

Cyber Security (4353204) - Summer 2025 Solution

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Question 1(a) [3 marks]

Describe CIA triad with example.

Solution

CIA Triad Components:

Figure 1. CIA Triad

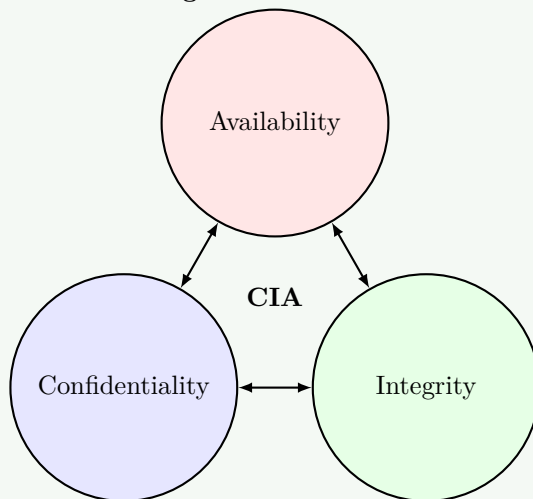


Table 1. CIA Triad Elements

Component	Definition	Example
Confidentiality	Protecting data from unauthorized access	Password protection on bank accounts
Integrity	Ensuring data accuracy and completeness	Digital signatures on documents
Availability	Ensuring systems are accessible when needed	24/7 online banking services

- **Confidentiality:** Only authorized users can access sensitive information
- **Integrity:** Data remains accurate and unaltered during transmission
- **Availability:** Systems remain operational and accessible to legitimate users

Mnemonic

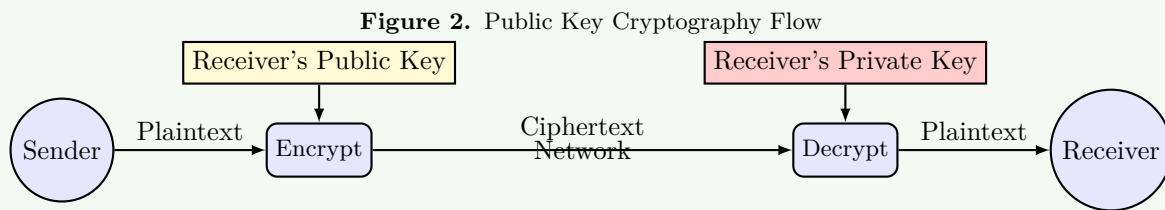
“CIA Keeps Information Safe”

Question 1(b) [4 marks]

Explain Public key and Private Key cryptography.

Solution

Public Key Cryptography (Asymmetric):



Key Characteristics:

Table 2. Public vs Private Key

Feature	Public Key	Private Key
Distribution	Freely shared	Kept secret
Usage	Encryption/Verification	Decryption/Signing
Security	Can be public	Must be protected

- **Public Key:** Used for encryption and signature verification
- **Private Key:** Used for decryption and digital signing
- **Security:** Based on mathematical complexity (RSA, ECC algorithms)

Mnemonic

“Public Encrypts, Private Decrypts”

Question 1(c) [7 marks]

Explain various security attacks, mechanisms, and services associated with each layer of the OSI model.

Solution

OSI Security Framework:

Figure 3. OSI Security Framework

Attacks	OSI Layer	Mechanisms
Malware, Social Eng.	Application	Antivirus
Format attacks	Presentation	Encryption
Hijacking	Session	Tokens
SYN Flooding	Transport	SSL/TLS
IP Spoofing	Network	IPSec/Firewall
MAC Flooding	Data Link	Auth/Encryption
Wiretapping	Physical	Shielding

Table 3. OSI Layers Security Details

Layer	Attacks	Mechanisms	Services
Physical	Wiretapping, Jamming	Physical security, Shielding	Access control
Data Link	MAC flooding, ARP poisoning	Encryption, Authentication	Frame integrity
Network	IP spoofing, Routing attacks	IPSec, Firewalls	Packet filtering
Transport	Session hijacking, SYN flooding	SSL/TLS, Port security	End-to-end security
Session	Session replay, Hijacking	Session tokens, Timeouts	Session management
Presentation	Data corruption, Format attacks	Encryption, Compression	Data transformation
Application	Malware, Social engineering	Antivirus, User training	Application security

Key Security Services:

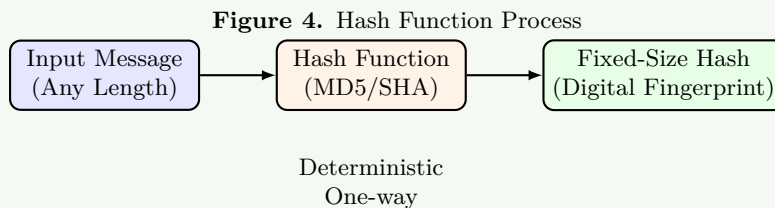
- **Authentication:** Verifying user identity
- **Authorization:** Controlling access permissions
- **Non-repudiation:** Preventing denial of actions
- **Data integrity:** Ensuring data accuracy

Mnemonic

“All People Seem To Need Data Protection”

Question 1(c OR) [7 marks]

Explain MD5 hashing and Secure Hash Function (SHA) algorithms.

