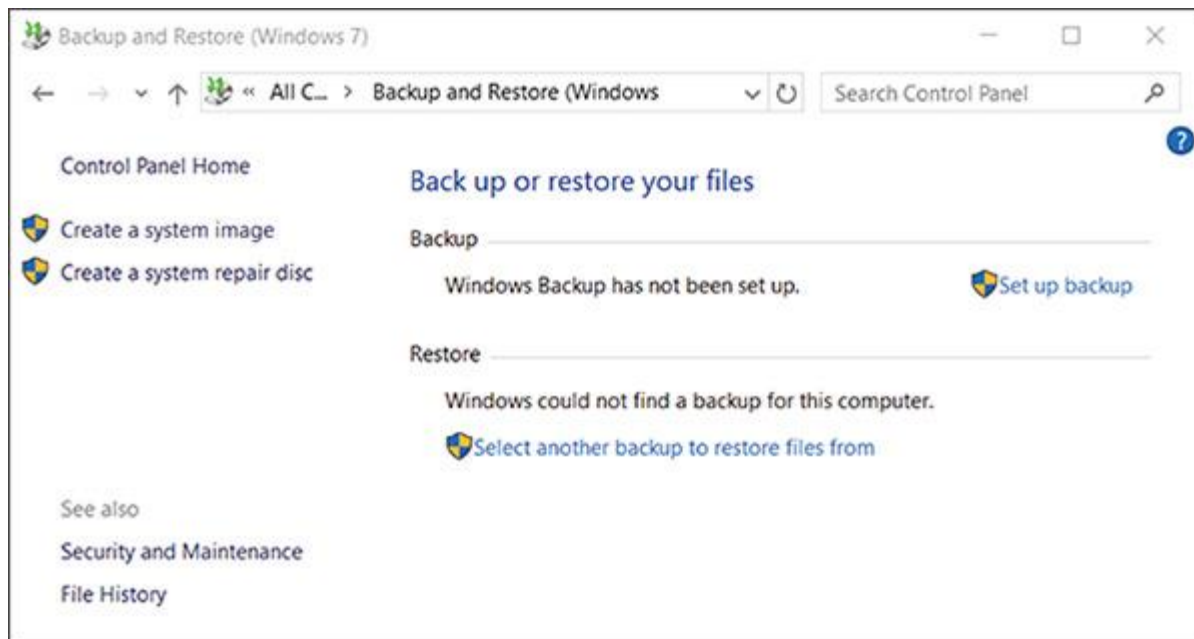
2. **2**

   Select the device or location to hold the backup. All Windows 10 professional and enterprise editions allow you to save the backup to a network location. To do so, click **Save on a network**, click **Browse**, and point to the folder. See . Also enter the user name and password on the remote computer that the backup utility will use to authenticate to that computer when it makes the backup. You cannot save to a network location when using Windows Home editions.

Figure 13-9

Point to a shared folder on the network to hold the backups
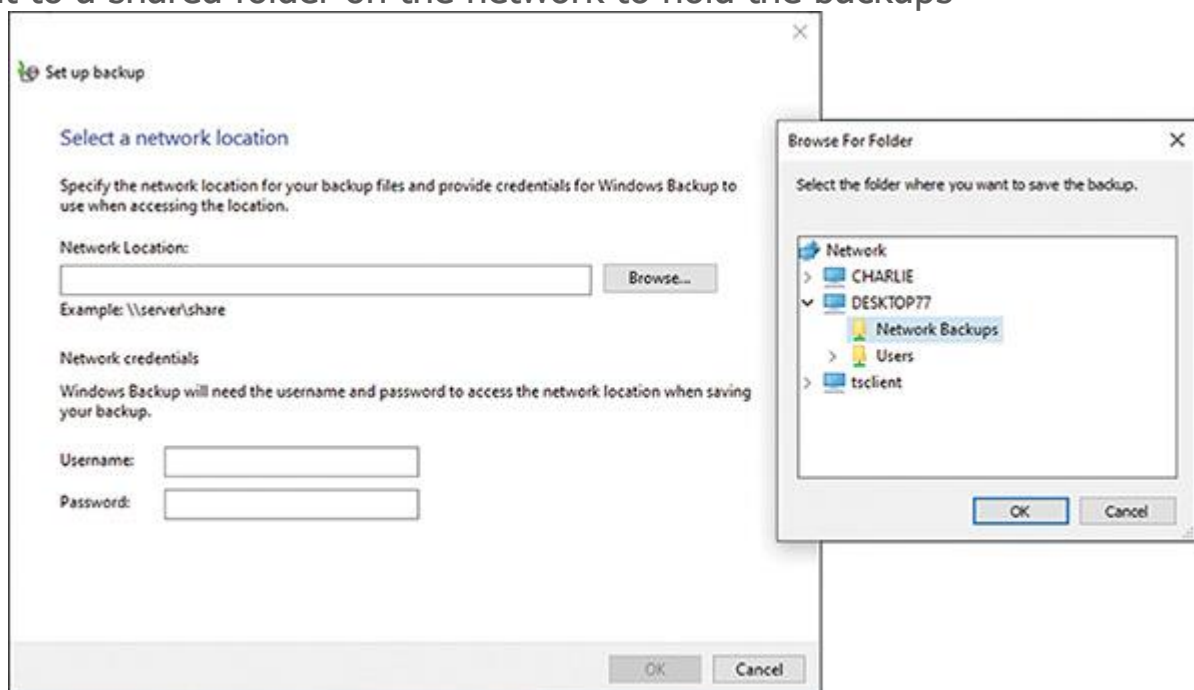
3. **3**

In the next box, you can allow Windows to decide what to back up or choose for yourself. Select **Let me choose** so you can select the folders to back up. Click **Next**.

4. 4

In the next box, make your selections. If the backup medium can hold the system image, the option to include the image is selected by default. If you don't want to include the image, uncheck the option. Click **Next** to continue. Here are folders that might contain important user data:

- Application data is usually found in C:\Users*username*\AppData.
- Better still, back up the entire user profile at C:\Users*username*.
- Even better, back up all user profiles at C:\Users.

5. 5

In the next box, you can verify that the correct items are selected. To change the default schedule, click **Change schedule**. In the next box, you can choose to run the backup daily, weekly, or monthly and select the time of day. Make your selections and click **OK**.

6. 6

Review your backup settings, and click **Save settings and run backup**. The backup proceeds. A shadow copy is made of any open files so they are included in the backup.

Later, you can return to the Backup and Restore window to change the backup settings or to turn off the backup.

Note 10

One limitation of Windows File History and Backup and Restore is that you can have only one scheduled backup routine.

Note 11

After Windows does a full backup, it only backs up files that have changed since the last full backup. Occasionally, it does another full backup. Each full backup is called a backup period. Windows keeps as many backup periods as it has space on the backup device. As free space fills, it deletes the oldest backup periods. To see how space is used on your backup media, click **Manage space** in the Backup and Restore window. In the Manage Windows Backup disk space, you can click **View backups** to delete a backup period, but be sure to keep the most recent backup periods.

Restoring Files and Folders

To restore backed-up items in File History, open **File History** in Control Panel, and click **Restore personal files**. To restore items in Backup and Restore, open the **Backup and Restore** window, and click **Restore my files**. Another way to restore a file or folder from backup is to use Explorer. Follow these steps:

1. 1

When you restore a file or folder to a previous version, the current file or folder can be overwritten by the previous version. To keep the original, first copy—not move—the folder or file to a new location so you can revert to the copy if necessary.

2. 2
   Right-click the file or folder, and select **Restore previous versions** from the shortcut menu. The Properties dialog box for the file or folder appears with the Previous Versions tab selected. Windows displays a list of all previous versions of the file or folder it has kept (see Figure 13-10); these versions were created by File History or Backup and Restore.

Figure 13-10

Restore a file or folder from a previous version
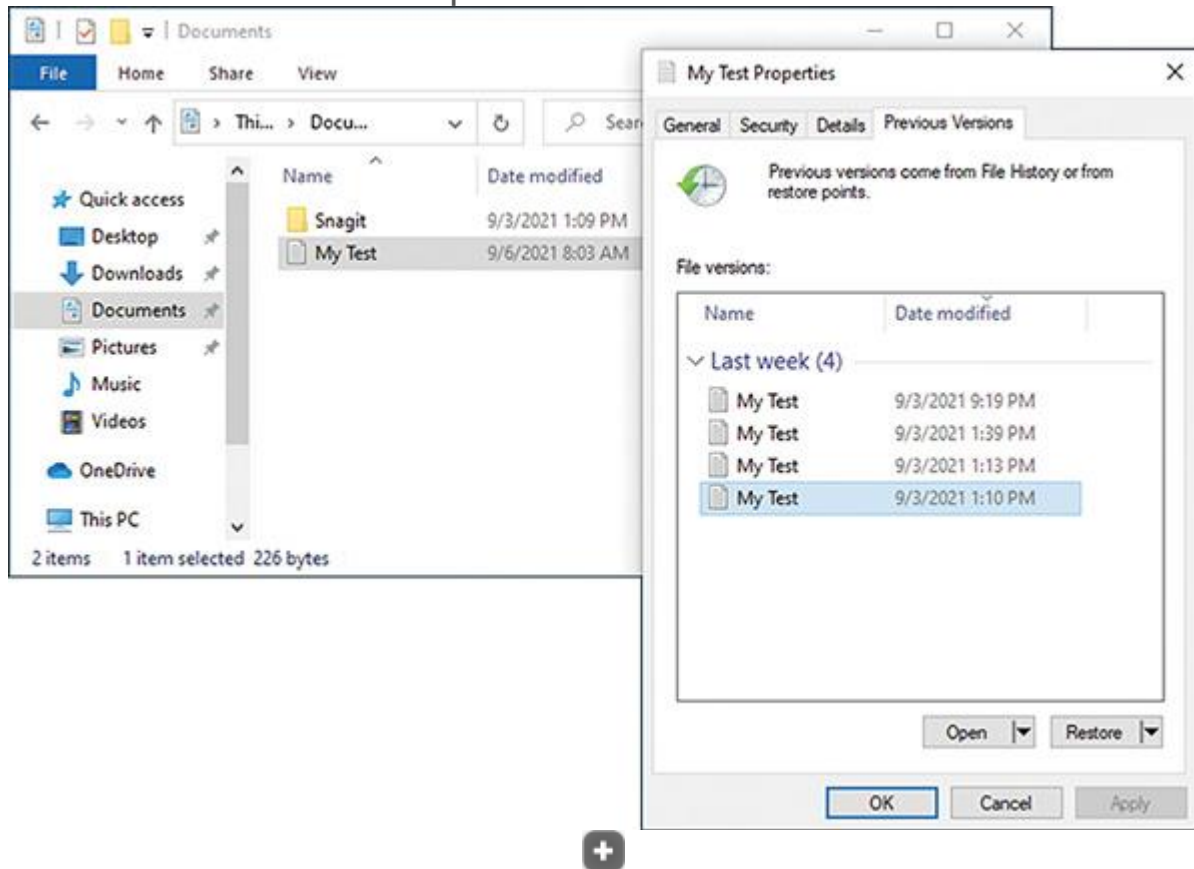
3. 3
   Select the version you want, and click **Restore**. A message box asks if you are sure you want to continue. Click **Restore** and then click **OK**.

4. 4
   Open the restored file or folder, and verify that it is the version you want. If you decide you need another version, delete the file or folder, and copy the file or folder you saved in Step 1 back into the original location. Then return to Step 2 and try again, this time selecting a different previous version.

Tips About the System Image

As you've already learned, the backup of a Windows volume is called a system image. Here are points to keep in mind when creating a system image and using it to recover a failed Windows volume:

- **Creating a system image takes some time.** Before creating a system image on a laptop, plug the laptop into an AC outlet so that a failed battery will not interrupt the process.
- **A system image includes the entire drive C: or other drive on which Windows is installed.** When you restore a hard drive using the system image, everything on the volume is deleted and replaced with the system image.
- **Don't depend just on the system image as your backup.** You should back up individual folders that contain user data separately from the system image. If only individual data files or folders need to be recovered, you would not want to use the system image for the recovery because it would totally replace the entire Windows volume.
- **You can create a system image any time after Windows is installed, and then you can use this image to recover from a failed hard drive.** Using the system image to recover a failed hard drive is called reimaging the drive. The details of how to reimage a drive are covered in the module "Troubleshooting Windows Startup."

Note 12

The system image you create can be installed only on the computer that was used to create it. A hardware-independent image is called a standard image or deployment image, as you learned in the module "Installing Windows."

13-1e Back Up Windows System Files with System Protection

Core 2 Objective

- 1.4

Given a scenario, use the appropriate Microsoft 10 Control Panel utility.

Before Windows gives trouble, you can prepare for an easy fix by backing up critical Windows system files. When the **System Protection** utility is turned on, it automatically backs up system files and stores them on the hard drive weekly and just before major Windows updates and user applications are installed. These snapshots of the system are called **restore points** and include Windows system files that have changed since the last restore point was made. A restore point does not contain all user data, and you can manually create a restore point at any time. **System Restore** (rstrui.exe) restores the system to its condition at the time a restore point was made. If

you restore the system to a previous restore point, user data on the hard drive will not be altered, but you can affect installed software and hardware, user settings and passwords, and OS configuration settings. You'll learn more about System Restore in the module "Troubleshooting Windows After Startup."

Enabling System Protection

System Protection is turned off by default in Windows 10. To enable System Protection, open **Control Panel**, open the **System** window in Settings, and click **About**. In the left panel of the About window, click **System protection**. (Alternately, you can click **Recovery** in Control Panel and then click **Configure System Restore**.) The System Protection tab of the System Properties dialog box appears (see the left side of Figure 13-11). Make sure protection is turned on for the drive containing Windows, which indicates that restore points are created automatically. In Figure 13-11, protection for drive C: is on, and other drives are not being protected. To make a change, click **Configure**. The System Protection dialog box appears, as shown on the right side of the figure. If you make a change to this box, click **Apply** and then click **OK**.

Figure 13-11

Make sure System Protection is turned on for the volume on which Windows is installed
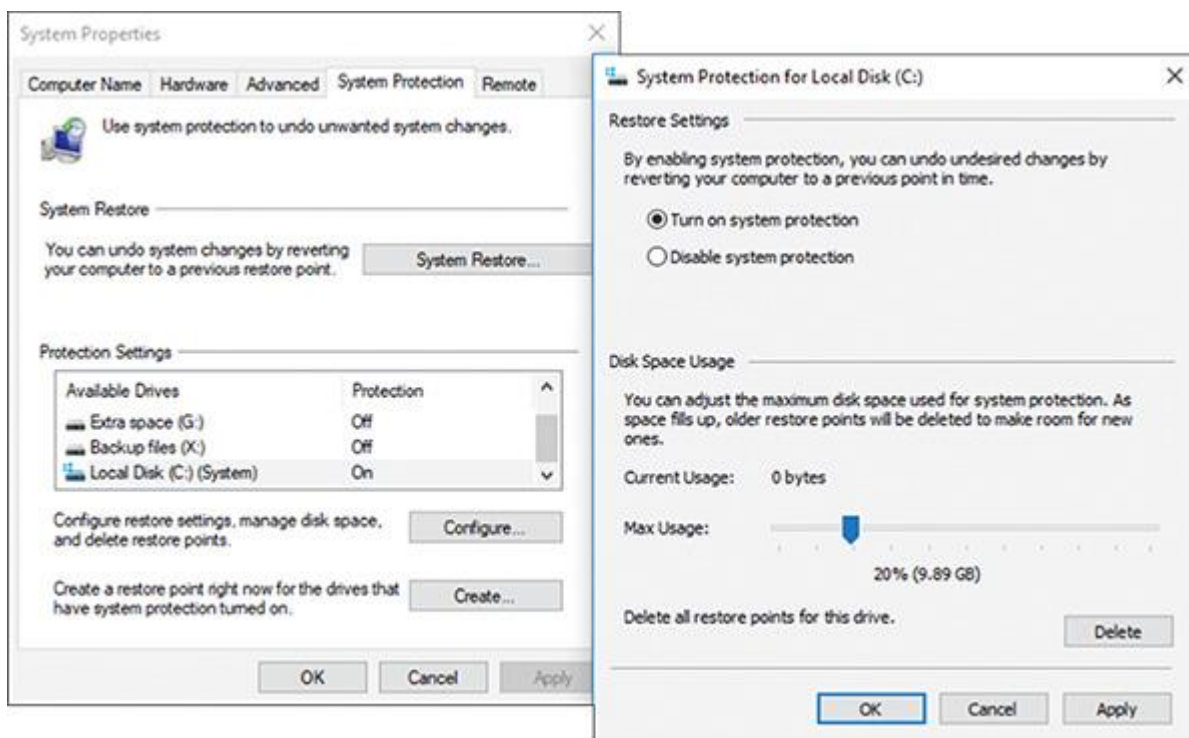
Restore points are normally kept in a hidden folder named C:\System Volume Information, which is not accessible to the user. Restore points are taken at least weekly, and they can use up to 10 GB or 5% of disk space. If overall disk space gets very low, restore points are no longer made, which is one more good reason to keep at least 15% or more of the hard drive free. Also notice in Figure 13-11 that you can limit how much of the disk can be used for restore points, and you can click **Delete** to delete all restore points.

