1. Which of the following statement is TRUE about throughput:
   a) Throughput is constraint by end to end Path
   b) If there are N connections which share T throughput, per connection throughput will be minimum of all connection.
   c) If there are N connections which share T throughput, per connection throughput will be Maximum of all connection
   d) All of the above
   e) None of the above
2. Scenario: A company is setting up a new email server and wants to ensure that its domain's MX (Mail Exchanger) records are correctly configured. Which DNS resource record should be used for this purpose?
   a) A record
   b) CNAME record
   c) MX record
   d) NS record
3. Scenario: A user wants to access a website, but when they type the domain name, they receive an error message saying "DNS resolution failed." What could be a possible reason for this issue?
   a) The website's server is down or unreachable.
   b) The user's internet connection is too slow.
   c) The user's browser is outdated and incompatible.
   d) The user has entered an incorrect domain name.
4. The Internet Control Message Protocol (ICMP) is used by:
   a) SNMP and NTP
   b) DNS and ARP
   c) ping and traceroute
   d) Web and email applications
   e) FTP and email applications
5. ICMP messages are delivered reliably. Choose the correct option.
   a) True
   b) False
   c) Difficult to tell
   d) ICMP is not a correct term
6. ICMP messages include:
   a) code plus first 4 bytes of IP datagram causing error
   b) code plus first 8 bytes of IP datagram causing error
   c) type, code plus first 16 bytes of IP datagram causing error
   d) type, code plus first 8 bytes of IP datagram causing error
7. Which of the following fields in IPv4 datagram is not related to fragmentation?
   a) Flags
   b) Offset
   c) TOS
   d) Identifier

8. A device receives multiple IP fragments with different Fragment Offset values but with the same identification value. How will the device identify that these fragments belong to the same original packet?
   a) By comparing the Fragment Offset values.
   b) By comparing the identification values.
   c) By comparing the IP header checksums.
   d) By comparing the TTL (Time-to-Live) values.
9. Assuming the TCP congestion control algorithm is in Slow Start phase and a batch of 10 acknowledgments are received. What would be the updated size of congestion window, if its size before reception were 10?
   a) 10 + (10/10) = 11
   b) 10 + (2x10) = 30
   c) Congestion window size cannot be 10; it doubles in slow start i.e. 2,4,8,16 ... not 10.
   d) None of the above
10. Assuming the TCP congestion control algorithm is in Congestion Avoidance phase and a batch of 10 acknowledgments are received. What would be the updated size of congestion window, if its size before reception were 10?
    a) 10 + (10/10) = 11
    b) 10 + (1x10) = 20
    c) It is not possible to answer this question, is it based on TCP Tahoe or Reno?
    d) None of the above
11. Scenario: A user is downloading a large file from a remote server and notices a sudden decrease in download speed. After a few moments, the download speed increases again. Which congestion control mechanism could be responsible for this behavior?
    a) Fast Retransmission
    b) Fast Recovery
    c) Congestion Window
    d) Congestion Avoidance
12. Which one of the following is true for the TCP fast recovery algorithm?
    a) After receiving three duplicates ACKs, the sender waits for the timer to expire and then retransmit.
    b) After receiving two duplicates ACKs, the sender retransmit without waiting for the timer to expire
    c) After receiving three duplicates ACKs, the sender retransmit without waiting for the timer to expire
    d) None of the above
13. In a connection, the value of rwnd is 5000 whereas the agreed MSS value is 500. The host has already send 2000 bytes, which have not been acknowledged. How many more packets can the host can send? (assuming there is no congestion in the network)
    a) 10
    b) 20
    c) 30
    d) 40

