Of course. Here is the combined list of all multiple-choice questions from the past papers, followed by the new questions generated from the textbook content.

# Past Paper Multiple-Choice Questions

## 2023 Semester Test 1

1. A proprietary network protocol is a protocol that... **B: is owned by a specific vendor**
2. Which of the following characters is not present in standard ASCII? **C: £**
3. A header added at layer n at node X... may be removed by... **A: Layer n at Z**
4. Which ISO layer enables process-to-process communication via the network? **C: 4**
5. Which node's (or nodes') layer 3 is/are deemed to be the peer(s) of layer 3 of X? **B: All the nodes on the path after X, up to and including Y.**
6. On which OSI layer(s) is error checking primarily performed? **B: 2**
7. The OSI layer that...attempts to emulate database transactions where messages can be rolled back...is layer... **C: 5**
8. Which protocol is primarily intended to manipulate a mailbox on a server? **A: IMAP4**
9. The capetown.sTLD has to adhere to policies prescribed by... **A: ICANN**
10. The SMTP submit port is... **D: 587**
11. With which architecture was the Napster service associated? **B: Peer-to-peer**
12. The popular network software known as bind... **A: Acts as a name server**
13. When a server opens a socket for communication with a remote host, it needs to supply... **C: The port number on the local host**
14. If the FQDNs of DNS root name servers are ordered lexicographically, the last entry in the list is... **E: m.root-servers.net**
15. An agent that monitors and controls network activity in an SNMP-managed network node, is a(n)... **E: All of the above (Client, Server, P2P-node)**
16. Which condition code will be returned by an SMTP server after successfully handling a helo or ehlo message? **C: 250**
17. The bulk, if not all, of the resource records in the DNS root name servers are of the following type(s)... **C: NS**
18. Which of the following is a popular application used to inspect traffic that flows on a network? **E: Wireshark**
19. Which South African Act specifically regulates 'wiretapping'? **B: RICA**
20. To avoid the need for the ... channel to connect to the FTP client, FTP ... mode should be used. **A: data, passive**

## 2023 Semester Test 2

1. The following is an example of an IGP. **B: OSPF**
2. The ASCII standard standardises a(n) ... character code. **A: 7-bit**
3. Accept-Charset... server supports iso-8859-1, utf-8 and Shift_JIS... response may be encoded using... **E: One of two of the encodings listed as options above (iso-8859-1, utf-8)**

4. A BER value in ASN.1 is, in principle, encoded as a triple consisting of... **B: A type, a length and a value.**
5. Routers using OSPF broadcast their ... and use the received information to apply the ... algorithm. **D: Version of the network topology; Dijkstra**
6. Which of the following is not a valid MIME type? **A: binary**
7. Morse code uses a version of a Huffman encoding... The letter N is deemed to be the fifth most common character... N is represented as follows: **A: -.**
8. The session layer is layer ... of the ISO OSI protocol stack. **D: 5**
9. The transport layer protocol that is predicted to eventually replace TCP is... **D: QUIC**
10. UDP uses the following flow-control mechanism: **C: Unrestricted**
11. Suppose A sends a TCP segment to B, but it arrives damaged... How is this resolved? **B: B discards the segment and does not acknowledge it, the retransmission timer at A expires and the packet is sent again.**
12. A sends a TCP segment to node B. The acknowledgement field contains the value 150. The ACK flag is not set. This means... **B: B should disregard the value 150 - it has no meaning.**
13. Node A sends a TCP segment to node B with its ACK flag set... What happens to one or more of the retransmission timers at A? **D: An existing timer is deleted.**
14. Node A sends a TCP segment to node B with its ACK flag set... What happens to one or more of the acknowledgement timers at A? **E: No acknowledgement timer will be affected.**
15. Node A sends a TCP segment to node B with its ACK flag set... B receives this segment without any error. What happens to one or more of the acknowledgement timers at B? **A: A timer is created.**
16. Suppose node A is connected to node B via TCP. When the persistence timer at A expires, it implies that... **B: A is waiting for space to free up in B's window before further data can be sent.**
17. A TCP connection in the TIME-WAIT state means that... **D: The node is waiting for "lost" traffic to arrive at the port that is no longer in use, before it will be available for reuse.**
18. You see the following line as part of the netstat program's output on Linux ... ESTABLISHED keepalive ... This means that this connection... **A: Is in use, but idle.**
19. A TCP node that is in the LISTEN state... **D: More than one of the above (A: is acting as a server and waiting for a SYN, C: May act as a client after sending a SYN)**
20. Which well-known port is used for control messages by an FTP server? **B: 21**
21. What is the address (in CIDR notation) of the netblock 41.32.0.0 to 41.39.255.255? **D: 41.32.0.0/13**
22. The private class B IPv4 addresses are: **E: 172.16.0.0 - 172.31.255.255**
23. The following type of router connects an organisation's network to other networks: **C: Boundary router**
24. Dynamic IP addresses are often assigned... In some cases a static address is assigned through network address translation. This means that the static IP address... **B: Is a public address that is redirected to the IP address associated with the**