Solution**Hash Function Comparison:****Table 4.** MD5 vs SHA Comparison

Feature	MD5	SHA-1	SHA-256
Output Size	128 bits	160 bits	256 bits
Security Level	Weak	Weak	Strong
Speed	Fast	Moderate	Slower
Current Status	Deprecated	Deprecated	Recommended

Hash Properties:

- **Deterministic:** Same input produces same hash
- **Avalanche Effect:** Small input change causes major hash change
- **One-way Function:** Cannot reverse hash to original data
- **Collision Resistant:** Difficult to find two inputs with same hash

Applications:

- Password storage and verification
- Digital signatures and certificates
- Data integrity verification

Mnemonic

“Hash Always Produces Same Output”

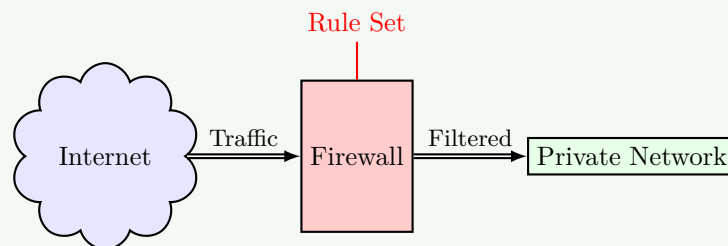
Question 2(a) [3 marks]

What is firewall? List out types of firewall.

Solution

Firewall Definition: Network security device that monitors and controls incoming/outgoing traffic based on security rules.

Figure 5. Firewall Architecture



Types of Firewalls:

Table 5. Firewall Types

Type	Function	Level
Packet Filter	Examines packet headers	Network Layer
Stateful	Tracks connection state	Transport Layer
Application Proxy	Inspects application data	Application Layer
Personal Firewall	Protects individual devices	Host-based

- **Hardware Firewall:** Dedicated network appliance
- **Software Firewall:** Installed on individual computers
- **Cloud Firewall:** Delivered as a service (FWaaS)

Mnemonic

“Firewalls Protect Networks Always”

Question 2(b) [4 marks]

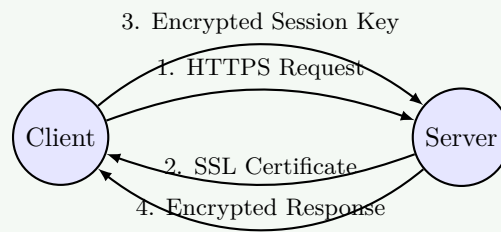
Define: HTTPS and describe working of HTTPS.

Solution

HTTPS Definition: Hypertext Transfer Protocol Secure - HTTP over SSL/TLS encryption.

HTTPS Working Process:

Figure 6. HTTPS Process



Secure Communication Established

HTTPS Components:

- **Port 443:** Standard HTTPS port
- **SSL/TLS:** Encryption protocols
- **Digital Certificates:** Server authentication
- **Symmetric Encryption:** Data transmission security

Benefits:

- Data encryption during transmission
- Server authentication verification
- Data integrity protection
- SEO ranking improvement

Mnemonic

“HTTPS Secures Web Traffic”

Question 2(c) [7 marks]

Explain different types of malicious software and their effect.

Solution

Malware Classification:

Figure 7. Malware Classification

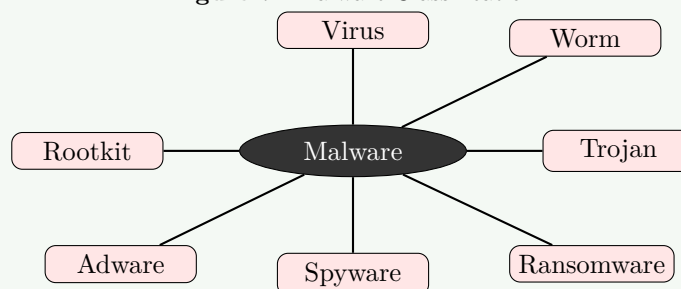


Table 6. Malware Types and Effects

Type	Behavior	Effect	Example
Virus	Attaches to files	File corruption	Boot sector virus
Worm	Self-replicating	Network congestion	Conficker worm
Trojan	Disguised malware	Data theft	Banking Trojans
Ransomware	Encrypts files	Data hostage	WannaCry
Spyware	Monitors activity	Privacy breach	Keyloggers
Adware	Shows unwanted ads	Performance degradation	Pop-up ads
Rootkit	Hides presence	System compromise	Kernel rootkits