Manually Creating a Restore Point

Before you make major changes to the system, you can manually create a restore point so you can back out of your changes if necessary. To create a restore point, use the System Protection tab of the System Properties box, as shown on the left side of Figure 13-11. Click **Create**. In the System Protection box, enter a name for the restore point, such as "Before I tested APP3 software," and click **Create**. The restore point is created.

13-2 Maintaining Hard Drives

Core 2 Objectives

- 1.3

  Given a scenario, use features and tools of the Microsoft 10 operating system (OS).

- 1.4

  Given a scenario, use the appropriate Microsoft 10 Control Panel utility.

  For best performance, Windows needs at least 15% free space on the hard drive that it uses as working space, so it's important to uninstall software you no longer need and occasionally delete unneeded files. In addition, you can optimize a hard drive and control indexing to improve performance. You also need to know how to set up a new hard drive installed in a system. All these tasks are covered in this section of the module. Let's start with changing settings in File Explorer Options.

Note 13

Files deleted from the hard drive are stored in the Recycle Bin on the desktop. Emptying the Recycle Bin will free up your disk space by permanently deleting the files. To empty the Recycle Bin, right-click the bin and select **Empty Recycle Bin** from the shortcut menu.

Note 14

A compressed folder can save space on the hard drive and is often used to make files smaller so they can more easily be sent by email. A compressed (zipped) folder has a .zip extension. Any file or folder that you put in this folder will be compressed to a smaller size than normal. When you remove a file or folder from a compressed folder, the file or folder is uncompressed back to its original size. In general, Windows treats a compressed folder more like a file than a

folder. To create a compressed folder, right-click in white space in the Explorer window, select **New** from the shortcut menu, and click **Compressed (zipped) Folder**.

13-2a File Explorer Options

- 1.4

Given a scenario, use the appropriate Microsoft 10 Control Panel utility.

The Windows **File Explorer Options applet** in Control Panel is used to control how users view files and folders in Explorer and what they can do with these files. Windows has an annoying habit of hiding file extensions if it knows which application is associated with a file extension. For example, just after installation, it hides .exe, .com, .sys, and .txt file extensions, but does not hide .docx, .pptx, or .xlsx file extensions until the software to open these files has been installed. Also, Windows really doesn't want you to see its own system files, and it hides these files from view until you force it to show them.

Note 15

The Windows desktop is itself a folder on the hard drive and is located at C:\Users*username*\Desktop. For example, if the user, Anne, creates a folder named MyFiles on her desktop, the folder path is C:\Users\Anne\Desktop\MyFiles.

Applying Concepts

### Changing File Explorer Options

- **Est. Time:** 15 minutes
- **Core 2 Objective:** 1.4

A technician is responsible for solving problems with system files (files that belong to the Windows operating system) and file extensions. To fix problems with these files and extensions, you need to see them first. To change File Explorer options so you can view system files and file extensions, do the following:

1. 1

   Open **Control Panel** in Classic view and click **File Explorer Options**. The File Explorer Options dialog box appears. On the General tab (see Figure 13-12A), you can change settings for how Explorer navigates folders and handles the navigation pane.

Figure 13-12

Use File Explorer Options to control how Explorer works and displays files and folders

(A)   (B)
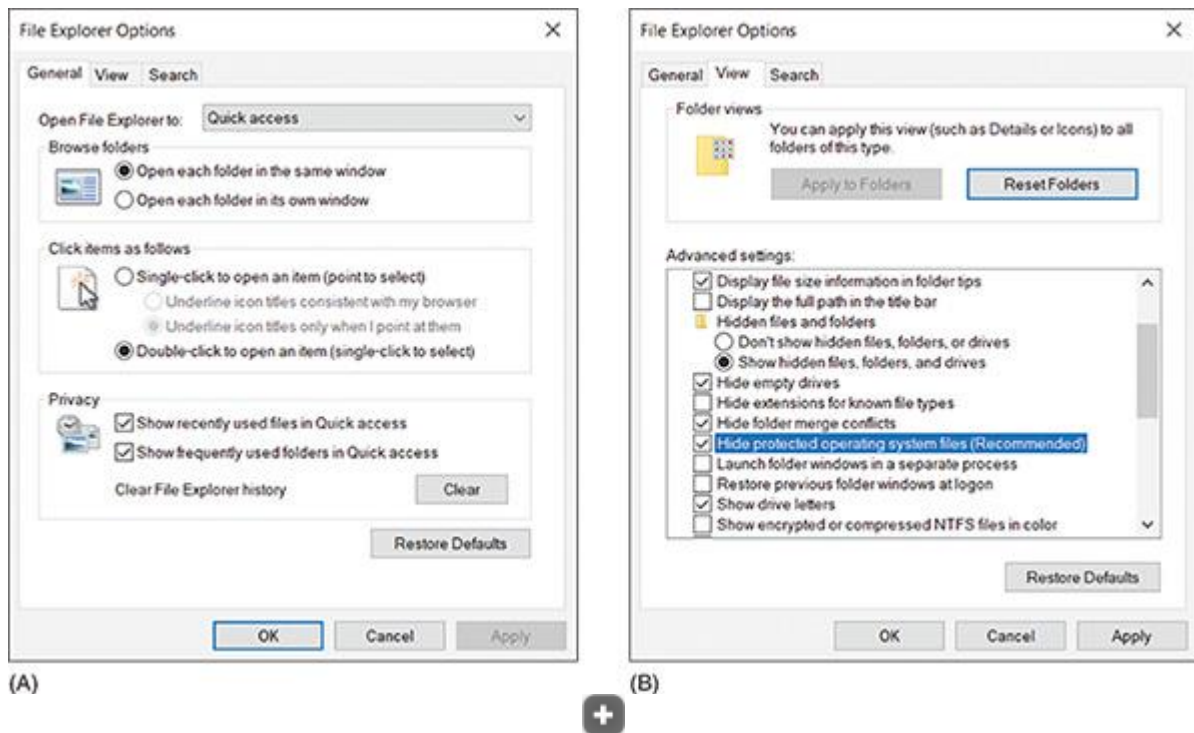
2. **2**

Click the **View** tab. Scroll down in the Advanced settings group, and make these selections to show hidden information about files, folders, and drives, as shown in :

- Select **Show hidden files, folders, and drives**.
- Uncheck **Hide extensions for known file types**.
- Uncheck **Hide protected operating system files (Recommended)**, and respond to the Warning box.

3. **3**

To save your changes and close the File Explorer Options box, click **OK**.

✔ Exam Tip

The A+ Core 2 exam expects you to know how to view hidden files and file extensions in Explorer.

13-2b Clean the Hard Drive

Core 2 Objective

- 1.3

  Given a scenario, use features and tools of the Microsoft 10 operating system (OS).

  The Windows **Disk Cleanup** (cleanmgr.exe) utility deletes temporary files on the drive. To delete unneeded files on a drive, do the following when starting the utilities from Explorer:

1. To delete unneeded files, open **Explorer**, right-click drive **C:**, and click **Properties**. On the General tab of the drive Properties box, click **Disk Cleanup** to calculate how much space can be cleaned up. See Figure 13-13.
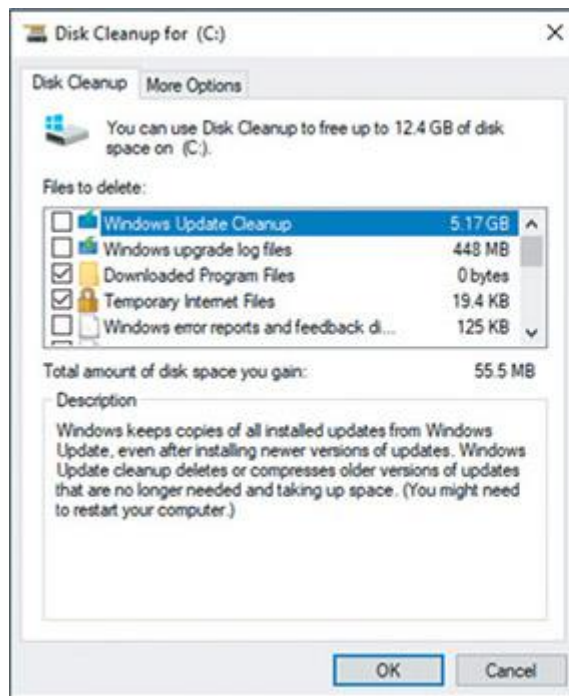
Figure 13-13
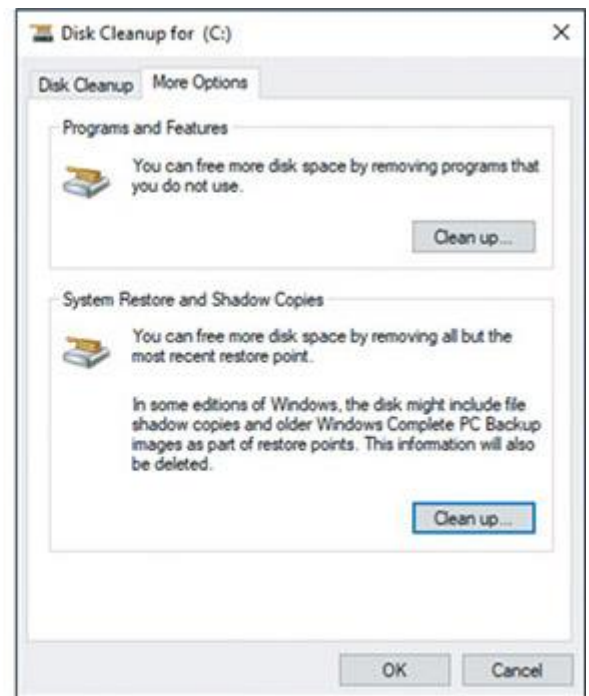
Delete unneeded files on a hard drive to free up space
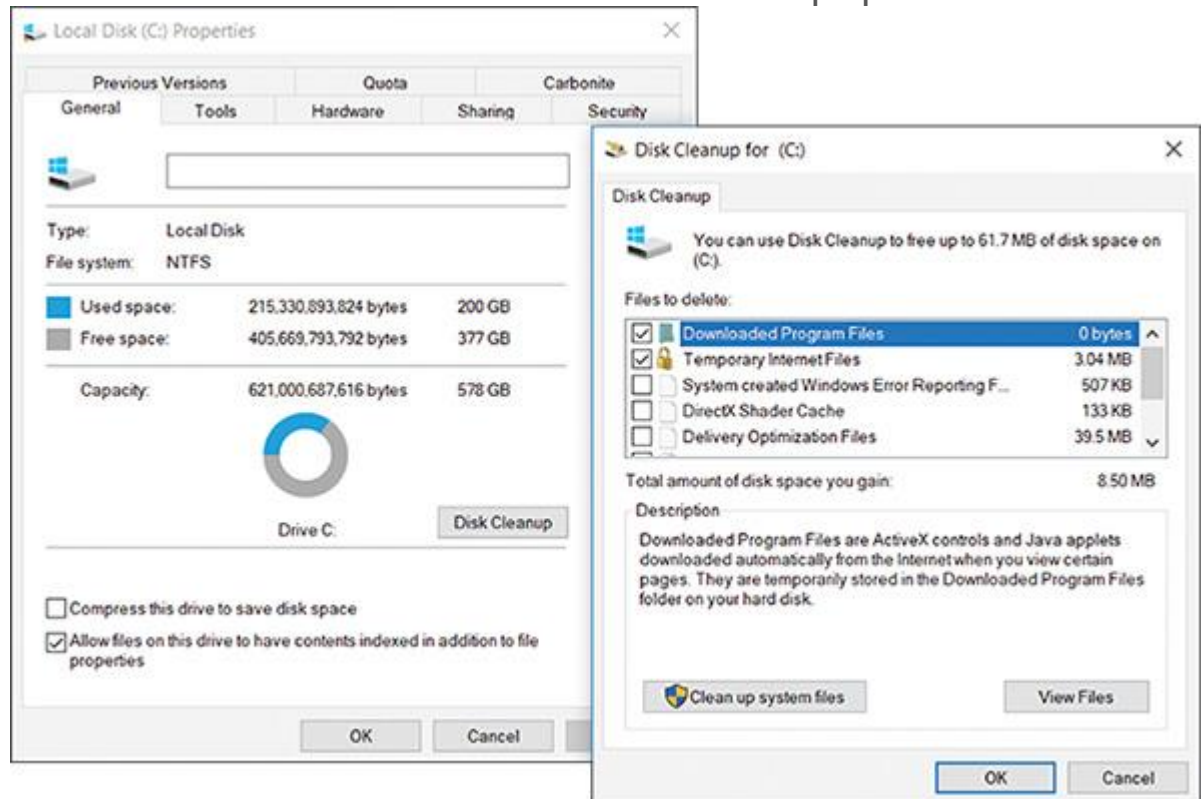
2. To see system files that can also be safely deleted, click **Clean up system files**. See Figure 13-14A. Highlight a file type to see a description about it. Select the file types to delete and click **OK**.

Figure 13-14

(A) Deleted unneeded files, including system files, and (B) delete all but the most recent restore point

(A)　　　　　　　　　　　　　　　　　　　(B)

3. Click the **More Options** tab (see Figure 13-14B). When you click **Clean up** in the System Restore and Shadow Copies area, all but the most recent restore point are deleted, which can clean up even more disk space.

When Windows installs, it stores the old installation in the Windows.old folder. Windows 10 deletes the folder 10 days after the installation. If you see the Windows.old folder left over from a Windows 8/7 systems, include it in the list to be deleted to free up disk space.

13-2c Optimize the Hard Drive

Core 2 Objective

- 1.3

Given a scenario, use features and tools of the Microsoft 10 operating system (OS).

Two types of hard drives are magnetic hard disk drives (HDDs), which contain spinning platters, and solid-state drives (SSDs), which contain flash memory. Windows uses the **Defragment and Optimize Drives** (dfrgui.exe) utility to automatically defragment a magnetic drive and to trim an SSD once a week. Let's look at what each of these operations accomplishes:

- **Magnetic hard drives.** To **defragment** (or defrag) is to rearrange fragments or parts of files on the drive so each file is stored on the drive in contiguous clusters. Each platter on a magnetic hard drive is

divided into tracks, which are divided into sectors (see [Figure 13-15](#)). In a file system, a **cluster**, also called a **file allocation unit**, is a group of whole sectors. The number of sectors in a cluster is fixed and is determined when the file system is first installed. A file is stored in whole clusters, and the unused space at the end of the last cluster, called **slack**, is wasted free space. As files are written and deleted from an HDD, clusters are used, released, and used again. New files written on the drive can be put in available clusters spread over the drive. Over time, drive performance is affected when the moving read/write arm of a magnetic drive must move over many areas of the drive to collect all the fragments of a file. Defragmenting a drive rewrites files in contiguous clusters and improves drive performance.