**subscriber's connection.**
25. If one sends a message to an IP multicast address, the message will be delivered to... **C: All nodes that are members of some group.**

## 2023 Final Exam

1. A layer in the protocol stack generally provides services for... **A: The layer above it.**
2. The nom.za second-level domain is intended to allow ... to register subdomains within it. **B: Individuals**
3. The primary metric used by interior gateway protocols is... **A: Cost**
4. The class of protocols used for routing between autonomous systems is known as... **A: EGP**
5. Which of the following data streams generally work(s) better with an unreliable layer 4 protocol? **C: Audio**
6. If MIME is deemed to be a data communications protocol it would fit best on layer ... of the ISO OSI model. **B: 6**
7. When writing an application that will serve as a server... the application would ... open a socket that would... **C: Wait for connections**
8. Which of the following characters is not present in standard ASCII? **C: £**
9. Which ISO layer enables process-to-process communication via the network? **D: 4**
10. The OSI layer that... attempts to emulate database transactions... is layer... **D: 5**
11. The capetown.sTLD has to adhere to policies prescribed by... **A: ICANN**
12. The SMTP submit port is... **D: 587**
13. With which architecture was the Napster service associated? **B: Peer-to-peer**
14. Which condition code will be returned by an SMTP server after successfully handling a helo or ehlo message? **C: 250**
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18. Routers using OSPF broadcast their ... and use the received information to apply the ... algorithm. **D: Version of the network topology; Dijkstra**
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22. Node A sends a TCP segment to node B with its ACK flag set... What happens to one or more of the acknowledgement timers at A? **D: An existing timer may be deleted.**
23. Suppose node A is connected to node B via TCP. When the persistence timer at A expires, it implies that... **B: A is waiting for space to free up in B's window before further data can be sent.**

24. A TCP connection in the TIME-WAIT state means that... **D: The node is waiting for "lost" traffic to arrive at the port that is no longer in use, before it will be available for reuse.**
25. A TCP node that is in the LISTEN state... **D: More than one of the above (A & C)**
26. What is the address (in CIDR notation) of the netblock 41.32.0.0 to 41.39.255.255? **D: 41.32.0.0/13**
27. The private class B IPv4 addresses are: **E: 172.16.0.0 - 172.31.255.255**
28. The following type of router connects an organisation's network to other networks: **C: Boundary router**
29. If one sends a message to an IP multicast address, the message will be delivered to... **C: All nodes that are members of some group.**
30. The syntactic structure of an ASN.1 message is defined using... **A: A grammar**
31. Suppose a message consists of JPG images embedded in HTML text. Which MIME type and subtype will be used to describe the message? **D: multipart/mixed**
32. Suppose A and B are communicating via TCP. A has n bytes to transmit. As far as A is aware, the window size at B is m. This means that... **C: A can transmit m bytes.**
33. An IP datagram addressed to 10.10.1.2 arrives at node R... R's routing table has entries for 10.10.10.0/24, 10.10.0.0/16, and 10.0.0.0/8... To which next hop does R forward the datagram? **A: 192.168.1.1**
34. Which of the following IPv6 addresses correspond with the IPv4 address 10.10.10.10? **D: ::FFFF:A0A:A0A**
35. Consider the IPv6 address fd12:3456:789a::bcde:f0f0:d0d0:9876. Which of the following is true about the part 12:3456:789a? **C: It is a random number.**
36. Consider the IPv6 address fd12:3456:789a::bcde:f0f0:d0d0:9876. Which of the following is true about the part bcde? **B: It designates a subnet.**
37. Consider the IPv6 address fe80::... This address... **A: Is an SLA address.**
38. Which of the following prefixes indicate an IPv4-mapped address... **C: ::ffff:0:0/96**
39. Suppose a router receives an IP datagram d and its TTL becomes 0. What may the router do next? **D: More than one of the above (A: Discard d, C: Send a time exceeded ICMP message)**
40. An IP datagram may be fragmented to... **B: Fit IP datagrams in size-constrained layer 2 frames.**
41. What is the name of the file that contains IP addresses and corresponding names... **E: hosts**
42. IEEE 802.3 defines... **A: Ethernet**
43. The Ethernet address FF:FF:FF:FF:FF:FF is... **B: A broadcast address**
44. The Ethernet card with the MAC address 00:20:10:61:47:72 was manufactured by 3Com. Which... was also manufactured by 3Com? **B: 00:20:10:61:47:73**
45. When no monitor's presence is detected on an 802.5 network... **D: A new monitor is elected by the remaining nodes.**
46. An Ethernet card that is in promiscuous mode will... **C: Accept messages not addressed to it.**
47. Manchester encoding is better than NRZ because... **A: Manchester is**