Effects on Systems:

- **Performance:** Slow system response
- **Data:** Loss, corruption, or theft
- **Privacy:** Unauthorized monitoring
- **Financial:** Direct monetary loss

Prevention Methods:

- Regular antivirus updates
- Safe browsing practices
- Email attachment caution
- System security patches

Mnemonic

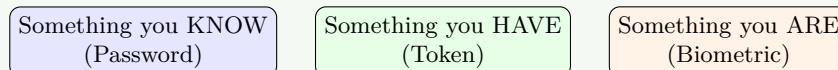
“Viruses Worms Trojans Really Steal All Resources”

Question 2(a OR) [3 marks]

What is authentication? Explain different methods of authentication.

Solution

Authentication Definition: Process of verifying user identity before granting system access.

Figure 8. Authentication Methods**Multi-Factor Authentication (MFA)****Authentication Methods:****Table 7.** Authentication Factors

Method	Description	Example
Password	Something you know	PIN, passphrase
Biometric	Something you are	Fingerprint, iris
Token	Something you have	Smart card, USB key

- **Single-Factor:** Uses one authentication method
- **Multi-Factor:** Combines multiple methods
- **Two-Factor (2FA):** Uses exactly two factors

Mnemonic

“Password Biometric Token Authentication”

Question 2(b OR) [4 marks]

Define: Trojans, Rootkit, Backdoors, Keylogger

Solution**Malware Definitions:****Table 8.** Malware Definitions

Term	Definition	Characteristics
Trojans	Malware disguised as legitimate software	Appears harmless, hidden payload
Rootkit	Software that hides malware presence	Deep system access, stealth operation
Backdoors	Unauthorized access method	Bypasses normal authentication
Keylogger	Records keyboard input	Captures passwords, sensitive data

- **Trojans:** Named after Greek Trojan Horse
- **Rootkit:** Operates at kernel level
- **Backdoors:** Can be hardware or software based
- **Keylogger:** Can be software or hardware device

Mnemonic

“Trojans Root Backdoors Keylog”

Question 2(c OR) [7 marks]

Explain Secure Socket Layer (SSL) and Transport Layer Security (TLS) protocols.

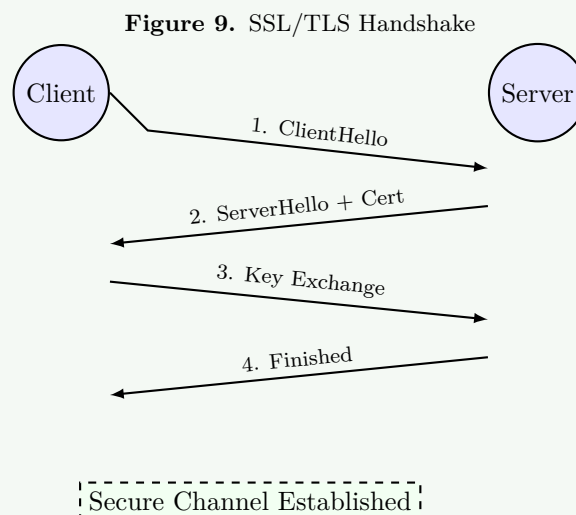
Solution**SSL/TLS Protocol Evolution:**

Table 9. SSL/TLS Comparison

Version	Year	Status	Security Level
SSL 2.0	1995	Deprecated	Weak
SSL 3.0	1996	Deprecated	Vulnerable
TLS 1.0	1999	Legacy	Limited
TLS 1.2	2008	Widely used	Good
TLS 1.3	2018	Current	Strong

Key Features:

- **Encryption:** Symmetric and asymmetric algorithms
- **Authentication:** Server and client verification
- **Integrity:** Message authentication codes
- **Forward Secrecy:** Session key protection

Applications:

- HTTPS web browsing
- Email security (SMTPS)
- VPN connections
- Secure file transfers

Mnemonic

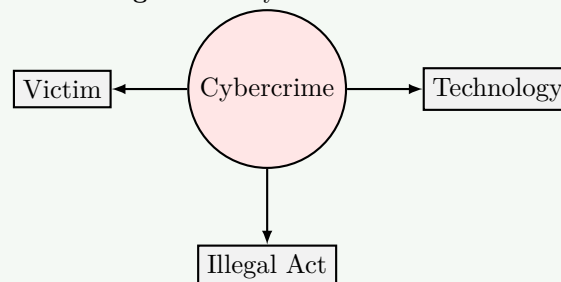
“TLS Encrypts All Network Traffic”

Question 3(a) [3 marks]

Explain in detail cybercrime and cybercriminal.