Figure 13-15

A magnetic hard drive is divided into concentric circles called tracks, and tracks are divided into sectors
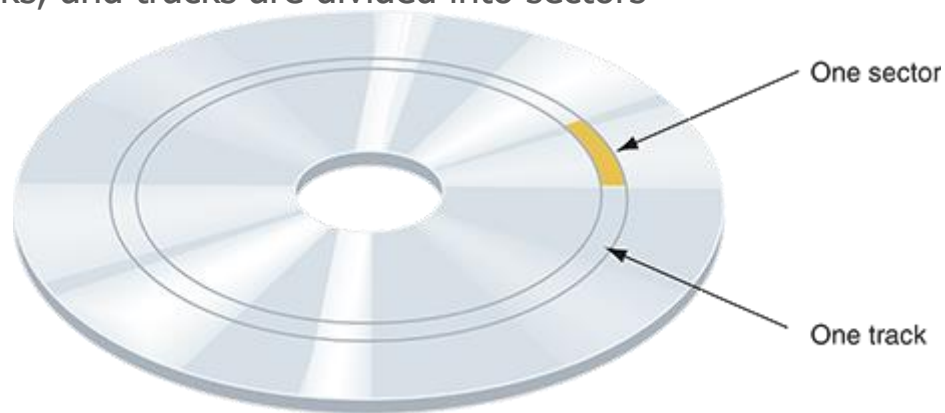

- **Solid-state drives.** The life span of an SSD is largely determined by the number of read/writes to the drive. Therefore, defragmenting an SSD can reduce the life of the drive and is not recommended—Windows disables defragmenting for solid-state drives. However, performance of an SSD can benefit from trimming. To **trim** an SSD is to erase a block on the drive that is filled with unused data. An SSD is organized in blocks, and each block contains many pages. A file can spread over several pages in various blocks. Each time a new page is written to the drive, the entire block to which it belongs must be read into a buffer, erased, and then rewritten with the new page included. When a file is deleted, information about the file is deleted, but the actual data in the file is not erased. This can slow down SSD performance and reduce the life of the drive because the unused data must still be read and rewritten in its block. Windows sends the trim command to an SSD drive to erase a block that no longer contains useful data so a write operation does not have to manage the data.

Follow these steps to optimize the hard drive:

1. Using Explorer, open the **Properties** dialog box for Drive C:, and select the **Tools** tab. Click **Optimize**. The Optimize Drives dialog box appears (see the left side of Figure 13-16). This system has two hard drives installed. Drive C: is an SSD, and drive E: is a magnetic HDD. Drive D: is a removable USB flash drive.

Figure 13-16

Windows is set to automatically defragment a magnetic hard drive once a week
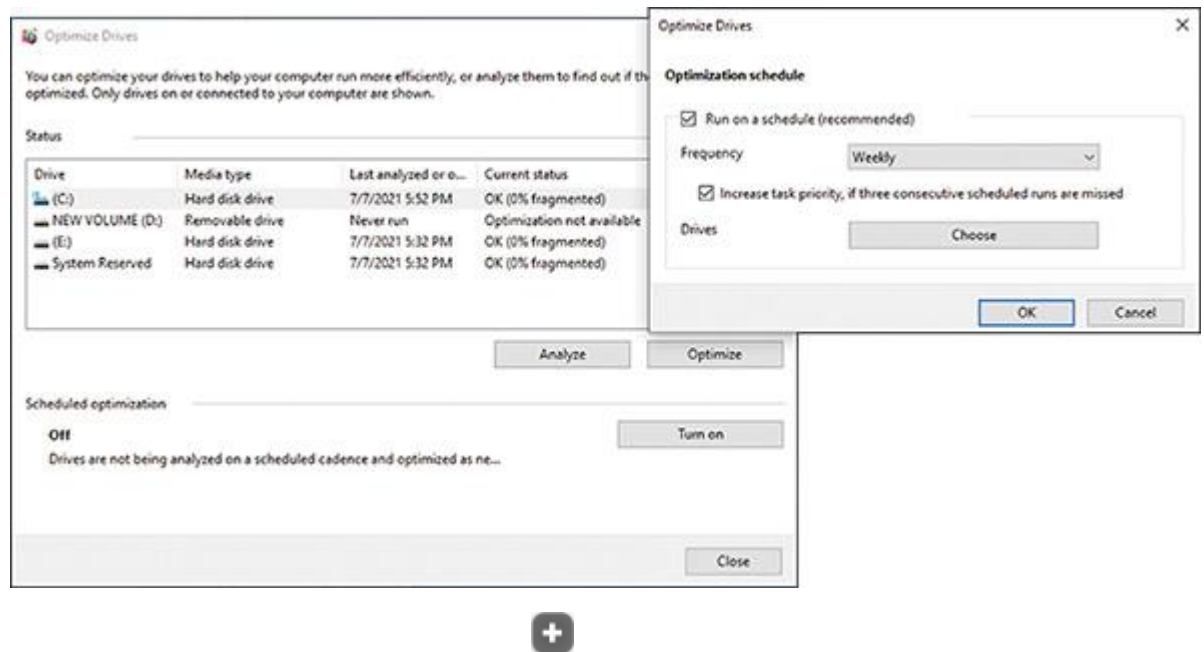
2. Here are tasks you can do:

   - For a magnetic drive, click **Analyze** for Windows to tell you if a drive needs defragmenting. To defrag the drive, click **Optimize**. The process can take a few minutes to several hours. If errors occur while the drive is defragmenting, check the hard drive for errors and try to defragment again.
   - For a solid-state drive, click **Optimize** to trim the SSD.
   - Near the bottom of Figure 13-16, you can see scheduled optimization is turned off. To turn it on, click **Turn on**. In the dialog box that appears (see the right side of Figure 13-16), check **Run on a schedule (recommended)**, and select **Weekly** for the Frequency. Click **OK**.
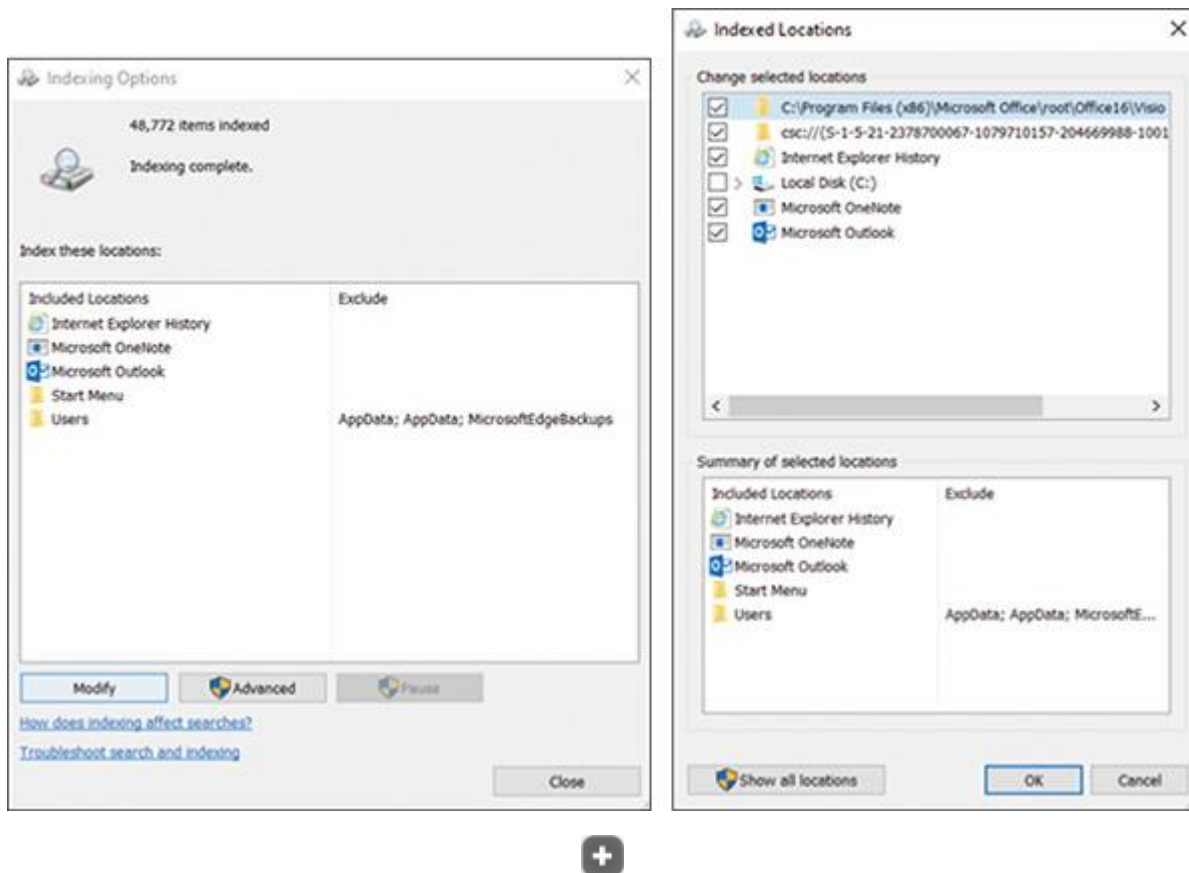
13-2d Indexing Options

- 1.4

Given a scenario, use the appropriate Microsoft 10 Control Panel utility.

File Explorer and the Windows taskbar offer a search box that can be used to search the hard drive. The **Indexing Options applet** in Control Panel is used to control how Windows manages an index of content on the drive to help make searches go faster. See Figure 13-17.

Figure 13-17

Use Indexing Options to manage what Windows indexes to speed up searches

Do the following to explore how indexing can be managed:

1. Open **Control Panel** in Classic view and then open the **Indexing Options** applet. The Indexing Options dialog box on the left side of Figure 13-17 shows what is currently indexed.
2. To modify this list, click **Modify**. In the Indexed Locations dialog box (see the right side of Figure 13-17), select what you want to index and click **OK**.
3. Click **Advanced**. In the Advanced Options dialog box (see Figure 13-18), notice you can rebuild the index. This can fix a problem if searches are giving errors. Also notice the File Types tab in this box. Use this tab to select what file types (listed by their file associations) are indexed.

Figure 13-18

Use Advanced Options to rebuild an index and decide what file types are indexed
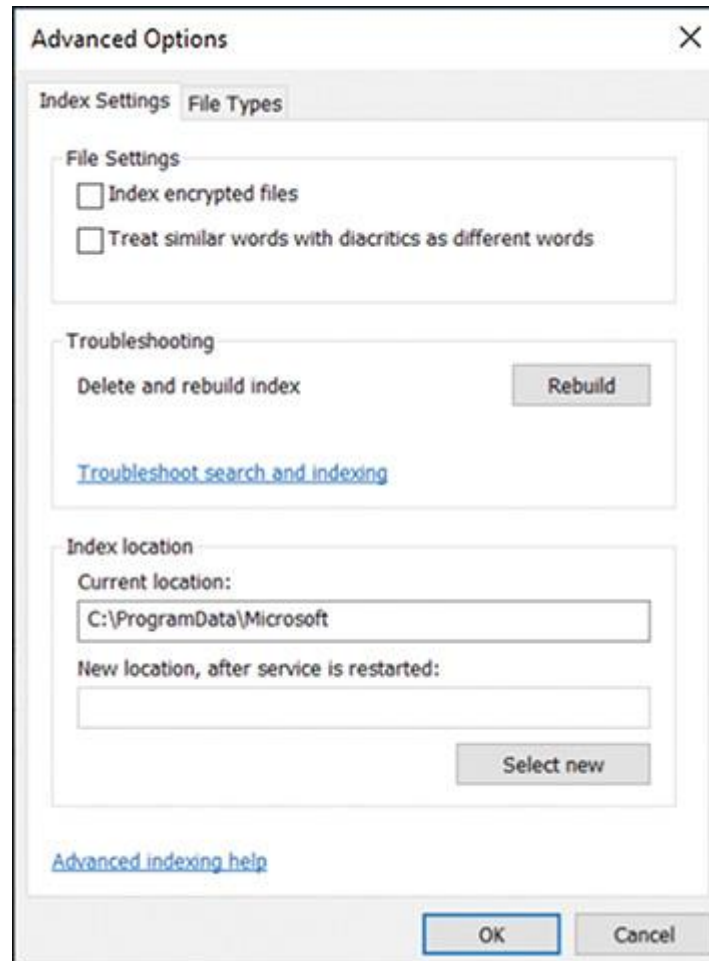
For best performance, select for indexing only those items that the user searches often. For example, at the top of Figure 13-17, you can see more than 48,000 items are being indexed. By selecting only a few types of files for indexing, such as OneNote and Outlook files, fewer system resources are required to maintain the index. If a user does not search often, turning off indexing can improve system performance. In addition, indexing is constantly writing to the hard drive, and if the drive is an SSD, the life span of the drive is decreased. Indexing is turned off by disabling the Windows Search background process, which you learn how to do in the module "Troubleshooting Windows After Startup." Searches still work; they are just slower.

13-2e Use Disk Management to Manage Hard Drives

Core 2 Objective

- 1.3

Given a scenario, use features and tools of the Microsoft 10 operating system (OS).

In the module "Installing Windows," you learned how to install Windows on a new hard drive. This installation process initializes, partitions, and formats the drive. After Windows is installed, you can use **Disk Management** (diskmgmt.msc) to install and manage drives. In this part of the module, you learn to use Disk Management to manage partitions on a drive, prepare a new drive for first use, mount a drive, use Windows dynamic disks, and troubleshoot problems with the hard drive.

⚠ Caution

Before you use Disk Management to make changes to a drive, be sure to back it up first.

Applying Concepts

Examining Hard Drives Using Disk Management

- **Est. Time:** 15 minutes
- **Core 2 Objective:** 1.3

Let's use Disk Management to view the hard drives in two systems:

1. 1

   To open the **Disk Management** window, use one of these methods:

   - Right-click **Start** and click **Disk Management**.
   - Enter **diskmgmt.msc** in the Windows search box in the taskbar.

   In Figure 13-19, you can see an example of the Disk Management window showing three MBR hard drives in a system. In this computer, Windows is installed on Disk 0; Disk 1 is an unformatted drive, and Disk 2 is formatted using the NTFS file system. On Disk 0, the first partition is the System Reserved partition, which is designated the active partition and the Windows system partition. The boot partition is drive C:, where Windows is stored.