**self-synchronising.**
48. ...how long does it take a signal to travel from an earth station to a geostationary satellite and back to another earth station? **B: 0.24s**
49. Advantages of a LEO satellite for data communications include... **A: Since it is placed closer... a smaller transmitter can be used...**
50. A master-slave protocol may solve the following problem on layer 2: **A: Media access control**

# 2024 Semester Test 1

1. When ISO and IEEE both issue standards... and they disagree... **E: It does not matter, because standards are not binding.**
2. IEEE 802.11ax is better known as... **D: WiFi 6**
3. Which historical event had a profound impact on many design decisions for the Internet? **A: Cold War**
4. The RIR for Europe is... **A: RIPE**
5. Which ISO OSI layer is responsible for regulating which node is allowed to transmit next when two computers are directly connected? **D: 2**
6. The phrase protocol stack is used... because... **A: Protocols are 'stacked' in layers on top of one another.**
7. Protocols such as SMTP, POP3 and FTP... often include functionality associated with... **B: Layers 6 and 5**
8. When an email client... transmits an email via SMTP... it may usually connect to... **D: More than one of the above (A: 25, C: 587)**
9. Suppose one searches the Internet for SMTP servers... and attempts to send an email... one would observe... **D: The server continues the interaction, but reports that it does not relay messages.**
10. When an email is sent using SMTP the From: header displayed... is... based on... **D: A header included as part of the message that followed the data SMTP command.**
11. After an SMTP client has sent a data command... it signals the end of the data block by sending... **C: .**
12. The Host: line... in an HTTP GET request... is necessary for... **C: Virtual hosting.**
13. FTP is based on the ... architecture. **A: Client-server**
14. User u sees graphical output on w that is produced on s... Which protocol(s) may be used... **A: X11**
15. A program that wants to open a socket... as a server needs to specify... **C: The port on the server**
16. (i) How does a CGI program send output to a browser? (ii) How does a CGI program receive input from a browser? **E: (i) Writes to standard output; (ii) Reads an environment variable set by the server**
17. A file on a name server that maps names to IP addresses is known as a ... file. **E: None of the above (Zone file)**
18. When one enters the command nslookup ns1.up.ac.za 8.8.8.8... **E: ns1.up.ac.za will be resolved using dns.google.**

19. To determine the address of a '.com' name server, one would… submit the following query… **D: com.**
20. The .io TLD is a(n)… **B: ccTLD**