Solution

Cybercrime Definition: Criminal activities conducted through computers or internet networks.

Figure 10. Cybercrime Overview**Cybercriminal Types:****Table 10.** Types of Cybercriminals

Type	Motivation	Skills	Target
Script Kiddies	Fun/Fame	Low	Random
Hacktivists	Political/Social	Moderate	Organizations
Cybercriminals	Financial Gain	High	Individuals/Banks

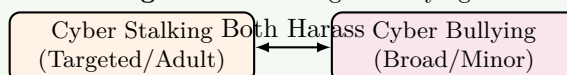
- **Cybercrime:** Illegal activities using digital technology
- **Cybercriminal:** Person who commits cybercrimes
- **Impact:** Financial loss, privacy breach, system damage

Mnemonic

“Cyber Criminals Create Chaos”

Question 3(b) [4 marks]

Describe cyber stalking and cyber bullying in detail.

Solution**Digital Harassment Comparison:****Figure 11.** Stalking vs Bullying**Table 11.** Stalking vs Bullying

Aspect	Cyber Stalking	Cyber Bullying
Target	Specific individual	Often minors
Duration	Persistent, long-term	Can be episodic
Intent	Intimidation, control	Harassment, humiliation
Platform	Social media, email	Schools, gaming platforms

Cyber Stalking Characteristics:

- Persistent unwanted contact
- Monitoring victim's online activity
- Threatening messages or behavior
- Identity theft or impersonation

Cyber Bullying Forms:

- Public humiliation online
- Exclusion from digital groups
- Spreading false information
- Sharing private content without consent

Prevention Measures:

- Privacy settings on social media
- Reporting harassment to platforms
- Legal action when necessary
- Digital literacy education

Mnemonic

“Stop Bullying, Report Stalking”

Question 3(c) [7 marks]

Explain Property based classification in cybercrime.

Solution**Property-Based Cybercrime Categories:****Figure 12.** Property-Based Cybercrime

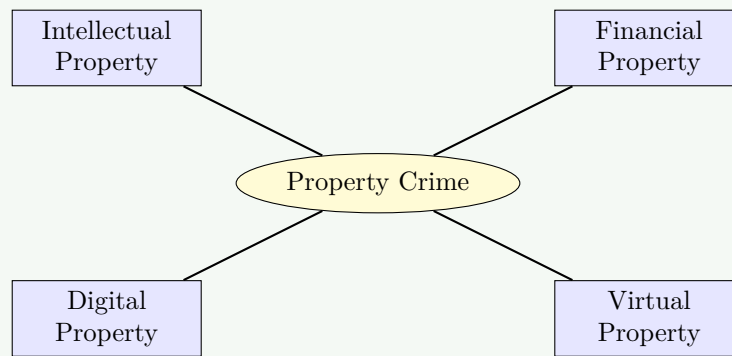


Table 12. Property Crime Classification

Category	Crime Type	Description	Example
Intellectual Property	Copyright infringement	Unauthorized use of copyrighted material	Software piracy
Financial Property	Credit card fraud	Unauthorized use of financial information	Online shopping fraud
Digital Property	Data theft	Stealing digital information	Database breaches
Virtual Property	Gaming asset theft	Stealing virtual goods	Online game currency theft

Legal Aspects:

- **Copyright Laws:** Protect creative works
- **Trademark Laws:** Protect brand identity
- **Patent Laws:** Protect inventions
- **Trade Secret Laws:** Protect confidential information

Impact on Economy:

- Revenue loss for legitimate businesses
- Reduced innovation incentives
- Consumer trust erosion
- Legal enforcement costs

Prevention Strategies:

- Digital rights management (DRM)
- Watermarking and tracking
- Legal enforcement mechanisms
- Public awareness campaigns

Mnemonic

“Property Protection Prevents Piracy”

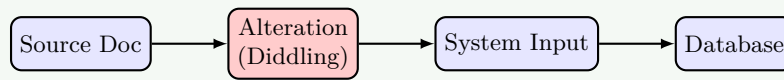
Question 3(a OR) [3 marks]

Explain Data diddling.