14. Why is IP Protocol considered as unreliable?
    a) A packet may be lost
    b) Packets may arrive out of order
    c) Both (a) and (b)
    d) Duplicate packets may be generated
    e) All of the above
15. For Fragmentation 32 bits are reserved in IPv6
    a) True
    b) False
16. Which protocol translates private (non-routable) IP addresses into public (routable) IP addresses?
    a) NAT
    b) DHCP
    c) DNS
    d) ICMP
17. Scenario: A client device wants to establish a TCP connection with a server. The client sends a TCP SYN packet with an MSS value of 1460 bytes. What does this MSS value represent?
    a) The maximum size of the TCP header.
    b) The maximum payload size that the client can receive in a single TCP segment.
    c) The maximum size of the IP packet.
    d) The maximum size of the Ethernet frame.
18. Scenario: Two devices need to communicate over a network. Device A has an MTU of 1500 bytes, and Device B has an MTU of 1400 bytes. What will be the maximum size of the TCP segments when these devices communicate?
    a) 1400 bytes
    b) 1500 bytes
    c) 1360 bytes
    d) 1460 bytes
19. Scenario: A device is sending a TCP segment with a payload of 2000 bytes over a network with an MTU of 1500 bytes. What will happen to the packet during transmission?
    a) The packet will be fragmented into two smaller packets.
    b) The packet will be dropped by the router.
    c) The packet will be delayed until it can fit within the MTU size.
    d) The packet will be transmitted as is, without any changes.
20. Scenario: A network administrator wants to ensure that all devices on the network receive IP addresses within a specific range. Which DHCP configuration option should be used for this purpose?
    a) Lease Time
    b) Default Gateway
    c) DNS Server
    d) IP Address Range

21. Scenario: A network administrator wants to ensure that all devices on the network receive IP addresses within a specific range. Which DHCP configuration option should be used for this purpose?
    a) The DHCP server sends a DHCP Offer message with an available IP address.
    b) The DHCP server sends a DHCP Request message to confirm the IP address assignment.
    c) The DHCP server sends a DHCP Acknowledge message to confirm the IP address assignment.
    d) The DHCP server sends a DHCP NAK (Negative Acknowledge) message indicating the IP address is not available.
22. When a newly connected client sends a DHCP Discover message, what are the contents of Transport layer source and destination port numbers, respectively?
    a) Source port: 68 and destination port: 67
    b) Source port: 65 and destination port: 60
    c) Source port: 67 and destination port: 68
    d) None of the above
23. The DHCP server can also provide:
    a. Address of the destination server
    b. Private and public IP mapping
    c. Name and address of the DNS server
    d. All of the above
24. When a newly connected client sends a DHCP Discover message, what are the contents of Network layer source and destination IP addresses, respectively?
    a) Source: 0.0.0.0 Destination: DHCP's IP Address
    b) Source: 127.0.0.1 Destination: Broadcast address of subnet, if the subnet to which client connected is represented by 201.12.0.0/16 then the destination address would be 201.12.0.255
    c) Source: 0.0.0.0 Destination: Broadcast address of subnet
    d) None of the above
25. The DHCP belongs to which layer:
    a) Network layer because it provides network mask
    b) Application layer because it uses TCP with port 67 and port 68 to communicate
    c) Application layer because it uses UDP with port 67 and port 68 to communicate
    d) All of the above
26. What is the relation between MSS and MTU
    a) The minimum amount of application layer data in a segment is called MSS
    b) The maximum amount of application layer data in a segment plus the size of TCP/IP header should not exceed maximum transmission unit (MTU)
    c) The maximum amount of application layer data in a segment plus the size of TCP should not exceed maximum transmission unit (MTU)
    d) All of the above
    e) None of the above

27. A Process A has 100bytes space available in its ***SendBuffer*** and 200 bytes space available in the ***RecvBuffer.*** Consider the MSS to be exactly 183 bytes. It receives 20 bytes data from Process B and in the TCP segment, the window size is mentioned as 300 bytes. Process A has just detected a packet loss by timeout. How much data (in bytes) Process A can send next?
    a) 183
    b) 180
    c) 200
    d) None of the above.
28. Why a router needs access to the network layer
    a) A router has no access to the network layer
    b) It needs to know the MAC address in order to forward the datagram
    c) It needs to know the IP address of the destination end system
    d) None of the above
29. Which of the following statement is **NOT TRUE** about Link state routing
    a) All routers have complete topology information.
    b) Routers only communicate (routing info) with the directly connected neighbors
    c) Each node can then run the LS algorithm and compute the same set of least-cost paths as every other node
    d) None of the above
30. Network layer is responsible of Transporting datagram from:
    a) Sending Host to receiving Process
    b) Sending Process to receiving port number
    c) Sending First hop router to receiving Last hop router
    d) None of the above
31. Which of the following statement is FALSE about Time To Live (TTL) field of datagram header:
    a) Decremented by each router and thus helps in reliability logic of the TCP
    b) There is no field in IPv6 header with the same exact name
    c) All of the above
    d) If the value is zero Datagram is dropped by the router
    e) None of the above
32. To deliver a message to the correct **Network Layer** protocol, at the receiver side, which of the following information in the header is consulted?
    a) Type of Service (ToS) fields in IP datagram header were meant exactly for that but not being used
    b) Upper layer protocol field in IP datagram
    c) There is only one network layer protocol, called IP, the choice to choose amongst multiple doesn't exist and there is no need for any such field
    d) None of the above