## 2024 Semester Test 2

1. Which protocol will a discless computer typically use to transfer an operating system image from a server…? **C: TFTP**
2. Which of the following are examples of network management protocols? **E: All of the above (SNMP, CMIP, CMOT)**
3. Which of the following statements about X.509 is/are true? **E: All of the above**
4. Item which of the following protocols is an / are examples of an external gateway protocol (EGP)? **A: BGP**
5. In which of the following algorithms is counting to infinity a cause for concern? **D: More than one of the above (B: Bellman-Ford, C: RIP)**
6. Consider a scenario in RIP… r sends its routing table to s… r can reach n at cost 5… s can reach n at cost 8… what will the new cost from s to n be? **B: 6**
7. Suppose computers A and B both use extended ASCII… What challenge(s) may be experienced? **E: None of the problems listed above will occur (but other challenges may exist).**
8. How many Unicode characters can… be represented in UTF-8 using exactly four bytes? If the answer is … $2^n$, what is n? **C: 21**
9. Suppose an email consists of a message encoded in HTML and a JPG image… Which MIME type will be used to describe the entire email message? **D: multipart/mixed**
10. Which Content-Transfer-Encoding would be most appropriate to transfer a PNG image via SMTP? **D: base64**
11. On which ISO OSI layer should encryption be placed…? **E: It depends… All of the layers mentioned above are options.**
12. Which ISO OSI layer may provide checkpoints…? **D: 5**
13. How are the SYN and ACK packets sent during a TCP handshake differentiated…? **A: The flags are used to determine the type of handshake packet.**
14. How does the server differentiate between the ACK packet that it receives as the last part of the handshake… and an ACK packet that acknowledges data…? **E: None of the above**
15. What is the minimum number of timer types required by any sliding window ARQ protocol? **B: 2**
16. The TCP quiet timer determines when a port may be used… Which of the following claims is/are true? **D: More than one of the above (A & C)**
17. Which command enables one to see the status of transport layer connections…? **A: netstat**
18. What type of port is port 55555? **C: Dynamic**
19. What does the claim that QUIC is a quick protocol mean? **D: More than one of the above (B & C)**
20. Which of the following actions always happen(s) when a client establishes a QUIC

connection with a server? **E: None of the above**

21. QUIC connections can migrate. Which party can initiate such a migration...? **A: The client**
22. Which of the following headers are always present in a long QUIC header? **E: All of the above (Version, Source ID, Destination ID)**
23. ...soonest time at which application data may (sometimes) be sent? **A: t0**
24. ...soonest time at which 1-RTT application data may (sometimes) be sent? **B: t1**
25. ...soonest time at which the connection may be deemed to be fully established? **C: t2**

## 2024 Final Exam

1. Which of the following is a popular application used to inspect traffic that flows on a network? **E: Wireshark**
2. The ASCII standard standardises a(n)... character code. **A: 7-bit**
3. On which layer is SSL/TLS usually positioned? **D: 'Just above 4'**
4. A BER value in ASN.1 is, in principle, encoded as a triple consisting of... **B: A type, a length and a value.**
5. EBNF is... **D: More than one of the above (A & B)**
6. Suppose an HTTP request contains Accept-Charset: Shift_JIS... server does not support Shift JIS... **D: The Accept-Charset header given implies ISO-8859-1, so the pages should be served and displayed without problems.**
7. According to RFC4511 all LDAP messages are "transferred using a subset of ASN.1 Basic Encoding Rules"... This means that messages will... **E: All of the above**
8. Which of the following is a valid ASN.1 encoding? **A: BER**
9. Which of the following is not a valid ASN.1 constructor? **B: MESSAGE**
10. The syntactic structure of an ASN.I message is defined using... **A: A grammar**
11. If MIME is deemed to be a data communications protocol it would fit best on layer... **B: 6**
12. Which character set is assumed to be understood by all parties involved in an HTTP exchange? **E: ISO-8859-1**
13. Suppose computers A and B both use extended ASCII... What challenge(s) may be experienced? **E: None of the problems listed above will occur...**
14. Which Content-Transfer-Encoding would be most appropriate to transfer a PNG image via SMTP? **D: base64**
15. Suppose A sends a TCP segment to B, but it arrives damaged... How is this resolved? **B: B discards the segment and does not acknowledge it...**
16. Which well-known port is used for control messages by an FTP server? **B: 21**
17. Which of the following fields does not occur in a TCP header? **E: Length**
18. A program that wants to open a socket... as a server needs to specify... **C: The port on the server**
19. Which command enables one to see the status of transport layer connections on a host...? **A: netstat**
20. What type of port is port 55555? **C: Dynamic**
21. What does the claim that QUIC is a quick protocol mean? **D: More than one of the above**