Solution

Data Diddling Definition: Unauthorized alteration of data before or during input into computer systems.

Figure 13. Data Diddling Process



Changes happen here

Characteristics:

Table 13. Data Diddling Characteristics

Aspect	Description
Method	Changing data values
Timing	Before system processing
Detection	Often difficult to identify

- **Examples:** Changing salary figures, altering exam scores
- **Target:** Input data during entry process
- **Impact:** Financial loss, incorrect records

Mnemonic

“Data Diddling Damages Databases”

Question 3(b OR) [4 marks]

Explain cyber spying and cyber terrorism.

Solution

Cyber Threats Comparison:

Table 14. Spying vs Terrorism

Aspect	Cyber Spying	Cyber Terrorism
Purpose	Information gathering	Causing fear/disruption
Target	Government, corporations	Critical infrastructure
Methods	Stealth infiltration	Destructive attacks
Impact	Intelligence loss	Public safety risk

Cyber Spying Activities:

- Corporate espionage
- Government surveillance
- Trade secret theft
- Personal information gathering

Cyber Terrorism Methods:

- Infrastructure attacks
- Mass disruption campaigns
- Psychological warfare
- Economic damage

Prevention Measures:

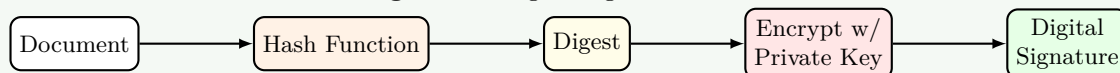
- Network security monitoring
- Incident response planning
- International cooperation
- Public-private partnerships

Mnemonic

“Spies Steal, Terrorists Terror”

Question 3(c OR) [7 marks]

Explain the role of digital signatures and digital certificates in cybersecurity.

Solution**Digital Security Components:****Figure 14.** Digital Signature Process**Table 15.** Digital Security Components

Component	Purpose	Function	Benefit
Digital Signature	Authentication	Proves sender identity	Non-repudiation
Digital Certificate	Verification	Validates public keys	Trust establishment

Digital Certificate Components:

- **Subject Information:** Certificate owner details
- **Public Key:** For encryption/verification
- **Digital Signature:** CA's signature
- **Validity Period:** Certificate expiration date

Certificate Authority (CA) Role:

- Issues digital certificates
- Verifies identity before issuance
- Maintains certificate revocation lists
- Provides trust infrastructure

Security Benefits:

- **Authentication:** Verifies sender identity
- **Integrity:** Ensures data hasn't been modified
- **Non-repudiation:** Prevents denial of actions
- **Confidentiality:** Enables secure communication

Mnemonic

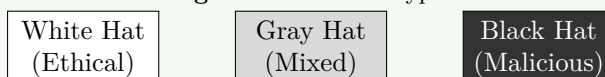
“Digital Signatures Authenticate Documents Securely”

Question 4(a) [3 marks]

What is Hacking? List out types of Hackers.

Solution

Hacking Definition: Unauthorized access to computer systems or networks to exploit vulnerabilities.

Figure 15. Hacker Types

Hacker Classifications:**Table 16.** Types of Hackers

Type	Intent	Legal Status
White Hat	Security improvement	Legal
Black Hat	Malicious activities	Illegal
Gray Hat	Mixed motivations	Questionable

Mnemonic

“White Good, Black Bad, Gray Questionable”

Question 4(b) [4 marks]

Explain Vulnerability and 0-Day terminology of Hacking.

Solution**Security Terminology:****Table 17.** Vulnerability vs 0-Day

Term	Definition	Risk Level	Example
Vulnerability	System weakness	Varies	Unpatched software
0-Day	Unknown vulnerability	Critical	Undiscovered flaw

Vulnerability Characteristics:

- Discovery through security testing
- Disclosure to vendors
- Patching via updates

0-Day Attack Process:

1. Hacker discovers unknown vulnerability
2. Exploits flaw before vendor awareness
3. No available patches or defenses
4. High success rate due to surprise element

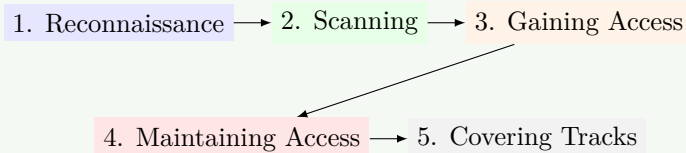
Mnemonic

“Vulnerabilities Need Patches, Zero-Days Need Vigilance”

Question 4(c) [7 marks]

Explain Five Steps of Hacking.