Figure 13-19

Three MBR disks with Windows 10 installed on Disk 0
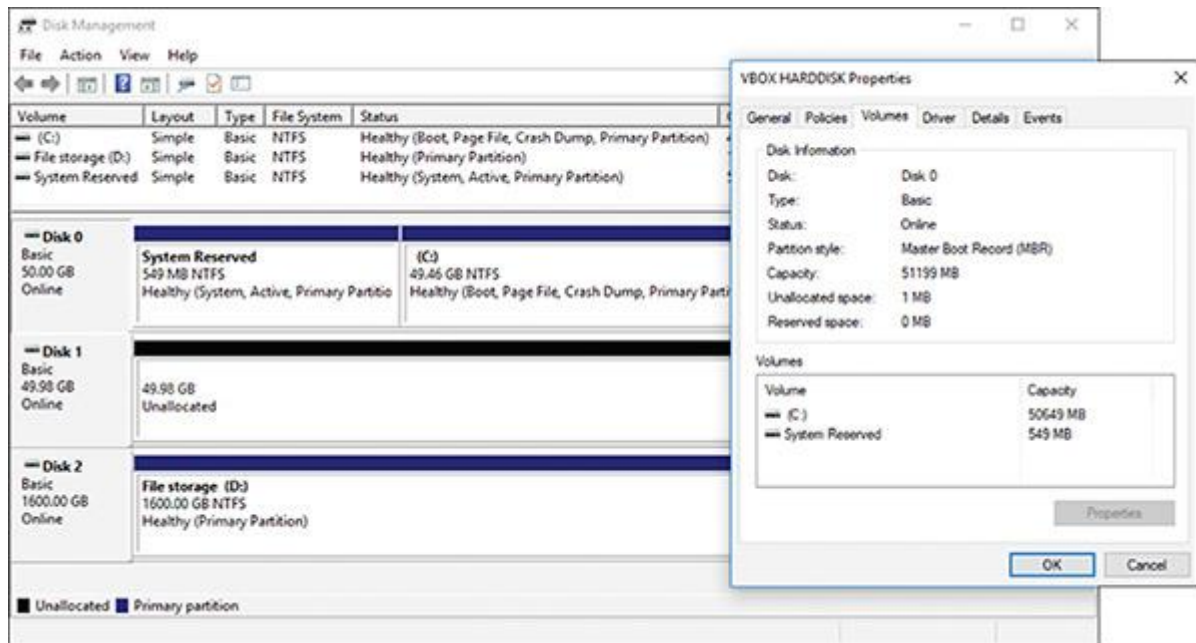
2. 2

To see the Disk 0 Properties box, right-click **Disk 0** on the left side of the Disk Management window and click **Properties**. The Properties dialog box appears, as shown in . Select the **Volumes** tab to find out the partitioning system for the disk.

shows another computer that has a single GPT hard drive installed. Among other partitions, it contains an OEM recovery partition, the EFI System Partition, and drive C:, which is designated the boot partition and holds the Windows 10 installation.

Figure 13-20

A GPT disk with Windows 10 installed
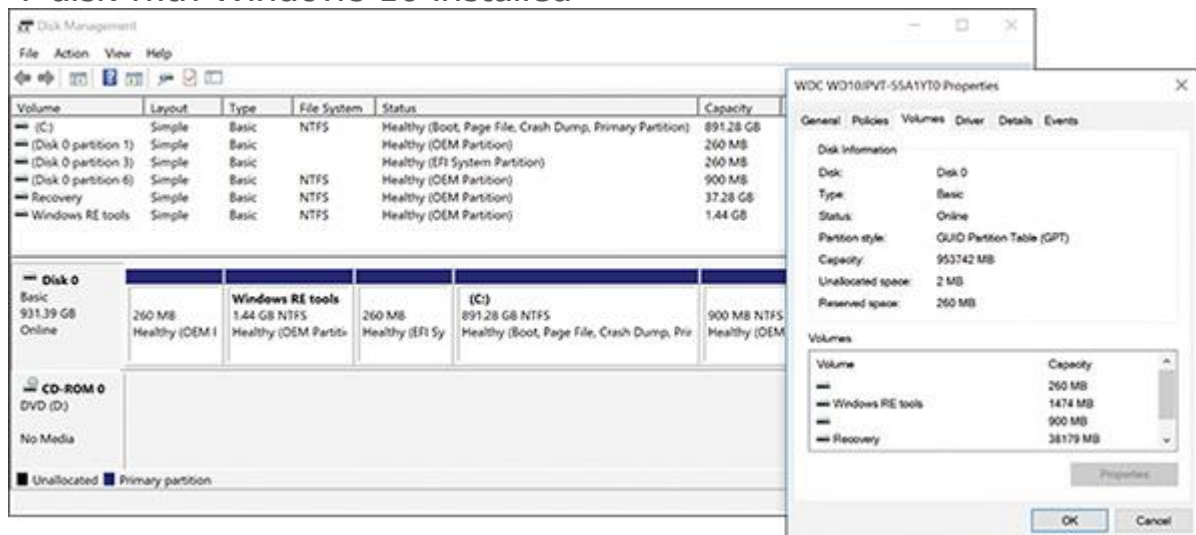
Resize, Create, and Delete Partitions

Suppose you have installed Windows 10 on a hard drive and used all available space on the drive for the one partition. Now you want to split the partition into two partitions so you can use the second one to hold the backups for another computer on the network. You can use Disk Management to shrink the original partition, which frees up some space for a new partition for Ubuntu on the network to use for backups. Let's see how it's done:

1. Open the **Disk Management** window (see Figure 13-21).

Figure 13-21

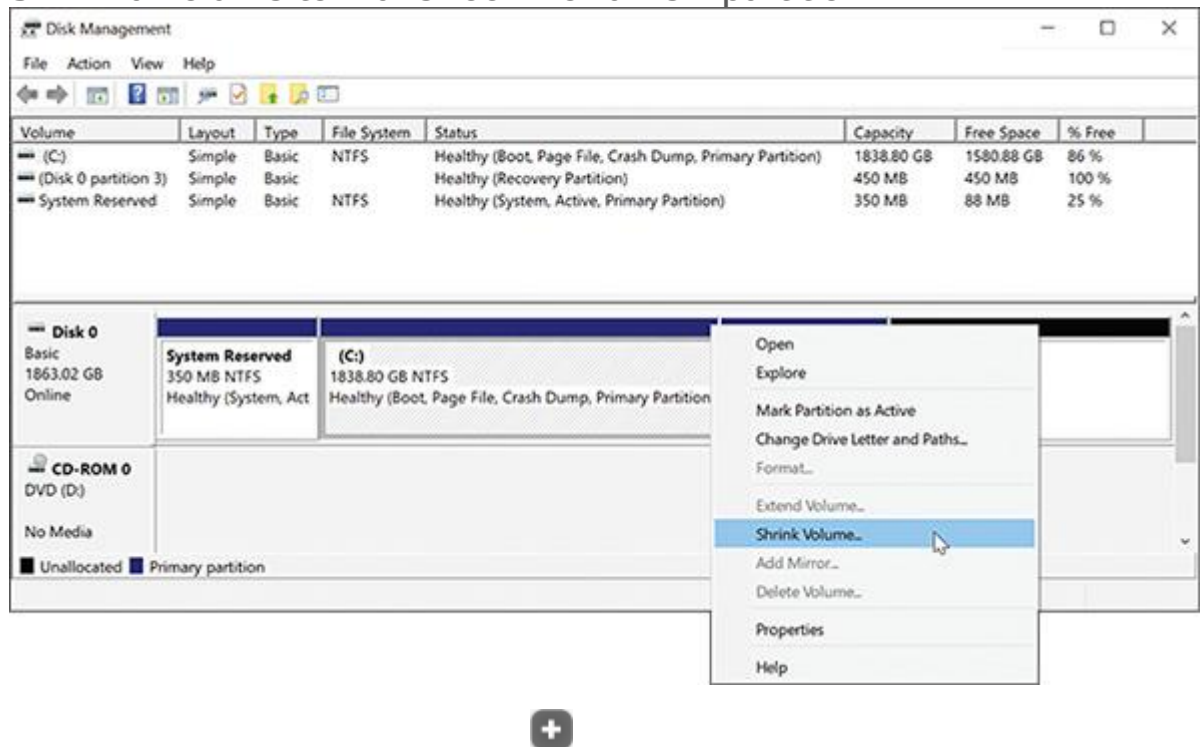Shrink a volume to make room for a new partition

2. To shrink the existing partition, right-click in the partition space and select **Shrink Volume** from the shortcut menu (see Figure 13-21). The Shrink dialog box appears and shows the amount of free space on the partition. Enter the amount in MB to shrink the partition; this amount cannot be more than the available amount of free space so no data on the partition will be lost. (For best performance, be sure to leave at least 20% free space on the existing partition.) Click **Shrink**. The disk now shows unallocated space.

3. To create a new partition in the unallocated space, right-click in that space and select **New Simple Volume** from the shortcut menu (see Figure 13-22). The New Simple Volume Wizard opens.

Figure 13-22

Use unallocated space to create a new partition
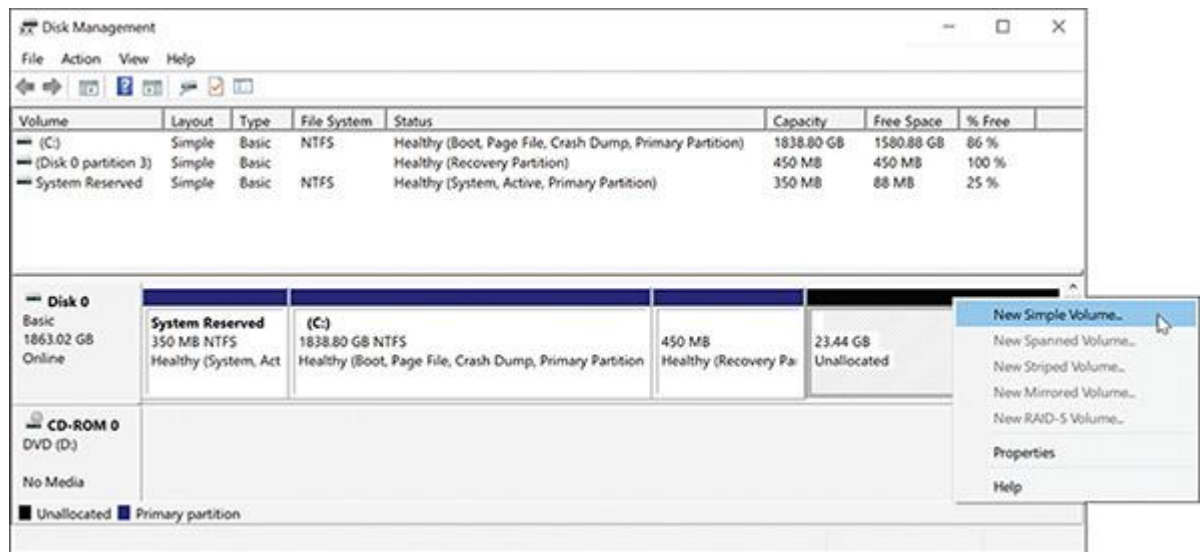
4. Follow the on-screen directions to enter the size of the volume in MB, select a drive letter for the volume, and select a file system. Leave the Allocation unit size at Default. You can also enter a Volume label and decide to do a quick format. (A **quick format** does not check the volume for bad sectors.) The partition is then created and formatted with the file system you chose. When you open Explorer, you should see the new volume listed.

Notice in [Figure 13-21](#) the options on the shortcut menu for this MBR system, where you can make the partition the active partition (the one BIOS/UEFI looks to for an OS), change the drive letter for a volume, format the volume (which erases all data on it), extend the volume (increase its size), and shrink or delete the volume. Any option not available for the particular volume and situation is grayed out.

✅ Exam Tip

The A+ Core 2 exam expects you to know how to use Disk Management to extend, split, and shrink partitions and configure a new hard drive in a system.

Prepare a Drive for First Use

When you install a new, second hard drive in a computer, use Disk Management to prepare the drive for use. This happens in a two-step process:

1. **1**

   Initialize the disk. When the disk is initialized, Windows identifies it as a basic disk. A **basic disk** is a single hard drive that works independently of other hard drives. When you first open Disk Management after you have installed a new hard drive, the Initialize Disk dialog box automatically appears (see [Figure 13-23](#)). Select the partitioning system (MBR or GPT) and click **OK**. Disk Management now reports the hard drive as a Basic disk.

Figure 13-23

Use the Initialize Disk box to set up a partitioning system on new hard drives
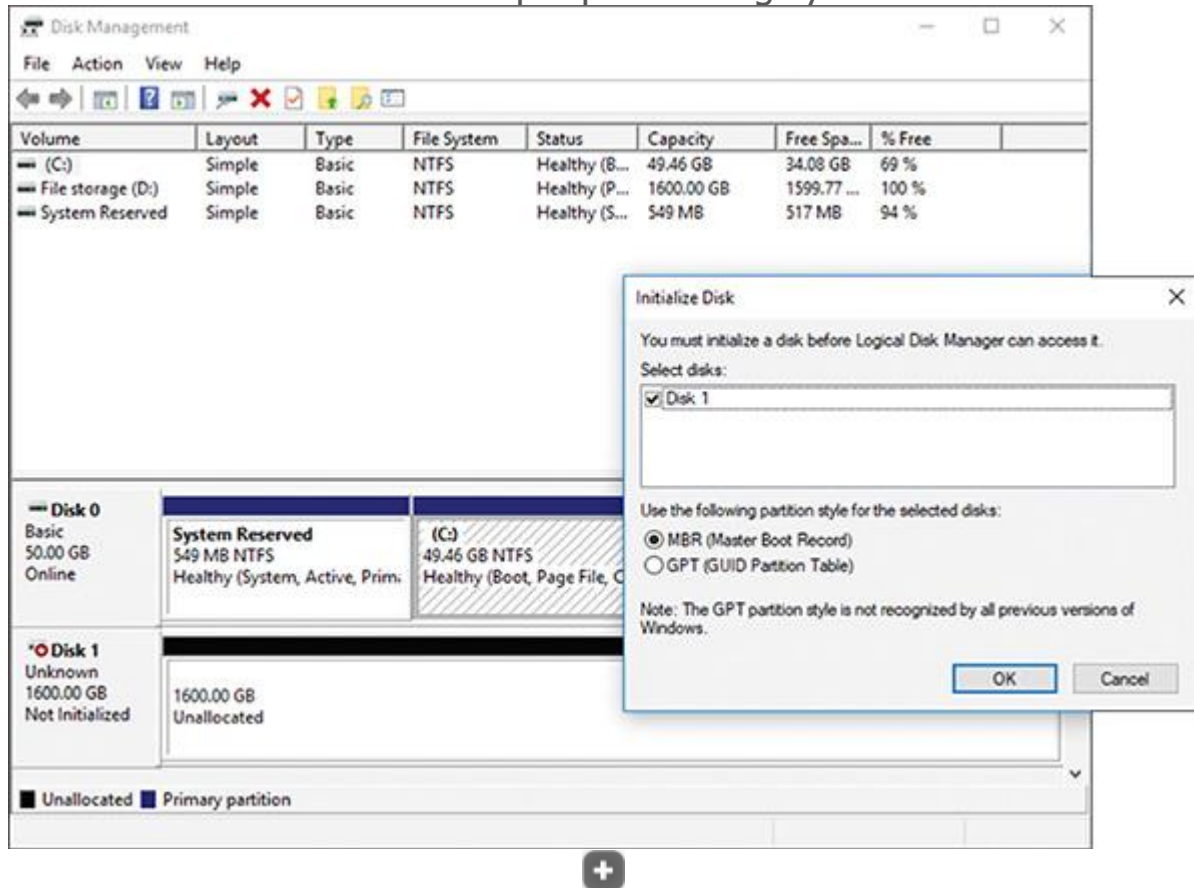
After installing a new hard drive, if you don't see the Initialize Disk dialog box when you first open Disk Management, right-click in the Disk area and select Initialize Disk from the shortcut menu. The Initialize Disk dialog box will appear.

2. 2

Create a volume and format it with a file system. As you learned to do earlier, you can now create a New Simple Volume in unallocated space on the disk.

How to Mount a Drive

A **mounted drive** is a volume that can be accessed by way of a folder on another volume so the folder has more available space. A mounted drive is useful when a folder is on a volume that is too small to hold all the data you want in the folder. In Figure 13-24, drive C: is 90 GB, and the mounted drive is 20 GB. The mounted drive gives the C:\Projects folder a capacity of 20 GB, which increases the effective space available for drive C: to 110 GB. Similar to how the ext4 file system works in Linux, the C:\Projects folder is called the mount point for the mounted drive.