22. Which of the following actions always happen(s) when a client establishes a QUIC connection...? **E: None of the above**
23. QUIC connections can migrate. Which party can initiate such a migration...? **A: The client**
24. Which of the following headers are always present in a long QUIC header? **E: All of the above**
25. ...soonest time at which application data may (sometimes) be sent? **A: t0**
26. ...soonest time at which 1-RTT application data may (sometimes) be sent? **B: t1**
27. ...soonest time at which the connection may be deemed to be fully established? **C: t2**
28. What is the address (in CIDR notation) of the netblock 41.32.0.0 to 41.39.255.255? **D: 41.32.0.0/13**
29. If one sends a message to an IP multicast address, the message will be delivered to... **C: All nodes that are members of some group.**
30. An IP datagram may be fragmented to... **B: Fit IP datagrams in size-constrained layer 2 frames.**
31. Which of the following IPv4 addresses is/are routable on the public Internet? **A: 137.215.103.222**
32. An IP datagram addressed to 10.10.1.2 arrives at node R... To which next hop does R forward the datagram? **B: 192.168.2.2**
33. The following command... may be used on a *nix host to obtain details about the owner of the specified IP address: **A: whois**
34. Consider the IP routing algorithm... after establishing that no routing table exists? **A: Check whether a default gateway is defined...**
35. Consider the following argument: ...organisation can therefore choose to use public addresses inside their network... Critique this argument. **E: The flaw of the argument is that one would be unable to reach some addresses on the public Internet...**
36. An IPv4 multicast packet... **D: More than one of the above (A & B)**
37. Which ISO OSI layer is generally expected to 'throttle' network communication...? **C: 4**
38. IP address 172.16.5.79 is a... address. **B: Class B**
39. ICMP is used to... **D: More than one of the above (A & B)**
40. Suppose one sends an IP datagram to a network address... What should happen...? **B: At the first router the routing algorithm will note that the destination is a network address and discard the datagram.**
41. Suppose i is an IPv4 address, n is its network address, m is the netmask... Which... is/are true? **A: i . m = n**
42. IEEE 802.3 defines... **A: Ethernet**
43. HDLC accomplishes transparency by using... **A: Bit stuffing**
44. When one node polls another, it wants to know whether... **A: The other node has something to send.**
45. Which of the following is not a function of the data link control layer? **C: Encoding**
46. When no monitor's presence is detected on an 802.5 network... **D: A new monitor is elected by the remaining nodes.**
47. IEEE 802.11 standardises... **E: Wireless LAN**

48. What does data delineation refer to on layer 2? **B: Marking the boundaries of a frame.**
49. A master-slave protocol may solve the following problem on layer 2: **A: Media access control**
50. Suppose a node using SDLC has to transmit the data 01111110. The data will be observed on the line as... **A: 011111010**

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# New Potential MCQs Based on Textbook Content

Here are new questions based on content from your textbook that has not been heavily featured in the multiple-choice sections of the past papers.

## Layer 7: Application Layer

1. What is the fundamental difference between POP3 and IMAP4 in how they handle emails?
   - **POP3 is designed to download emails to a local client, while IMAP4 is designed to manage emails on the server.**
2. In a 3-tier network architecture, where does the database engine typically reside?
   - **In the back-end tier.**
3. The text describes X.400 as a "Message Handling System." According to the text, what was one visionary but ultimately unrealized feature of X.400?
   - **The ability to send emails to and receive them from physical "snail mail" addresses.**
4. Which protocol is specifically used to mount remote file systems on local hosts and is described as being particularly popular in Microsoft environments?
   - **SMB**
5. What is the intended purpose of the Real Time Streaming Protocol (RTSP)?
   - **To control the streaming of multimedia entertainment, like Internet radio.**
6. The textbook mentions that the d in the name of the FTP server program ftpd stands for what?
   - **Dæmon**
7. In the IMAP4 protocol, what is the purpose of the \Seen flag?
   - **To indicate that the user has already read or viewed the message.**
8. What is the primary function of the X.11 Window System protocol?
   - **To enable a program on a remote computer to display its graphical output on a local machine.**
9. The text describes ANSI escape sequences. What are these sequences used for in a virtual terminal protocol like Telnet?
   - **To control the terminal's cursor position, clear the screen, and change text colors.**
10. Which protocol was developed as a secure replacement for Telnet, using port 22?

- ○ **SSH**
11. What is the primary purpose of the Lightweight Directory Access Protocol (LDAP)?
    - ○ **To provide a simplified way to query and manage directory information services.**
12. What is the well-known port number used by POP3 servers for unencrypted connections?
    - ○ **110**
13. In the client-server architecture, what is the term for a server process that is activated when a computer starts and remains active to listen for requests?
    - ○ **Dæmon**
14. Mobile Ad-hoc Sensor Networks (MANETs) are given as an example of an application that requires which network architecture?
    - ○ **Peer-to-peer (P2P)**
15. The text mentions that RIP implements a variant of which algorithm?
    - ○ **Bellman-Ford Algorithm**