Solution**Hacking Methodology:****Figure 16.** Hacking Steps



Detailed Steps:

Table 18. Hacking Phases

Step	Description	Tools/Methods	Objective
Reconnaissance	Information gathering	Google dorking, Social media	Target profiling
Scanning	System enumeration	Nmap, Nessus	Vulnerability identification
Gaining Access	Exploit vulnerabilities	Metasploit, Custom exploits	System compromise
Maintaining Access	Persistent presence	Backdoors, Rootkits	Long-term control
Covering Tracks	Evidence removal	Log cleaning, File deletion	Avoid detection

Techniques Breakdown:

- **Reconnaissance:** Passive vs Active information gathering
- **Scanning:** Port scanning, vulnerability scanning
- **Access Methods:** Password attacks, exploits, social engineering
- **Persistence:** Backdoors, user accounts, scheduled tasks
- **Covering Tracks:** Log wiping, encryption, timestamp modification

Mnemonic

“Reconnaissance Scans Generate Access, Maintain Coverage”

Question 4(a OR) [3 marks]

Explain any three basic commands of Kali Linux with suitable example.

Solution

Essential Kali Linux Commands:

Table 19. Kali Commands

Command	Function	Example
nmap	Network scanning	<code>nmap -sS 192.168.1.1</code>
netcat	Network communication	<code>nc -l -p 1234</code>
hydra	Password cracking	<code>hydra -l admin -P pass.txt ssh://target</code>

- **Nmap:** Discovers hosts and services on network
- **Netcat:** Creates network connections for data transfer
- **Hydra:** Performs brute-force password attacks

Mnemonic

“Network Map, Connect, Crack”

Question 4(b OR) [4 marks]

Describe Session Hijacking in detail.

Solution

Session Hijacking Overview: Attack where attacker takes over legitimate user's session.

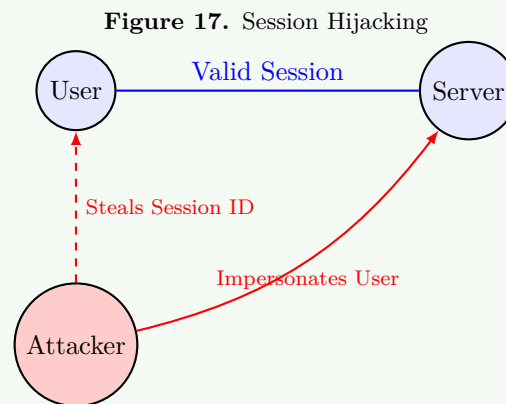


Table 20. Hijacking Types

Type	Method	Prevention
Active	Takes over session	Strong session management
Passive	Monitors session	Encryption (HTTPS)
Network-level	TCP hijacking	Secure protocols
Application-level	Cookie theft	Secure cookie attributes

Prevention Measures:

- Use HTTPS for all communications
- Implement secure session management
- Set secure cookie attributes
- Monitor for suspicious activity

Mnemonic

“Sessions Hijacked Need Secure Handling”

Question 4(c OR) [7 marks]

Explain how Virtual Private Networks (VPNs) create secure, encrypted connections over public networks.

Solution

VPN Architecture:

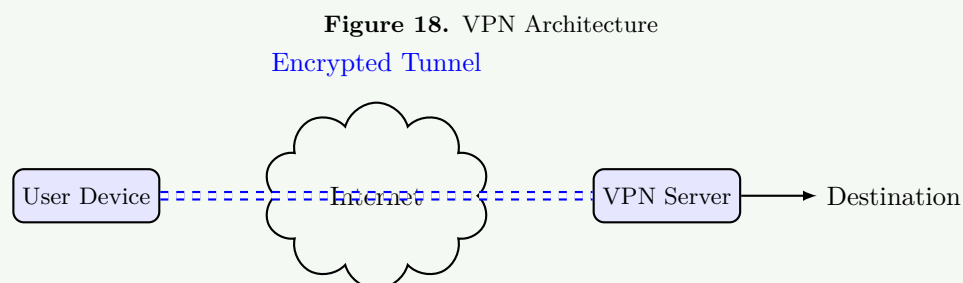


Table 21. VPN Protocols

Protocol	Security	Speed	Use Case
OpenVPN	High	Good	General purpose
IPSec	Very High	Moderate	Enterprise
WireGuard	High	Excellent	Modern solution
PPTP	Low	Fast	Legacy (deprecated)

VPN Working Process:

1. **Connection:** Client connects to VPN server
2. **Authentication:** User credentials verified
3. **Tunnel Creation:** Encrypted pathway established
4. **Data Encryption:** All traffic encrypted
5. **Routing/Decryption:** Traffic routed/decrypted at destination

Benefits:

- **Data Protection:** Encryption prevents eavesdropping
- **Privacy:** IP address masking
- **Access Control:** Authenticate before connection
- **Bypass Restrictions:** Access geo-blocked content

Mnemonic

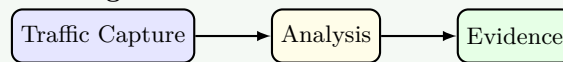
“VPNs Provide Network Privacy”

Question 5(a) [3 marks]

Explain Network forensics.