Figure 13-24

The C:\Projects folder is the mount point for the mounted drive
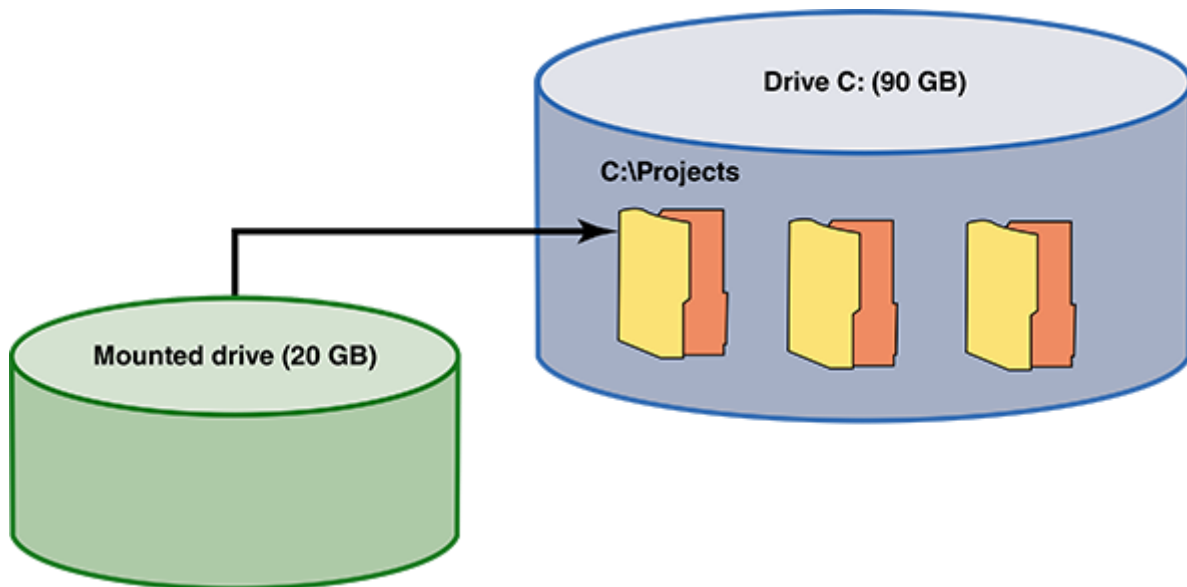
Follow these steps to mount a drive:

1. Make sure the volume (drive C: in our example) that will host the mounted drive uses the NTFS file system. The folder on this volume, called the mount point, must be empty. You can also create the folder during the mount process. In this example, we are mounting a drive to the C:\Projects folder.

2. Using Disk Management, right-click in the unallocated space of a disk. Select **New Simple Volume** from the shortcut menu. The New Simple Volume Wizard launches. Using the wizard, specify the amount of unallocated space you want to devote to the volume. Our example uses 20 GB, although the resulting size of the C:\Projects folder will only show about 19 GB because of overhead.

3. As you follow the wizard, the dialog box shown on the left side of Figure 13-25 appears. Select **Mount in the following empty NTFS folder**, and then click **Browse**. In the Browse for Drive Path dialog box that appears (see the right side of Figure 13-25), you can drill down to an existing folder or click **New Folder** to create a new folder on drive C:.

Figure 13-25

Select the folder that will be the mount point for the new volume

New Simple Volume Wizard

Assign Drive Letter or Path
For easier access, you can assign a drive letter or drive path to your partition.

○ Assign the following drive letter: E

⦿ Mount in the following empty NTFS folder:

Browse...

○ Do not assign a drive letter or drive path

Browse for Drive Path

Volumes that support drive paths are shown in the following list. To create a drive path, select an empty folder. To create a folder, click New Folder.

C:\

⊞ ━ C:\
⊞ ━ D:\
⊞ ━ X:\

New Folder...

OK

Cancel

< Back   Next >   Cancel

4. Complete the wizard by selecting a file system for the new volume; you can also name the volume. The volume is created and formatted.
5. To verify that the drive is mounted, open **Explorer** and then open the **Properties** dialog box for the folder. In our example, the Properties dialog box for the C:\Projects folder is shown in the middle of [Figure 13-26](). Notice the Properties dialog box reports the folder type as a Mounted Volume. When you click **Properties** in the Properties dialog box, the volume Properties box appears (see the right side of [Figure 13-26]()). In this box, you can see the size of the mounted volume minus overhead.

Figure 13-26

The mounted drive in Explorer appears as a very large folder
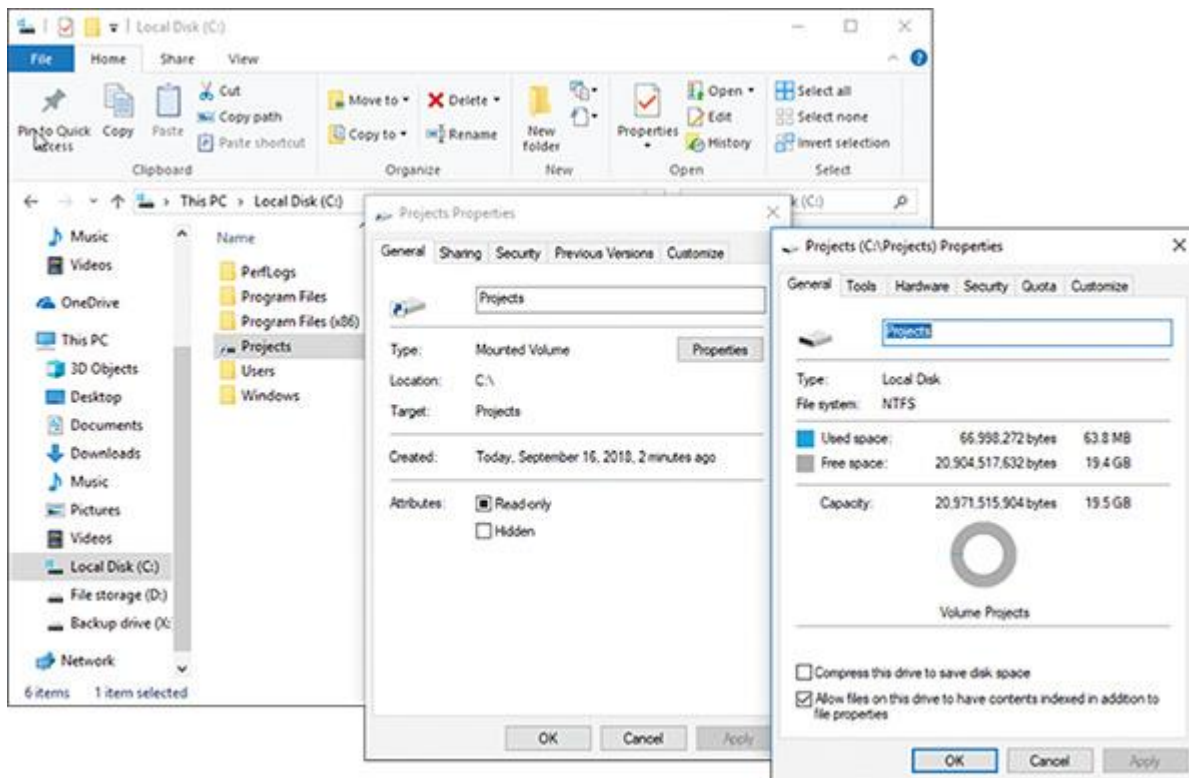
You can think of a mount point, such as C:\Projects, as a shortcut to a volume on a second hard drive. If you look closely at the left window in Figure 13-26, you can see the shortcut icon beside the Projects folder.

Windows Dynamic Disks

A basic disk works independently of other hard drives, but a **dynamic disk** can work with other hard drives to hold data. Volumes stored on dynamic disks are called **dynamic volumes**. Several dynamic disks can work together to collectively present a single dynamic volume to the system.

When dynamic disks work together, data to configure each hard drive is stored in a disk management database that resides in the last 1 MB of storage space on each hard drive. Note that Home editions of Windows do not support dynamic disks.

Here are three uses of dynamic disks:

- **Improve reliability.** For better reliability, you can configure a hard drive as a dynamic disk and allocate the space as a simple volume. This is the best reason to use dynamic disks and is a recommended best practice. Because of the way a dynamic disk works, the simple volume is considered more reliable than when it is stored on a basic disk. A volume that is stored on only one hard drive is called a **simple volume**.

- **Extend a volume across multiple drives.** You can implement dynamic disks on multiple hard drives to extend a volume across these drives (called spanning). This volume is called a spanned volume.
- **Improve performance and/or provide fault tolerance.** Dynamic disks can be used to piece data across multiple hard drives to improve performance and/or provide fault tolerance (protecting data against loss). The technology to configure two or more hard drives to work together as an array of drives is called **RAID (redundant array of inexpensive disks or redundant array of independent disks)**.
  - Joining hard drives together to improve performance is called **striping** or **RAID 0**. The volume is called a striped volume (see Figure 13-27). RAID 0 can improve performance because the work is shared between two hard drives. However, RAID 0 does not provide fault tolerance (if one drive fails, the data is lost).
  - Copying one hard drive to another as a backup is called **mirroring** or **RAID 1**. The volume is called a mirrored volume (see Figure 13-27). RAID 1 improves fault tolerance because if one drive fails, you have another copy of the data. RAID 1 can reduce performance because the drives operate at the speed of the slowest drive and all data must be written twice.

Figure 13-27

A simple volume is stored on a single disk, but a striped volume or a mirrored volume is stored on an array of dynamic disks
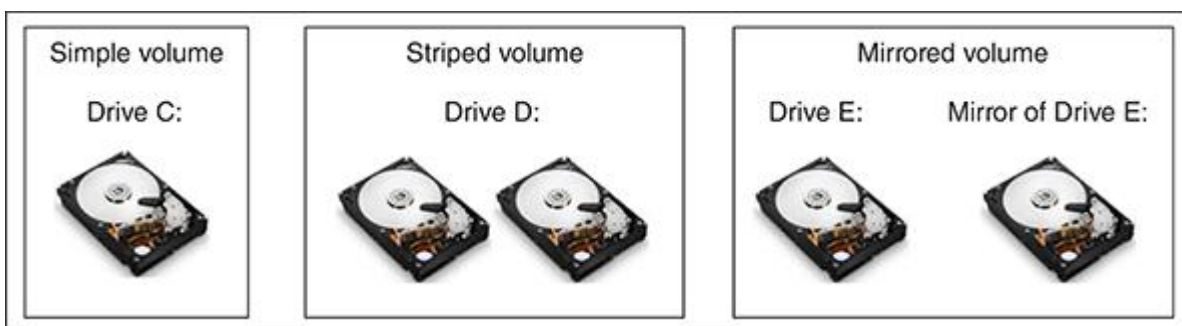
When RAID is implemented in this way using Disk Management, it is called **software RAID**. A more reliable way of configuring RAID is to use BIOS/UEFI setup on a motherboard that supports RAID, which is called **hardware RAID**.

✅ Exam Tip

The A+ Core 2 exam expects you to select which RAID type is appropriate to use in a given scenario.

You can use Disk Management to convert two or more basic disks to dynamic disks. Then you can use unallocated space on these disks to create a simple volume or a Windows **array** of disks using a spanned, striped, or mirrored volume. To convert a basic disk to dynamic, right-click the Disk area and select **Convert to Dynamic Disk** from the shortcut menu (see Figure 13-28). Then right-click free space on the disk and select **New Simple Volume**, **New Spanned Volume**, **New Striped Volume**, or **New Mirrored Volume** from the shortcut menu. If you were to select spanning or striping in Figure 13-28, you could make Disk 1 and Disk 2 dynamic disks that hold a single volume. The size of the volume would be the sum of the space on both hard drives. If you were instead using mirroring in Figure 13-28, you could make Disk 2 mirror the volume on Disk 1 as a backup copy. The size of the volume would be the amount of space both hard drives have in common—which means it would be the size of the smaller of the two disks.

Figure 13-28

Convert a basic disk to a dynamic disk
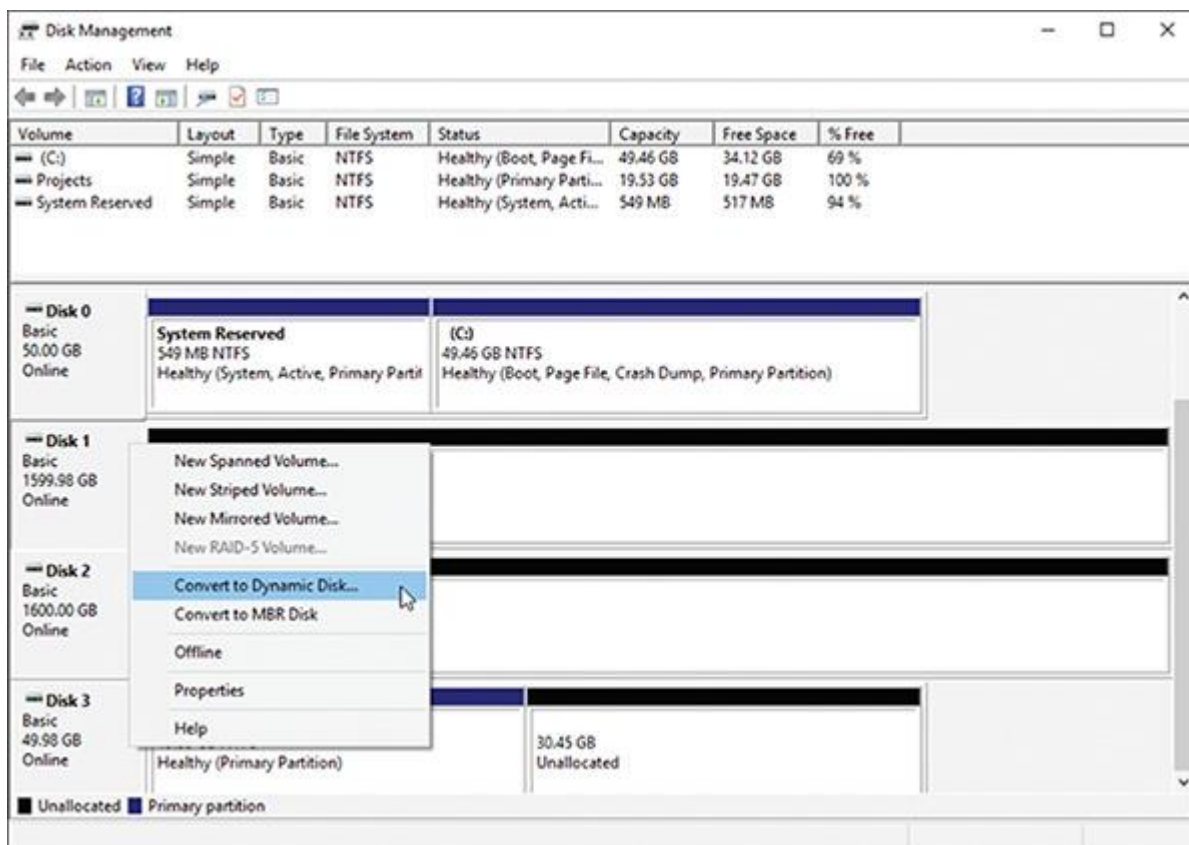
Note 18

When Windows implements RAID, you cannot install an OS on a spanned or striped volume that uses software RAID. You can, however, install Windows on a hardware RAID drive.

Also, after you have converted a basic disk to a dynamic disk, you cannot revert it to a basic disk without losing all data on the drive.

Now for some serious cautions about software RAID where you use Windows for spanning, striping, and mirroring: Microsoft warns that when Windows is used for software RAID, the risk of catastrophic failure increases and can lead to data loss. Microsoft suggests you only use Windows spanning, striping, or mirroring when you have no other option. In other words, spanning, striping, and mirroring in Windows aren't very safe. Instead, use a mounted drive or use hardware RAID to expand the size of a volume or to copy a volume to another drive.