## Layer 6: Presentation Layer

1. What is the "transparency problem" in the context of the Presentation Layer?
    - ○ **The challenge of sending data that contains the same bit pattern as a control character or framing sequence.**
2. Which compression technique works by replacing repeated sequences of bytes with a pointer to their first occurrence?
    - ○ **Lempel-Ziv**
3. When discussing markup languages, the textbook argues for separating intent from representation. Which HTML tag is given as an example of expressing "intent" (emphasis) rather than specific formatting?
    - ○ **<em>**
4. Which ASN.1 encoding rule is specifically designed to produce XML output?
    - ○ **XER (XML Encoding Rules)**
5. What is a key difference between ASN.1 and XML?
    - ○ **ASN.1 provides an abstract syntax, separate from the encoding rules (like BER or DER), while XML combines syntax and encoding via tags.**
6. In the context of data exchange formats, which format is specifically designed for moving an entire LDAP directory between servers?
    - ○ **LDIF**
7. What does the mimencode utility with the -u option do?
    - ○ **It will decode the input rather than encode it.**
8. Which data delineation technique uses non-data symbols like 'J' and 'K' that are code violations in the line coding scheme?
    - ○ **Token Ring (IEEE 802.5)**
9. Which of the following is an example of a "container format" as described in the text?
    - ○ **A WMA (Windows Media Audio) file**
10. What is the process of translating a data structure into a linear sequence of values for

storage or network transmission called?
- ○ **Serialization**
11. The textbook discusses byte stuffing as a technique to solve the transparency problem in character-oriented protocols like Bisync. What character is typically used to escape data characters that have the same value as control characters?
    - ○ **DLE (Data Link Escape)**
12. What is the fundamental problem with simply using parity for error detection in network transmissions?
    - ○ **It fails to detect an even number of bit errors within the checked sequence.**
13. The textbook describes USAGE IS COMPUTATIONAL from the COBOL programming language as an analogy for what modern data representation choice?
    - ○ **Encoding numbers in binary format, such as in ASN.1.**
14. The textbook explains that Huffman codes use variable-length bit strings for characters. What is the underlying principle for assigning code lengths?
    - ○ **More frequent characters get shorter codes.**
15. What does the q parameter in an Accept-Charset HTTP header, such as *;q=0.1, signify?
    - ○ **The relative quality or preference level for a given charset.**

## Layer 5: Session Layer

1. The textbook suggests that the Session Layer is responsible for dialogue control. What does this mean?
   - ○ **It determines which connected node may send a message at any given moment.**
2. A key function of the Session Layer is establishing synchronization points. What is the purpose of these points?
   - ○ **To allow a long-running transaction to be rolled back to a known good state if the connection fails.**
3. Which early IBM networking architecture had a seven-layer model with a "Data Flow Control" layer that performed session services?
   - ○ **SNA (Systems Network Architecture)**
4. The textbook mentions that the prevalence of which architectural style might "revive the interest in a true session layer"?
   - ○ **Service-oriented Architectures (and Web services)**
5. In the textbook's example of a reservation system, which task is managed by the session layer?
   - ○ **Transparently re-establishing a connection to a backup server if the primary fails.**

## Layer 4: Transport Layer

1. In the ISO OSI model, which Transport Protocol class (TP0-TP4) is designed for the most unreliable underlying networks and therefore provides the most comprehensive error control?
   - ○ **TP4**