Solution

Network Forensics Definition: Investigation of network traffic to detect and analyze security incidents.

Figure 19. Network Forensics Process

Wireshark, tcpdump

Key Components:**Table 22.** Network Forensics Components

Component	Purpose	Tools
Traffic Capture	Record network data	Wireshark, tcpdump
Analysis	Examine patterns	NetworkMiner, Snort
Evidence	Document findings	Forensic reports

- **Scope:** Analyzes packets, flows, and network behavior
- **Objective:** Identify security breaches and attack patterns
- **Challenge:** Large data volumes and real-time processing

Mnemonic

“Network Forensics Finds Facts”

Question 5(b) [4 marks]

Explain why CCTV plays an important role as evidence in digital forensics investigations.

Solution

CCTV in Digital Forensics:

Figure 20. CCTV Evidence

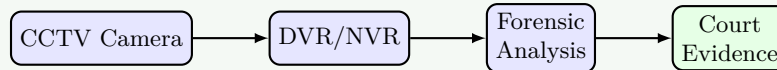


Table 23. CCTV Evidence Value

Aspect	Importance	Value
Visual Evidence	Direct observation	High credibility
Timeline	Time-stamped records	Event correlation
Digital Format	Easy to analyze	Metadata extraction
Backup	Multiple copies	Evidence preservation

Evidence Value:

- **Corroboration:** Supports other digital evidence
- **Timeline:** Establishes sequence of events
- **Identity:** May reveal perpetrator identity
- **Context:** Shows physical environment during incident

Forensic Considerations:

- **Chain of Custody:** Proper evidence handling
- **Authentication:** Verify video integrity
- **Analysis:** Enhancement and interpretation
- **Legal Admissibility:** Court-acceptable format

Mnemonic

“CCTV Captures Criminal Conduct Clearly”

Question 5(c) [7 marks]

Explain phases of Digital forensic investigation.

Solution

Digital Forensics Investigation Phases:

Figure 21. Digital Forensics Phases

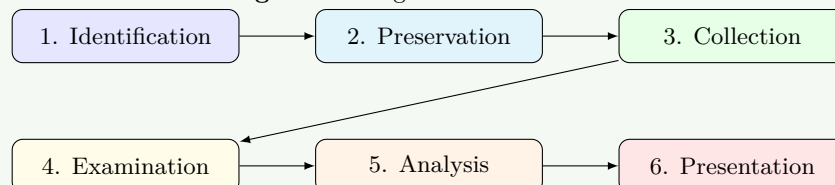


Table 24. Investigation Phases

Phase	Activities	Tools	Objective
Identification	Recognize potential evidence	Visual inspection	Scope definition
Preservation	Prevent evidence contamination	Write blockers	Evidence integrity
Collection	Acquire digital evidence	Forensic imaging	Complete data capture
Examination	Extract relevant data	Autopsy, FTK	Data recovery
Analysis	Interpret findings	Timeline tools	Pattern identification
Presentation	Document results	Report generators	Legal presentation

Phase 1 - Identification:

- Survey the scene and identify evidence sources
- Document initial observations and establish scope

Phase 2 - Preservation:

- Secure crime scene and prevent contamination
- Use write-protection mechanisms

Phase 3 - Collection:

- Create forensic images and maintain chain of custody
- Generate hash values for verification

Phase 4 - Examination:

- Extract file systems and recover deleted data
- Identify relevant files

Phase 5 - Analysis:

- Correlate evidence and reconstruct events
- Identify patterns and form conclusions

Phase 6 - Presentation:

- Prepare detailed reports and visual presentations
- Explain technical findings for legal proceedings

Quality Assurance:

- Documentation, Validation, Reproducibility, Legal Compliance

Mnemonic

“Investigators Preserve, Collect, Examine, Analyze, Present”

Question 5(a OR) [3 marks]

List applications of microcontrollers in various fields related to cybersecurity.