Use Disk Management to Troubleshoot Hard Drive Problems

Notice in [Figure 13-28](#) that the system has four hard drives (Disk 0, Disk 1, Disk 2, and Disk 3), and information about the disks and volumes is shown in the Disk Management window. When you are having a problem with a hard drive, it helps to know what the information in the window means. Here are the disk and volume statuses you might see in this window:

- **Healthy.** The healthy volume status shown in [Figure 13-28](#) indicates that the volume is formatted with a file system and that the file system is working without errors.
- **Unknown.** The boot sector most likely is corrupted, which may have been caused by malware.
- **Unreadable.** The file system database cannot be read. Try a reboot.
- **Failed.** The hard drive is damaged, or the file system is corrupt. Replace the data cable to the drive, and make sure it's getting power. Data on a failed volume is likely to be lost.
- **Active.** One volume on an MBR system will be marked as Active. This is the volume that startup BIOS/UEFI looks to for an OS boot manager to load.
- **EFI System Partition.** In GPT systems, one volume will be marked as the EFI System Partition. BIOS/UEFI looks to this volume to find an OS boot manager to load an OS.
- **Unallocated.** Space on the disk is marked as unallocated if it has not yet been partitioned.
- **Formatting.** This volume status appears while a volume is being formatted.
- **Basic.** When a hard drive is first sensed by Windows, it is assigned the Basic disk status. A basic disk can be partitioned and formatted as a stand-alone hard drive.
- **Dynamic.** The following status indicators apply only to dynamic disks:

- **Online.** An online disk status indicates the disk has been sensed by Windows and can be accessed by either reading or writing to the disk.
- **Online (Errors).** A region of the disk is giving errors. Try returning the disk to online status. If the volume status does not return to healthy, back up all data and replace the drive.
- **Offline or Missing.** An offline or missing disk status indicates a dynamic disk has become corrupted or is unavailable. The problem can be caused by a corrupted file system, a loose or bad drive cable, a failed hard drive, or another hardware problem. If you believe the problem is corrected, right-click the disk and select **Reactivate Disk** from the shortcut menu to bring the disk back online.
- **Foreign drive.** If you move a hard drive that has been configured as a dynamic disk on one computer to another computer, it will report the disk as a foreign drive. To fix the problem, you need to import the foreign drive. Right-click the disk and select **Import Foreign Disks** from the shortcut menu. You should then be able to see the volumes on the disk.
- **Data Incomplete.** Some but not all of the drives in the volume have been moved. Move and import the remaining disks.
- **Healthy (At Risk).** The disk can be accessed, but I/O errors have occurred. Try returning the disk to online status. If the volume status does not return to healthy, back up all data and replace the drive.

If you are still having problems with a hard drive, volume, or mounted drive, check Event Viewer for events about the drive that might have been recorded there. These events might help you understand the nature of the problem and what to do about it. How to use Event Viewer is covered in the module "Troubleshooting Windows After Startup."

Throughout this module, you've learned a lot about Windows tools that use a graphical interface. The next part of this module discusses ways to perform many related tasks from a command-line interface.

13-3 Using a Command-Line Interface (CLI)

- 1.2

Given a scenario, use the appropriate Microsoft command-line tool.

IT support technicians find it much faster to manipulate files and folders and perform other tasks by using commands in a command prompt window than by using Explorer and other graphical tools. In some troubleshooting situations, you have no other option but to use a command prompt window.

Windows has two levels of command prompt windows: a standard window and an elevated window. In a standard window, the default directory is the currently signed-in user's folder and commands have the same permissions as that user. Commands issued in an **elevated command prompt window** have administrative privileges, and the default directory is C:\Windows\System32.

To open a standard command prompt window (see Figure 13-29), enter **command** or **cmd** in the Windows search box.

Figure 13-29
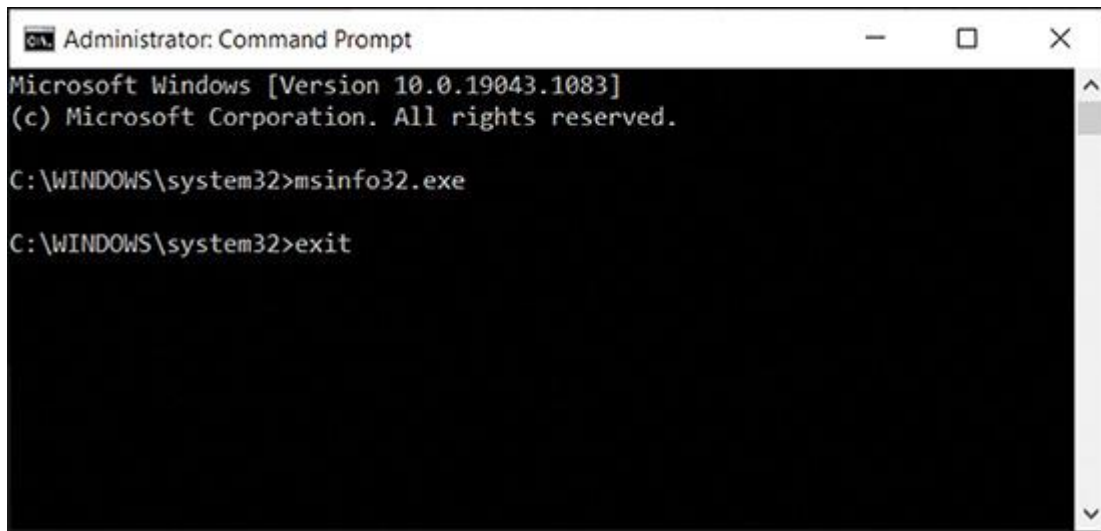
A command prompt window with two commands
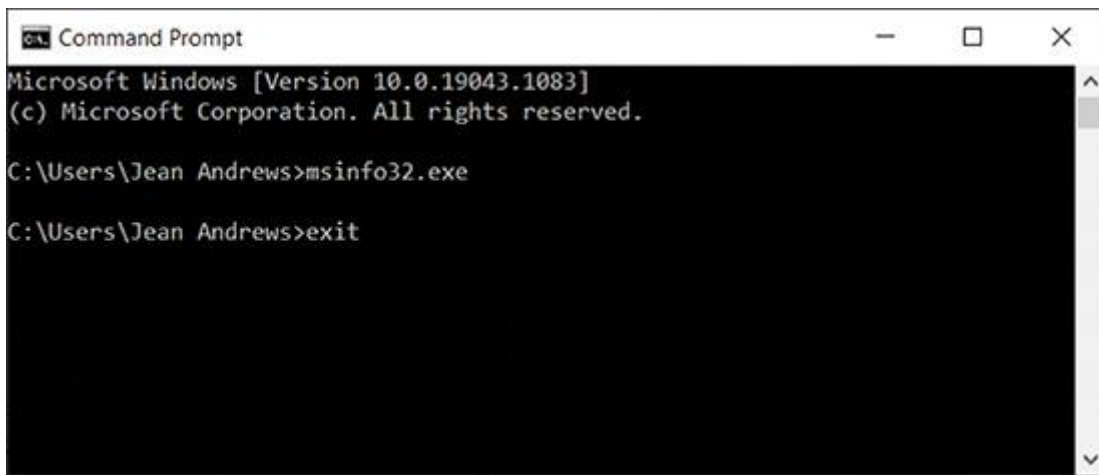
To open an elevated command prompt window, type `cmd` or `command` in the Windows search box, right-click **Command Prompt**, and click **Run as administrator**. Then respond to the UAC box. The Administrator: Command Prompt window is shown in Figure 13-30. Notice the word "Administrator" in the title bar, which indicates the elevated window, and the default directory, which is the C:\WINDOWS\system32 folder.

Figure 13-30

An elevated command prompt window with administrative privileges and two commands

Here are some tips for working in a command prompt window:

- Type **cls** and press **Enter** to clear the window.
- To retrieve the last command you entered, press the up arrow. To retrieve the last command line one character at a time, press the right arrow.
- To terminate a command before it is finished, press **Ctrl+C**, **Ctrl+Break**, or **Ctrl+Pause**.
- To access settings for the command prompt window, right-click the title bar and click **Properties**. You can change the background color, font, font color, and font size so you can better read the text in the window, adjust opacity so you can see what's behind the window as you work, and access Ctrl key shortcuts.
- To close the window, type **exit** (see [Figure 13-30](#)) and press **Enter**.

Many of the commands you learn about in this section can also be used in the Windows Recovery Environment (Windows RE), which can be loaded from within Windows during troubleshooting. When Windows fails to start, you can load Windows RE from Windows setup media or a USB or DVD recovery drive. How to use the Recovery Environment is covered in the module "[Troubleshooting Windows Startup](#)."

Help or <Command Name> /?

Use the **help** command to get help information about any command. You can enter help followed by the command name or enter the command name followed by /?. [Table 13-2](#) lists some sample applications of this command.

Table 13-2

Sample Help Commands

Command	Result
help xcopy xcopy /?	Gets help information about the xcopy command
help	Lists all commands
help xcopy | more	Lists information about the xcopy command one screen at a time; press the spacebar to see the next screen, or press Enter to advance one line at a time

Note 20

Windows commands are not case sensitive. You can type help, Help, or HELP and you'll get the same result.

Winver

The **winver** command displays the About Windows box (see Figure 13-31), which gives information about the Windows edition, latest update installed, and registered owner of the computer.

Figure 13-31

Display information about the current Windows installation

13-3a Commands to Manage Files and Folders

Core 2 Objective

- 1.2

Given a scenario, use the appropriate Microsoft command-line tool.

If the command you are using applies to files or folders, the path to these files or folders is assumed to be the default drive and directory. The default drive and directory, also called the current drive and directory, shows in the command prompt. For example, in Figure 13-29, the default drive is C: and the default path is C:\Users\Jean Andrews. If you use a different path in the command line, the path you use overrides the default path. Also know that Windows makes no distinction between uppercase and lowercase in command lines (however, Linux does).

Now let's look at the file-naming conventions you will need to follow when creating files, wildcard characters you can use in command lines, and several commands useful for managing files and folders.

File-Naming Conventions

When using the command prompt window to create a file, keep in mind that file name and file extension characters can be the letters *a* through *z*, the numbers *0* through *9*, and the following characters:

- _ ^ $ ~ ! # % & – { } ( ) @ ' `

In a command prompt window, if a path or file name has spaces in it, it is sometimes necessary to enclose the path or file name in double quotation marks.

Wildcard Characters in Command Lines

As you work at the command prompt, you can use **wildcard** characters in a file name to apply the command to a group of files or to abbreviate a file name if you do not know the entire name. The question mark (?) is a wildcard for one character, and the asterisk (*) is a wildcard for one or more characters. For example, if you want to find all file names in a directory that start with *A* and have a three-letter file extension, you would enter the `dir a*.???` command.

✔ Exam Tip

The A+ Core 2 exam expects you to know how to use the /?, winver, dir, cd, md, rd, copy, xcopy, robocopy, chkdsk, format, diskpart, and shutdown commands, which are all covered in this module. Other commands also required for the A+ Core 2 exam are covered in other modules.

Note 21

Many commands can use parameters in the command line to affect how the command will work. Parameters (also called options, arguments, or switches) often begin with a slash or a hyphen followed by a single character. In this module, you learn about the basic parameters used by a command for the most common tasks. For a full listing of the parameters available for a command, use the help command. Follow this link on the Microsoft website: docs.microsoft.com/en-us/windows-server/administration/windows-commands/windows-commands to learn more about commands.

Dir [<*Filename*>] [/P] [/S] [/W] [/A]

Use the **dir** command to list files and directories. In Microsoft documentation about a command (also called the command syntax), the brackets [ ] in a command line indicate the parameter is optional. In addition, the parameter included in < >, such as *<filename>*, indicates that you can substitute any file name in the command. This file name can include a path or file extension. Table 13-3 lists some examples of the dir command.

Table 13-3

Sample DIR Commands

Command	Result
dir /p	Lists one screen at a time
dir /w	Presents information using wide format, where details are omitted, and files and folders are listed in columns on the screen
dir *.txt	Lists all files with a .txt file extension in the default path
dir d:\data*.txt	Lists all files with a .txt file extension in the D:\data\ folder
dir myfile.txt	Checks that a single file, such as myfile.txt, is present
dir /s	Includes subdirectory entries
dir /a	List all files, including hidden files and system files

CD [<Drive>:\[<Path>]] or CD..

The **cd (change directory)** command changes the current default directory. You enter **cd** followed by the drive (a volume letter, such as C:) and the entire path that you want to be current, like so:

`C:\> ` **`cd C:\game\chess`**

The command prompt now looks like this:

`C:\game\chess>`

To move up from a child directory to its parent directory, enter the `..` (dot, dot) variation of the command:

`C:\game\chess> ` **`cd..`**

The command prompt now looks like this:

`C:\game>`

Remember that .. (dot, dot) always indicates the parent directory. You can move from a parent directory to one of its child directories simply by stating the name of the child directory:

`C:\game> ` **`cd chess`**

The command prompt now looks like this:

`C:\game\chess>`

Remember not to put a backslash in front of the child directory name; doing so tells the OS to go to a directory named chess that is directly under the root directory.

Drive Navigation

Whereas the cd command moves from one directory to another on the same drive, to move from one drive to another, type the drive letter followed by a colon. For example, to go from the D: drive to the C: drive:

```
D:\> c:
```

The command prompt now looks like this:

```
C:\>
```

Know that Windows is usually installed on drive C:.

Note 22

In the Windows Recovery Environment, the main drive is X:, but this drive is not always the same as the drive holding the Windows installation.

MD [<Drive>:]<Path>

The **md** or **mkdir** command creates a directory. If no drive is given, the directory is created on the current drive, and if no path is given, the directory is created in the current directory. For example, to create a subdirectory under the C:\game directory:

```
C:\game> md checkers
```

To create a game directory on the D: drive:

```
C:\game> md d:\game
```

Del [<Drive>:] [<Path>][<Filename>]

The **del** command deletes files. You can use the wildcard characters to delete multiple files. For example, to delete all files with a .txt file extension in the C:\game\chess directory, use this command:

```
C:\> del \game\chess\*.txt
```

Attrib [+ OR − S] [+ OR − H] [<Drive>:]<Path>

The del command does not delete a file that is a system file or a hidden file. To change the system and hidden attributes for a file(s), use the **attrib** command. For example, to remove the hidden and system attributes assigned to all files in the C:\game\chess directory, use this command:

```
C:\> attrib -h -s c:\game\chess\*.*
```

The del and attrib commands can be used together to delete Windows system files, making these commands scary powerful. Use them with caution!

RMDIR [<Drive>:]<Path> [/S]

The **rmdir** or rd command removes or deletes a directory. Before you can use the rmdir command, know the following:

- Unless you use the /s switch, the directory must be empty; it cannot contain files or subdirectories.
- The directory must not be the current directory.

For the C:\game\chess example given earlier, to remove the \game directory, you must first remove the chess directory:

```
C:\> rmdir c:\game\chess
```

```
C:\> rmdir c:\game
```

Use the /s switch to remove a directory that is not empty. The directory and all its subdirectories and files will be removed. With this switch, the rmdir command is very powerful—use it with caution!

Copy [/V] [/Y] <Source> [<Destination>]

The **copy** command copies a single file or group of files. The original files are not altered. To copy a file from one drive to another, use a command similar to this one:

```
E:\> copy C:\Data\Myfile.txt E:\mydata\Newfile.txt
```

The drive, path, and file name of the source file follow the copy command. The drive, path, and file name of the destination file follow the source file name. If you don't specify the file name of the destination file, the OS assigns the file's original name to this copy. If you omit the drive or path of the source or the destination, then the OS uses the current default drive and path.

To copy the file myfile.txt from the root directory of drive C: to drive E:, use the following command:

```
C:\> copy myfile.txt E:
```

Because the command does not include a drive or path before the file name myfile.txt, the OS assumes that the file is in the default drive and path. Also, because there is no destination file name specified, the file written to drive E: will be named myfile.txt.