2. What is the purpose of the TCP "persistence timer"?
    - **To prevent deadlock when a receiver's window size is advertised as zero.**
3. A TCP connection transitions to the CLOSE-WAIT state. What does this signify?
    - **The node has received a FIN from the remote party and is now waiting for a connection termination request from its own local user.**
4. In a sliding window ARQ protocol, what is the primary purpose of the acknowledgement timer at the *receiver*?
    - **To ensure that an acknowledgement is sent within a reasonable time, even if no data packets are being sent back to the sender.**
5. In QUIC, what is the purpose of a MAX_STREAM_DATA frame?
    - **To advertise to the peer that it has more buffer space available for a specific stream, allowing the peer to send more data.**
6. What is the primary motivation behind the concept of "protocol ossification" that the designers of QUIC aim to combat?
    - **The inability to evolve a protocol because intermediate network devices (middleboxes) make assumptions about its wire format and block updated versions.**
7. Which of these is a valid stream ID for a *server-initiated, bidirectional* stream in QUIC?
    - **1**
8. What happens when a TCP slow start algorithm reaches its defined threshold (ssthresh)?
    - **The algorithm switches from exponential growth to a slower, linear growth phase (congestion avoidance).**
9. A combination of an IP address and a port number is known as a:
    - **Socket**
10. What does it mean when a TCP connection is in the FIN-WAIT-2 state?
    - **The node has received an acknowledgment for its own FIN and is now waiting for a FIN from the remote party.**
11. What is the purpose of a 0-RTT packet in QUIC?
    - **To send early application data from the client to the server during connection establishment, assuming a previous connection's parameters can be reused.**
12. What is the key difference between TCP's and QUIC's handling of packet loss in a multi-stream scenario (e.g., loading a web page with many images)?
    - **In TCP, a lost packet can delay all subsequent data (head-of-line blocking); in QUIC, it only blocks the specific stream it belongs to.**
13. What is an "ephemeral port" as described in the textbook's appendix on socket programming?
    - **A temporary, high-numbered port assigned by the operating system to a client application for a single connection.**
14. In QUIC, what is the purpose of a PING frame?
    - **To verify that a peer is still responsive and to check the network path, without carrying any application data.**

15. What is the purpose of the PSH (Push) flag in a TCP header?
    ○ **To indicate that the data in the payload should be passed to the receiving application immediately.**

## Layer 3: Network Layer

1. What is the purpose of the IHL (Internet Header Length) field in the IPv4 header?
    ○ **To specify the length of the IP header in 32-bit words.**
2. An ICMP Redirect message is sent by a router to a host to inform it of what?
    ○ **That there is a better or more direct route to a specific destination.**
3. When a host needs to resolve an IP address to a MAC address on a local network, how does the ARP protocol send its initial request?
    ○ **It broadcasts the ARP request to all nodes on the local network.**
4. In IPv6, what is the purpose of Extension Headers?
    ○ **To carry optional information, like fragmentation or routing options, without cluttering the main IPv6 header.**
5. What is the IPv6 unspecified address (::/128) used for?
    ○ **As the source address for a host that is attempting to acquire a network address (e.g., via DHCPv6).**
6. The Hop Limit field in the IPv6 header serves the same purpose as which field in the IPv4 header?
    ○ **Time to Live (TTL)**
7. What is the defining characteristic of IPv6 "anycasting"?
    ○ **A packet is delivered to any single member of a group of receivers, typically the one that is topologically nearest.**
8. The textbook describes Asynchronous Transfer Mode (ATM) routing. What do the VPI (Virtual Path Identifier) and VCI (Virtual Channel Identifier) fields in an ATM cell header represent?
    ○ **The specific virtual circuit the cell belongs to, which determines its path through the network.**
9. What does the "More Fragments" (MF) flag in an IPv4 header indicate when it is set to 1?
    ○ **That this is not the last fragment of the original datagram.**
10. In the context of network topology, what is the role of an "ingress router"?
    ○ **It is the router where traffic enters a specific network or domain.**
11. Which Regional Internet Registry (RIR) is responsible for allocating IP addresses in the Asia-Pacific region?
    ○ **APNIC**
12. The Protocol field in the IPv4 header indicates the layer 4 protocol of the payload. What is the value for UDP?
    ○ **17**
13. The textbook describes routing in ATM as establishing a "switched virtual circuit." How does this differ from IP routing?
    ○ **IP is connectionless, whereas ATM is connection-oriented and establishes a**

**virtual circuit.**
14. What is the "dual stack" approach to IPv6 transition?
    ○ **Running both IPv4 and IPv6 protocol stacks simultaneously on a single device, allowing it to communicate with both types of networks.**
15. In IPv4, what is the primary purpose of the Identification field in the header?
    ○ **To identify which fragments belong to the same original datagram.**