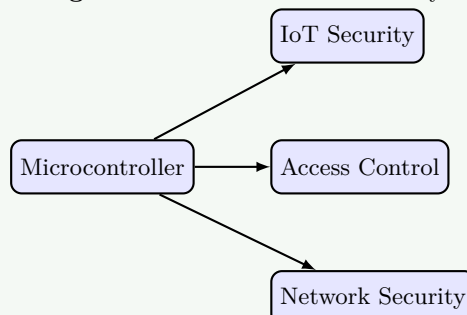
Solution**Microcontroller Security Applications:****Figure 22.** Microcontroller Security

Table 25. Microcontroller Applications

Field	Application	Security Function
IoT Security	Smart home devices	Authentication, encryption
Access Control	Key cards, biometric	Identity verification
Network Security	Hardware firewalls	Packet filtering

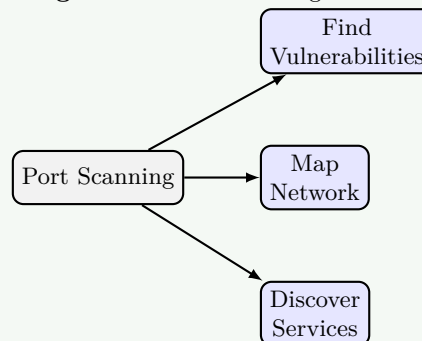
- **Smart Cards:** Secure authentication tokens
- **HSM (Hardware Security Modules):** Cryptographic processing
- **Embedded Systems:** Secure boot, tamper detection

Mnemonic

“Microcontrollers Manage Multiple Security Functions”

Question 5(b OR) [4 marks]

Explain the importance of port scanning in ethical hacking.

Solution**Port Scanning in Ethical Hacking:****Figure 23.** Port Scanning Benefits**Table 26.** Port Scanning Importance

Aspect	Importance	Benefit
Service Discovery	Identify running services	Attack surface mapping
Vulnerability Assessment	Find open ports	Security gap identification
Network Mapping	Understand topology	Infrastructure analysis
Security Testing	Validate configurations	Compliance verification

Port Scanning Techniques:

- **TCP Connect:** Full connection establishment
- **SYN Scan:** Stealth scanning method
- **UDP Scan:** User Datagram Protocol scanning
- **Service Detection:** Identify service versions

Ethical Considerations:

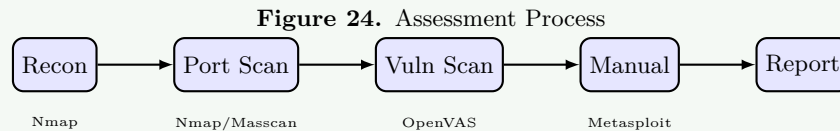
- **Authorization:** Obtain proper permissions
- **Scope:** Stay within defined boundaries
- **Documentation:** Record all activities
- **Reporting:** Provide detailed findings

Mnemonic

“Port Scanning Provides Security Insights”

Question 5(c OR) [7 marks]

Describe the process of conducting a vulnerability assessment using Kali Linux tools.

Solution**Vulnerability Assessment Process with Kali:****Step-by-Step Process & Tools:****Table 27. Assessment Steps**

Step	Kali Tool	Command Example	Purpose
Reconnaissance	Nmap	<code>nmap -sn 192.168.1.0/24</code>	Host discovery
Port Scanning	Nmap	<code>nmap -sS -O target</code>	Open port identification
Service Enumeration	Nmap	<code>nmap -sV target</code>	Service version detection
Vulnerability Scan	OpenVAS	<code>openvas-start</code>	Automated detection
Web App Test	Nikto	<code>nikto -h target</code>	Web vulnerability scanning

Detailed Phases:

- **Phase 1 - Target Identification:** Map network, identify live hosts.
- **Phase 2 - Port/Service Analysis:** Find open ports and service versions.
- **Phase 3 - Automated Scanning:** Use OpenVAS/Nessus for automated checks.
- **Phase 4 - Manual Testing:** Verify findings, test specific flaws (SQLi, XSS).
- **Phase 5 - Reporting:** Document findings, risk ratings, and remediation.

Common Kali Tools:

- **Nmap:** Network scanning
- **OpenVAS:** Vulnerability scanning
- **Nikto:** Web server scanning
- **Metasploit:** Validation/Exploitation
- **Burp Suite:** Web proxy for manual testing

Best Practices:

- **Authorization:** Always obtain written permission
- **Documentation:** Maintain detailed logs
- **Minimal Impact:** Avoid disrupting production
- **Confidentiality:** Protect discovered data

Mnemonic

“Vulnerability Assessment Validates Application Security”