To copy all files in the C:\Docs directory to the USB flash drive designated drive E:, use the following command:

```
C:\> copy c:\docs\*.* E:
```

To make a backup file named system.bak of the SYSTEM registry hive file in the \Windows\System32\config directory of the hard drive, use the following command:

```
C:\Windows\system32\config> copy system system.bak
```

If you use the copy command to duplicate multiple files, the files are assigned the names of the original files. When you duplicate multiple files, the destination portion of the command line cannot include a file name.

Here are two parameters that are useful with the copy command:

- **/v.** When the /v switch is used, the size of each new file is compared with the size of the original file. This slows down the copying but verifies that the copy is done without errors.
- **/y.** When the /y switch is used, a confirmation message does not ask you to confirm before overwriting a file.

Note 23

When trying to recover a corrupted file, you can sometimes use the copy command to copy the file to new media, such as from the hard drive to a USB drive. If the copy command reports a bad or missing sector during the copying process, choose the option to ignore that sector. The copying process then continues to the next sector. The corrupted sector will be lost, but others can likely be recovered. The recover command can be used to accomplish the same thing.

XCOPY <Source> [<Destination>] [/S] [/E] [/C] [/Y] [/D:[Date]]

The **xcopy** command is more powerful than the copy command. It follows the same general command-source-destination format as the copy command, but it offers several more options. Table 13-4 shows some of these options.

Table 13-4

Sample XCOPY Commands

Command	Result
xcopy C:\docs*.* E: /s	Uses the /s parameter to include subdirectories in the copy; this sample command copies all files in the directory C:\docs, as well as all subdirectories under \docs and their files, to drive E:, unless the subdirectory is empty
xcopy C:\docs*.* E: /e	Works the same as /s but empty subdirectories are included in the copy
xcopy C:\docs*.* E: /d :03-14-2022	Uses the /d switch to examine the date; this sample command copies all files from the directory C:\docs created or modified on or after March 14, 2022
xcopy C:\docs*.* E: /y	Uses the /y switch to overwrite existing files without prompting

Command	Result
xcopy C:\docs*.* E: /c	Uses the /c switch to keep copying even when an error occurs

Robocopy <*Source*> <*Destination*> [/S] [/E] [/Log:<*Logfile*>] [/Log+:<*Log*file>] [/Move] [/Purge]

The **robocopy (robust file copy)** command is similar to the xcopy command. It offers more options than xcopy and is intended to replace xcopy. A few options for robocopy are listed in <u>Table 13-5</u>.

Table 13-5

Sample Robocopy Commands

Command	Result
robocopy C:\docs*.* E: /s	Uses the /s switch to include subdirectories in the copy but does not include empty directories
robocopy C:\docs*.* E: /e	Uses the /e switch to include subdirectories, even the empty ones
robocopy C:\docs*.* E: /log:Mylog.txt	Records activity to a log file and overwrites the current log file
robocopy C:\docs*.* E: /log+:Mylog.txt	Appends a record of all activity to an existing log file
robocopy C:\docs*.* E: /move	Moves files and directories, deleting them from the source
robocopy C:\docs*.* E: /purge	Deletes files and directories at the destination that no longer exist at the source

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✔️ **Exam Tip**
The A+ Core 2 exam expects you to know how to structure every command (and its parameters) covered in this and other modules.

13-3b Commands to Manage Hard Drives

Core 2 Objective

- 1.2

Given a scenario, use the appropriate Microsoft command-line tool.

Several commands can be used to manage hard drives when setting up a new hard drive, refreshing a hard drive, or troubleshooting. Sometimes these commands are easier than digging through menus for a needed utility. If you're restricted to the Windows Recovery Environment during

troubleshooting, these commands might be your only means of accessing some of these tools.

CHKDSK [<*Volume*>:] [/F] [/R]

The **chkdsk (check disk)** command fixes file system errors and recovers data from bad sectors. Recall that a file is stored on the hard drive as a group of clusters. The FAT32 and exFAT file systems use a **FAT (file allocation table)** to keep a record of each cluster that belongs to a file. In Figure 13-32, you can see that each cell in the FAT represents one cluster and contains a pointer to the next cluster in a file. The NTFS file system uses a database called the **master file table (MFT)** to hold similar information.

Figure 13-32

Lost and cross-linked clusters
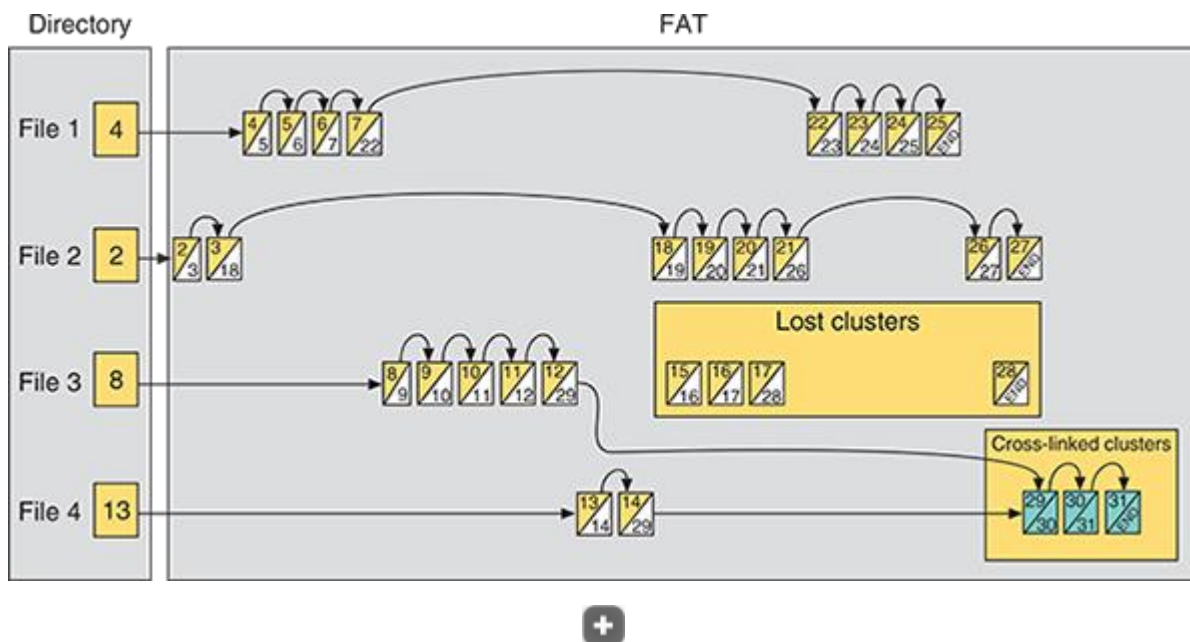
Used with the /f parameter, chkdsk searches for and fixes two types of file system errors made by the FAT or MFT:

- **Lost clusters (also called lost allocation units).** Lost clusters are clusters that are marked as used in the FAT or MFT, but they do not belong to any file. In effect, the data in these clusters is lost.
- **Cross-linked clusters.** Cross-linked clusters are marked in the FAT or MFT as belonging to more than one file.

Used with the /r parameter, chkdsk checks for lost clusters, cross-linked clusters, and bad sectors on the drive. The FAT and MFT keep a table of bad sectors that they normally do not use. However, over time, a sector might become unreliable. If chkdsk determines that a sector is unreliable, it attempts to recover the data from the sector and marks the sector as bad so the FAT or MFT will not use it again.

Used without any parameters, the chkdsk command only reports information about a drive and does not make any repairs.

An elevated command prompt is required to use the chkdsk command. In the following sample commands, the command prompt is not shown because the default drive and directory are not important. To check the hard drive for file system errors and repair them, use this command:

`chkdsk C:/f`

To redirect a report of the findings of the chkdsk command to a file that you can later print, use this command:

`chkdsk C: >Myfile.txt`

Use the /r parameter of the chkdsk command to fix file system errors and examine each sector of the drive for bad sectors, like so:

`chkdsk C: /r`

If chkdsk finds data that it can recover, it asks you for permission to do so. If you give permission, it saves the recovered data in files that it stores in the root directory of the drive.

Note 24

Use either the /f or /r parameter, but not both, with chkdsk. Using both parameters is redundant. For the most thorough check of a drive, use /r.

The chkdsk command will not fix anything unless the drive is locked, which means the drive has no open files. If you attempt to use chkdsk with the /f or /r parameter when files are open, chkdsk alerts you to the problem and asks permission to schedule the run the next time Windows is restarted. Know that the process will take plenty of time.

Note 25

The chkdsk command is also available from the Windows Recovery Environment.

Format <*Volume*:>[/Q] [FS:<*Filesystem*>]

You can format a hard drive or other storage device using Disk Management. In addition, you can use the **format** command from a command prompt window and from the Windows Recovery Environment. This high-level format installs a file system on the device and erases all data on the volume. Table 13-6 lists various sample uses of the format command.

Table 13-6

Sample Format Commands

Command	Result
format D:	Performs a full format of volume D: using the default file system for the volume type
format D: /q	Performs a quick format of volume D: by recreating an empty root directory; use it to quickly format a previously formatted disk that is in good condition; /q does not read or write to any other part of the disk
format D: /fs:NTFS	Formats volume D: using the NTFS file system
format D: /fs:FAT32	Formats volume D: using the FAT32 file system
format D: /fs:EXFAT	Formats volume D: using the extended FAT file system

Diskpart

Use the diskpart command interpreter to manage partitions on a hard drive. The command requires an elevated command prompt and is often used in the Windows Recovery Environment. Enter the diskpart command at the command prompt to see the diskpart prompt. Then list objects and select one of the objects to give it focus. Commands that follow apply to the object selected.

Applying Concepts

Prepare a Corrupted Hard Drive for a Clean Windows Installation

- **Est. Time:** 15 minutes
- **Core 2 Objective:** 1.2

Windows setup is not always able to overwrite or repair a corrupted partition table on a hard drive. To practice using the diskpart command to prepare a corrupted hard drive for a clean installation of Windows, do the following:

1. 1

   Using a VM you have already created in this course, add a second hard drive to the VM. Start the VM and open an elevated command prompt window.

2. 2

   Enter the `diskpart` command. At the diskpart prompt, enter the commands shown in Table 13-7 to clean all partitions off the drive, create a new partition, and format it using the NTFS file system. Then open **Explorer** in your VM, and verify that the second hard drive is present and available for use.

Table 13-7

Diskpart Commands to Partition and Format a GPT Hard Drive

Diskpart Command	Result
`list disk`	Lists the hard drives installed; select the one to clean based on the size of the drive
`select disk=1`	Makes Disk 1 the selected hard drive
`clean`	Cleans the partition table and all partitions from the drive
`convert gpt`	Installs the GPT partitioning system
`create partition primary`	Creates the primary partition
`list partition`	Lists the partitions; note the number of the primary partition
`select partition=2`	Selects the primary partition
`format fs=ntfs quick`	Formats the drive using the NTFS file system
`assign letter=W`	Assigns a drive letter to the volume
`detail partition`	Displays partition details
`detail volume`	Displays volume details
`exit`	Exits diskpart

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Note 26

For a complete list of diskpart commands, go to the Microsoft support site (docs.microsoft.com), and search on "Diskpart Commands."

Shutdown [/I] [/R] [/S] [/M \\<*Computername*>] [/T XX]

Use the **shutdown** command to shut down the local computer or a remote computer. You must be signed in with an administrator account to use this command. By default, the command gives users a 30-second warning before shutdown. To shut down a remote computer on the network, you must have an administrator account on that computer and be signed on the local computer with that same account and password. Table 13-8 lists some shutdown commands.

Table 13-8

Sample Shutdown Commands

Command	Result
shutdown /r	Restarts the local computer
shutdown /s /m \\bluelight	Shuts down the remote computer named \\bluelight

Command	Result
shutdown /s /m \\bluelight /t 60	Shuts down the \\bluelight computer after a 60-second delay
shutdown /i	Displays the Remote Shutdown dialog box so you can choose computers on the network to shut down

Module Review

_{13-4a}# Module Summary

Critical Windows Settings and Backup Procedures

- Regular preventive maintenance includes verifying Windows Update, anti-malware, and network security settings, as well as backup routines. In addition, uninstall software you no longer need, and clean up and optimize the hard drive.
- Use the Power Options app in Control Panel to control power settings in a laptop.
- You need a plan for disaster recovery in the event the hard drive fails. This plan needs to include routine backups of data files and possibly the entire Windows volume, critical applications, and system files.
- Three types of backups are full, incremental, and differential backups.
- You can back up to local storage or to the cloud. Best practice is to maintain two backups and keep one backup off site. This is known as the 3-2-1 backup rule (three copies, two backup media, and one kept off site).
- Regularly test your backup plan to make sure you can recover files if needed.
- Windows File History and Backup and Restore can be used to schedule routine backups of user data files on a workstation. Both tools can back up a system image. Neither tool can maintain more than one backup routine.
- The best time to create a system image is right after you've installed Windows, hardware, applications, and user accounts and customized Windows settings.
- System Protection creates restore points, which include Windows system files that have changed since the last restore point was made.

Maintaining Hard Drives

- Use File Explorer Options to unhide files and file extensions that are hidden by default in Explorer.
- To improve hard drive performance, use the Disk Cleanup tool and the Defragment and Optimize Drives tool to clean and optimize the drive.
- Use Indexing Options to control which file types are indexed, which can speed up searches but potentially slow down overall system performance.

- Use Disk Management to manage hard drives and partitions. Use it to create, delete, and resize partitions, mount a drive, manage dynamic disks, and solve problems with hard drives.

Using a Command-Line Interface (CLI)

- Commands can use wildcard characters ? and * to apply the command to a group of files or to abbreviate a file name.
- Commands used to manage files, folders, and storage media include help, dir, cd, md, del, attrib, rmdir, copy, xcopy, and robocopy, The winver command displays the About Windows box.
- Commands to manage hard drives include chkdsk, format, and diskpart. The shutdown command shuts down the system.

Module Review

13-4c Thinking Critically

These questions are designed to prepare you for the critical thinking required for the A+ exams and may use information from other modules and the web.

1. Jack needs to email two documents to a friend, but the files are so large his email server bounced them back as undeliverable. What is your advice?

   1. Tell Jack to open the documents, break each of them into two documents, and then email the four documents separately.
   2. Tell Jack to put the two documents in a compressed folder and email the folder.
   3. Tell Jack to put each document in a different compressed folder and email each folder separately.
   4. Tell Jack to put the documents on a USB drive and snail mail the drive to his friend.

2. Order the following routine maintenance tasks from most to least important when securing a computer.

   1. Verify anti-malware settings.
   2. Verify Windows Update settings.
   3. Verify the Recycle Bin is emptied weekly.
   4. Verify that hard drives are being optimized weekly.

3. While verifying Windows settings, you discover defragmenting is turned off for the hard drive. What do you do next?

   1. Immediately defrag the drive.
   2. Turn on defragmenting.
   3. Analyze the drive for errors.
   4. Check the type of hard drive installed.

4. Jawana has been working on a paper for her anatomy class for weeks. One day, her little brother was using her computer and accidentally deleted her paper from the Documents folder. How can Jawana recover her deleted paper?

5.   What are reasons to uninstall software you no longer use? (Choose all that apply.)

    1. To prevent Windows errors
    2. To speed up Windows performance
    3. To free up hard drive space
    4. To clean the system of malware

6.   What type of storage media can be used to create a Windows system image? (Choose all that apply.)

    1. DVDs
    2. Internal hard drive
    3. External hard drive
    4. Network drive

7.   Which Windows utilities are used to create previous versions of files that can be recovered from the file properties dialog box? (Choose all that apply.)