## Layer 2: Data Link Layer

1. In a token passing network, what mechanism is used to handle the loss of the token?
   ○ **A designated "active monitor" detects the absence of the token and generates a new one.**
2. The text describes the "hidden node problem" in wireless networks. What is the fundamental cause of this issue?
   ○ **A node is within range of a common destination but not within range of another transmitting node.**
3. In CSMA protocols, what is the defining characteristic of *p-persistent* CSMA?
   ○ **When the medium becomes idle, a waiting station transmits with a probability p.**
4. In the HDLC protocol, what is the primary function of a U-frame (Unnumbered frame)?
   ○ **To send control commands, such as setting the connection mode or disconnecting.**
5. What is the purpose of an RR (Receiver Ready) S-frame in SDLC/HDLC?
   ○ **To acknowledge previously received frames and indicate that the receiver is ready for more, often used when there is no data to piggyback an acknowledgement on.**
6. The textbook mentions that the IEEE 802.4 (Token Bus) standard was popular in which specific industry?
   ○ **The manufacturing industry.**
7. What is a key advantage of Slotted Aloha over pure Aloha?
   ○ **It reduces the collision window by requiring transmissions to start only at the beginning of a time slot, which can double the maximum throughput.**
8. What is a "jumbo frame" in the context of modern Gigabit Ethernet?
   ○ **A frame with an MTU larger than the standard 1500 bytes, typically around 9000 bytes, to improve efficiency.**
9. According to the text, how many single-bit errors can a 3-modular redundancy scheme reliably correct?
   ○ **One.**
10. The text describes how a CRC is calculated. What mathematical operation is used?
    ○ **Polynomial division with modulo-2 arithmetic.**
11. The textbook describes flow control in the legacy Bisync protocol. What message sequence does Bisync use to acknowledge a frame but request the sender to wait before sending more data?
    ○ **WACK (Wait-before-transmit Acknowledgment)**

12. What is the purpose of the wiring hub in a physical token ring topology?
    - **To automatically bypass a station that is turned off or has failed, maintaining the integrity of the ring.**
13. What is the primary function of the DSAP and SSAP fields in an IEEE 802.2 LLC header?
    - **To identify the Network Layer protocol that the data belongs to.**
14. Which MAC protocol is most susceptible to the "exposed node problem"?
    - **CSMA/CA (as used in WiFi)**
15. What is the primary difference between a network hub and a switch?
    - **A hub broadcasts incoming frames to all ports, while a switch forwards frames only to the specific port of the destination MAC address.**

## Layer 1: Physical Layer

1. What is the key difference between the older CSD (Circuit-Switched Data) and the GPRS (General Packet Radio Service) cellular technologies?
   - **GPRS is packet-switched and billed per megabyte, whereas CSD was circuit-switched and billed per minute.**
2. According to the textbook, what is the defining characteristic of ISDN BRI (Basic Rate Interface)?
   - **It consists of two 64kbps B (bearer) channels and one 16kbps D (delta/signalling) channel.**
3. The textbook describes ADSL as an "asymmetric" technology. What does this asymmetry refer to?
   - **It provides significantly higher downstream (to the user) bandwidth than upstream (from the user) bandwidth.**
4. Which undersea cable system, described in the textbook, connects South Africa with Europe along the west coast of Africa?
   - **WACS (West Africa Cable System)**
5. What is a primary advantage of using Low Earth Orbiting (LEO) satellites like StarLink compared to geostationary (GEO) satellites?
   - **They orbit much closer to Earth, resulting in significantly lower latency.**
6. In network performance metrics, what does "jitter" refer to?
   - **The variation in the delay of received packets, which affects the smoothness of real-time streams.**
7. What is the purpose of "inverse multiplexing" or "bonding"?
   - **To combine several low-speed links to create a single, higher-speed logical link.**
8. What is the fundamental difference between Time-Division Multiplexing (TDM) and Statistical Time-Division Multiplexing (STDM)?
   - **TDM allocates a fixed, unchanging time slot to each channel, while STDM allocates time slots dynamically based on which channels have data to send.**
9. Which line coding scheme represents a 1 with a transition in the middle of the bit interval and a 0 with no transition in the middle (but with a transition at the start)?

- - **Differential Manchester encoding**
10. What is the primary purpose of modulation in data communications?
    - **To convert a digital signal into an analogue signal suitable for transmission over an analogue medium.**
11. Which physical network topology connects all nodes to a central device like a switch or a hub?
    - **Star topology**
12. The textbook describes different network plugs. Which connector is typically used for standard telephone lines?
    - **RJ-11**
13. The text mentions Ethernet naming conventions like 10BaseT. What does the 'T' in 10BaseT signify?
    - **That the medium used is Twisted Pair copper cable.**
14. The term "triple play" is used to describe network convergence. What three services does it refer to?
    - **Voice, data, and video over a single network.**
15. What is the defining characteristic of a "simplex" communication channel?
    - **Data can only be transmitted in one direction.**