    1. Windows File History
    2. Windows Backup and Restore
    3. Disk Management
    4. Windows Folder Options

8.   Samolley is setting up Backup and Restore and wants to create a system image. She has discovered that drive E: in the system has plenty of free space for the image. What is the next thing she should do before she creates the image?

    1. Verify that the Windows volume has enough free space to perform the procedure.
    2. Decide if there is a drive on the network she can use. Network drive images are faster to create.
    3. Determine if drive E: is on the same hard drive as drive C:.
    4. Ask the user which folders on drive C: are the most important and need backing up.

9.   You suspect malware might have infected restore points saved on the computer, and you want to delete them all. What is your next step?

    1. Turn off System Protection.
    2. Run anti-malware software to scan the system for malware.
    3. Harden the Windows Firewall, closing all open ports.
    4. Update Windows.

10.   You suspect the hard drive is corrupted. Which window do you open to repair the drive?

    1. Command prompt window to use chkdsk
    2. Elevated command prompt window to use chkdsk
    3. Disk Management
    4. Explorer

11.   You are planning to install Windows 10 on a computer in a dual-boot configuration. The computer already has Windows 8 installed. You open Disk Management and discover

there is one hard drive with an EFI System Partition, a primary partition with plenty of free space, and no unallocated space. In Disk Management, how can you prepare the drive to hold the Windows 10 installation?

1. There's nothing more to do in Disk Management. Close the windows and begin the installation.
2. Shrink the EFI System Partition and create a new partition for Windows 10.
3. Shrink the primary partition and create a simple volume for Windows 10.
4. Shrink the primary partition and create a new basic disk for Windows 10.

12. Your friend is setting up a computer and plans to use Windows RAID striping. They ask you how many hard drives they should install in the system. What do you tell them?

1. Install at least three drives: one to hold the Windows installation and two for the array.
2. Install at least two drives. The striped array can install on two drives, and it can also hold the Windows installation.
3. Only one drive is necessary. They can create extra partitions on the drive; the first can hold Windows and the other two can hold the array.
4. Suggest to your friend that they use hardware RAID, which is more stable.

13. A family member calls and wants to copy the Notepad text editor to a folder they just created in the root of drive C:. They ask you to help construct the command line. Which is the correct command?

1. Copy C:\notepad.exe C:\Windows
2. Copy C:\Windows\Notepad.exe C:\
3. Copy C:\Windows\System32\Notepad.exe C:\
4. Copy notepad.exe C:\

14. Without changing the default folder, what is the command to list all files in the C:\Linda\test2 folder that have file extensions of only two characters?

1. Dir C:\Linda\test2*.??
2. Dir *.*
3. Dir C:\Linda\test2********.**
4. Dir C:*.*

15. You are trying to clean up a slow Windows 10 system that was recently upgraded from Windows 8, and you discover that the 75 GB hard drive has only 5 GB of free space. The entire hard drive is taken up by the Windows volume. What is the best way to free up some space?

1. Compress the entire hard drive.
2. Move the /Program Files folder to an external hard drive.
3. Delete the Windows.old folder.
4. Uninstall several applications.

16. A technician needs to be prepared to launch programs even when utility windows or the Windows desktop cannot load, and the A+ Core 2 exam expects you to know the commands to launch several Windows utilities. What is the command to launch Disk Management? Device Manager? Disk Cleanup? Disk Defragment?

17. Which is the best first step to protect important data on your hard drive?

    1. Use dynamic disks to set up a striped volume so the data has redundancy.
    2. Back up the data to another device.
    3. Compress the folder that holds the data.
    4. Put password protection on the data folder.
18. Which of the following tools can be used to improve Windows performance? (Choose all that apply.)

    1. System Protection
    2. Indexing Options
    3. System Restore
    4. Power Options
    5. File History

13-4d Hands-On Projects

Performing Routine Maintenance

- **Est. Time:** 30 minutes
- **Core 2 Objective:** 4.3

Sign in to a Windows system using a standard user account. Step through the process described in the module to do the following routine maintenance. As you work, note which chores you cannot perform unless you know the password to an administrator account. Do the following:

1. 1
   Verify critical Windows settings in Windows Update, anti-malware software, and the Network and Sharing Center.

2. 2
   Open **Explorer** and view the Properties dialog box of drive C:. What percentage of the volume is free space? Click **Disk Cleanup**. Is the Windows.old folder available for deletion? How much space will Disk Cleanup free?

3. 3
   Click **Clean up system files**. How much space will Disk Cleanup free when system files are included in the cleanup? To understand what types of files are selected for deletion, highlight an item and read its description. Don't include files in the cleanup that you think you might need later (for example, previously installed device drivers).

4. 4
   Unhide Windows system files and file extensions in Explorer. Verify in Explorer that you can view these files.

5. 5
   Clean the drive. After cleanup, what percentage of the volume is free space?

6. 6

   Find out the brand and model of the hard drive that holds Windows. What is the brand and model? Is the drive a magnetic or solid-state drive? How do you know?

7. 7

   Check hard drive optimization settings and change them as necessary. Analyze the hard drive and determine if it needs defragmenting or optimizing. If so, optimize the drive.

8. 8

   Check the hard drive for errors.

Hands-On Project 13-2

Using System Restore

- **Est. Time:** 30 minutes
- **Core 2 Objective:** 1.4

Do the following to find out how System Restore works and how it can affect a system:

1. 1

   Create a restore point.

2. 2

   Make a change to the display settings.

3. 3

   Change the desktop background.

4. 4

   Create a new text file in your Documents folder.

5. 5

   Restore the system using System Restore.

Is the text file still in your Documents folder? Are the other changes still in effect? Why or why not?

Hands-On Project 13-3

Using Disk Management on a Virtual Machine

- **Est. Time:** 30 minutes
- **Core 2 Objective:** 1.3

In a project in the module "Installing Windows," you used Client Hyper-V software to install Windows in a virtual machine. Use this VM to practice using Disk Management. Do the following:

1. 1

   Open **Hyper-V Manager**, but do not open the virtual machine.

2. **2**

With the virtual machine selected, click **Settings**. Use the Settings dialog box to add a new hard drive to the VM: Click **IDE Controller 0** in the left pane, click **Hard Drive** in the right pane, and then click **Add**. The Settings dialog box to add a hard drive appears (see). With **Virtual hard disk** selected, click **New**.

Figure 13-33

Add a new virtual hard drive to IDE Controller 0
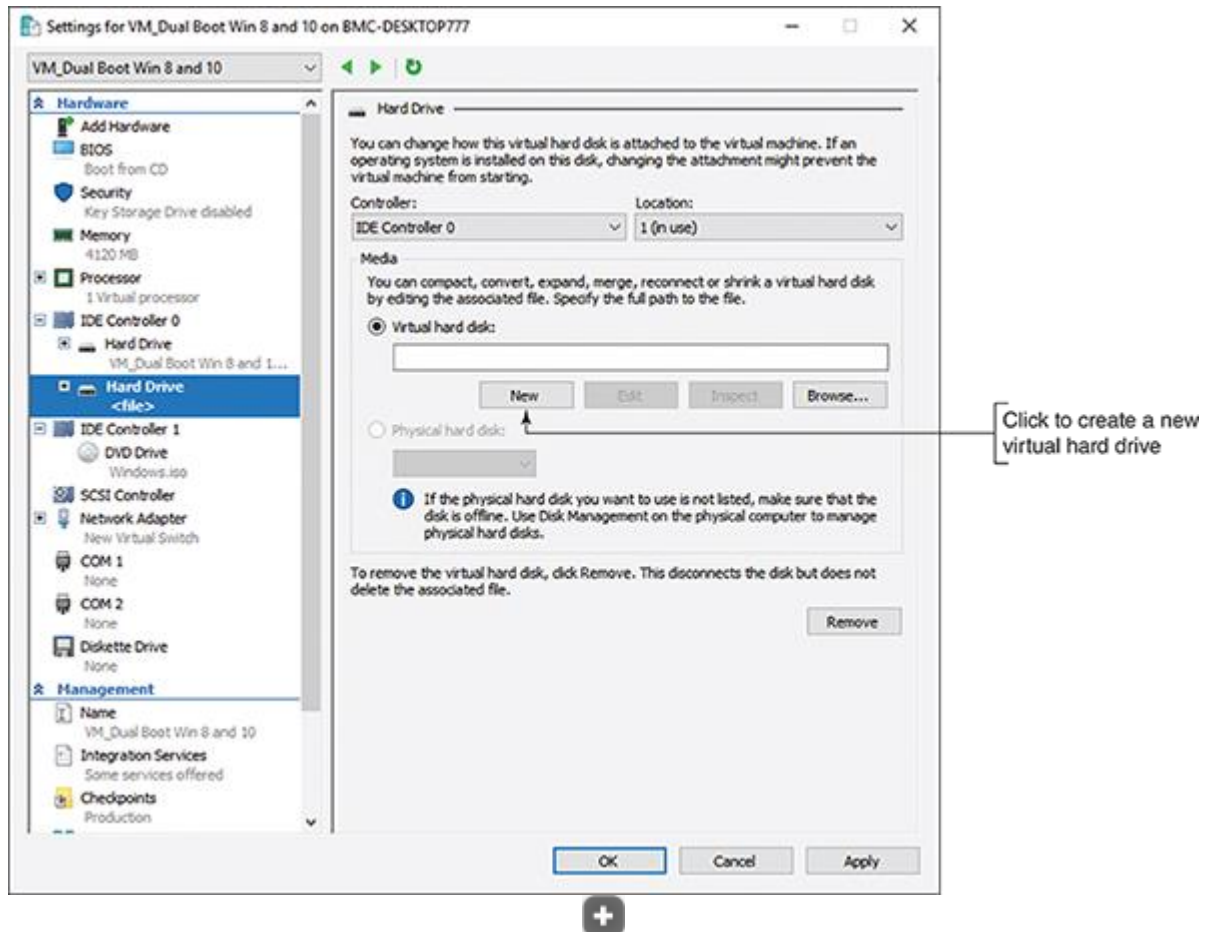
3. **3**

The New Virtual Hard Disk Wizard starts. Step through the wizard using these values:

   1. **a**

   For the format type, select **VHDX**.

   2. **b**

   For the type of virtual hard drive, select **Dynamically expanding**.

   3. **c**

   Name the virtual hard drive: **HDD2**.

   4. **d**

   To specify the location of the virtual hard drive, click **Browse** and point to the same folder where the VM is stored.

    5. e

        Leave all other settings at their default values.

4. 4

   Click **Finish** to create the virtual hard drive. The wizard closes.

5. 5

   In the Settings box, click **Apply** to save your changes. Close the Settings box.

6. 6

   Start up the VM, sign in to Windows 10, and open **Disk Management**.

7. 7

   Use Disk Management to initialize the new disk and partition it. Create two partitions on the disk: one formatted using the NTFS file system and one using the FAT32 file system.

8. 8

   View the new volumes using Explorer.

9. 9

   Create and save a snip of your screen showing the virtual machine with the new volumes created. Email the snip to your instructor.

Hands-On Project 13-4

Researching Backup Software
- **Est. Time:** 15 minutes
- **Core 2 Objective:** 4.3

File History and Backup and Restore are limited in that they support only a single backup routine. Suppose you want to create two backups of data on your hard drive: one backup will be stored on an external hard drive, and the second backup will be stored in the cloud. Both backups should happen automatically. Research the web and propose the backup software solution to accomplish these tasks. Compare your work with another student and discuss who has the best solution.

Hands-On Project 13-5

Using a Batch File
- **Est. Time:** 45 minutes
- **Core 2 Objective:** 1.2

A file with a .bat file extension is called a batch file. You can use a batch file to execute a group of commands, sometimes called a script, from a command prompt. Do the following to learn to use a batch file:

1. 1

Make sure you have at least two files in your Documents folder, not including subfolders. What are the names of the two files?

2. **2**
   Using a command prompt window, copy the two files in your Documents folder to a folder named \Save on a USB flash drive. Don't include subfolders in the copy. Create a new subfolder named \Save\Myfiles on the flash drive. Copy (don't move) the two files in your \Save folder to the \Save\Myfiles folder.

3. **3**
   Using Notepad, create a batch file named MyBatch.bat on the USB flash drive that contains the commands to do the following:

   1. **a**
      Clear the Command Prompt window.

   2. **b**
      Create the C:\Data folder on your hard drive.

   3. **c**
      Use xcopy to copy the contents of the \Save folder and subfolder to your C:\Data folder.

   4. **d**
      List the contents of the C:\Data\Myfiles folder.

   5. **e**
      Create a new folder named \Save\Newfolder on your flash drive.

   6. **f**
      Use the robocopy command to copy the contents of the \Save folder and both subfolders to the C:\Data folder, creating a log file of the command results on your flash drive. Name the log file Mylog.txt.

4. **4**
   Using a command prompt window, execute the MyBatch.bat file, and fix any problems you see. What happens when you execute the batch file and the C:\Data folder already exists?

Hands-On Project 13-6

Verifying TCP/IP Settings

- **Est. Time:** 15 minutes
- **Core 2 Objective:** 1.2

To solve problems with failed network connections, the ipconfig, ping, and nslookup commands can help. Follow these steps to learn the basics of using these commands. You learn more about these commands in the module "Network Security and Troubleshooting."

1. **1**

   Open a command prompt window, and enter the `ipconfig` command to verify TCP/IP settings for the network connection. What is the IP address of your connection? What is the IP address of the default gateway (a gateway is a computer on your network that allows access to the Internet)?

2. **2**

   Enter the `ping cengage.com` command to verify you can reach that website.

3. **3**

   To verify DNS is working, enter the `nslookup cengage.com` command. The results should show the IP address for *cengage.com*. What is the IP address?

Module Review

13-4e **Real Problems, Real Solutions**

Real Problem 13-1

Researching the WinSxS Folder

- **Est. Time:** 45 minutes
- **Core 2 Objective:** 4.1

While cleaning up a hard drive, you begin to look for folders that are excessively large and discover the C:\Windows\WinSxS folder is more than 7 GB. That's almost half the size of the entire C:\Windows folder on this drive. Use the web to research the purpose of the WinSxS folder. What goes in this folder and how does it get there? How can the size of the folder be reduced without causing major trouble with the OS? Write a one-page paper about this folder, and cite at least three articles about it that you find on the web.

Real Problem 13-2

Cleaning Up a Sluggish Windows System

- **Est. Time:** 30 minutes
- **Core 2 Objective:** 1.3

Do you have a Windows system that is slow and needs optimizing? If not, talk with family and friends, and try to find a slow system that could use your help. Using all the tools and techniques presented in this module, clean up this sluggish Windows system. Take detailed notes as you go, listing what you checked before you started to solve the problems, describing what you did to solve the problems, and describing the results of your efforts. What questions did you have along the way? Bring these questions to class for discussion.

Real Problem 13-3

Creating a Virtual Hard Drive

- **Est. Time:** 15 minutes
- **Core 2 Objective:** 1.3

You can use the Disk Management tool or the diskpart command to create a virtual hard drive (VHD) on a physical computer. The VHD is a file that takes up some free space on the physical hard drive, but to the Windows interface, it appears as a second hard drive. You can store data in folders and files on the VHD and even install Windows in the VHD. Follow these steps to create a VHD:

1. 1
   In Disk Management, click **Action** in the menu bar and click **Create VHD**. Follow the on-screen directions to create the VHD, specifying its location on the hard drive and its size. You can make the size dynamically expanding. The VHD is listed as a Disk in the Disk Management window.

2. 2
   Right-click the new disk and click **Initialize Disk**. Use the GPT partitioning system for the disk.

3. 3
   To format the disk, right-click the unallocated space on the disk, and click **New Simple Volume**. The VHD is now ready for use.

4. 4
   Open **Explorer** and verify you can access the new volume.

Discuss in your class and research online how a VHD might be useful. What are two uses of a VHD in which it offers advantages over using a physical hard drive?