33. The TTL field has value 10. How many routers (max) can process this datagram?
    a) 11
    b) 9
    c) 10
    d) 20
34. If the value in protocol field is 17, the transport layer protocol used is
    a) TCP
    b) UDP
    c) ARP
    d) OSPF
    e) None of the above
35. What should be the flag value to indicate the last fragment?
    a) 0
    b) 1
    c) 2
    d) None of the above
36. The packet sent by a node to the source to inform it of congestion is called
    a) Explicit
    b) Discard
    c) Choke
    d) Ping
37. DHCP client and servers on the same subnet communicate via
    a) TCP broadcast
    b) UDP unicast
    c) Point-to-point
    d) UDP broadcastd
38. The computation of the shortest path in OSPF is usually done by
    a) Bellman-ford algorithm
    b) Routing information protocol
    c) Dijkstra's algorithm
    d) Distance vector routing
39. Scenario: In a network where IPv4 is the predominant protocol, a method is employed to allow IPv6 hosts to communicate with IPv4 hosts. Which technology facilitates this communication?
    a) IPv6 over IPv4 Translation
    b) IPv4 Address Resolution Protocol (ARP)
    c) IPv6 Subnetting
    d) IPv4 to IPv6 Transition Mechanism
40. Scenario: A network administrator wants to provide external access to a web server located within the internal network. The internal IP address of the web server is 192.168.1.10, and the public IP address assigned by the ISP is 203.0.113.50. Which type of NAT should be used to enable external access to the web server?
    a) Static NAT
    b) Dynamic NAT
    c) PAT (Port Address Translation)
    d) NAT-PT (Network Address Translation - Protocol Translation)

41. In classful addressing, a large part of available addresses are
    a) Organized
    b) Blocked
    c) Wasted
    d) Communicated
42. What is the broadcast address of the network 192.168.49.208/28?
    a) 192.168.49.223
    b) 192.168.49.200
    c) 192.168.49.224
    d) None of the above

What is the subnet mask for a host with the IP address 1.199.17.247/26?
    a) 255.255.0.0
    b) 255.255.255.90
    c) 255.255.255.190
    d) 255.255.255.192

44. What is the network address for a host with the IP address 1.199.17.247/26?
    a) 1.199.17.191
    b) 1.199.17.190
    c) 1.199.17.192
    d) None of the above
45. Determine the network Id of the host with the IP 201.222.5.42 and subnet mask of 255.255.255.248
    a) 201.222.5.41
    b) 201.222.4.40
    c) 201.222.5.42
    d) 201.222.5.40
46. You are designing a subnet mask for the 172.21.0.0 network. You want 10 subnets with up to 3700 hosts on each subnet. Which subnet mask should you use?
    a) 255.255.240.12
    b) 255.255.240.0
    c) 255.255.240.10
    d) 255.255.240.1
47. Which of the following statement is Not True about Go-Back-N protocol:
    a) Sender can have up to N unacked packets in pipeline
    b) Discard out of order packets at receiving end
    c) All of the above
    d) Receiver send individual ACK
48. Which of the following statement is Not True about Selective Repeat protocol:
    a) Sender can have up to N unacked packets in pipeline
    b) Receiver send individual ACK
    c) Sender maintains timer for each unacked packet
    d) Sender buffer out of order packets
    e) All of the above

Note: For all the questions, you need to be as specific as possible and provide the answers in the space provided. Anything written outside the allocated space (box) would not be considered for evaluation. Corrected and overwritten text would be considered as incorrect.

Read again, anything written outside the allocated space (box) would not be considered for evaluation. Corrected and overwritten text would be considered as incorrect.

Question No.2: [10 Marks]

Being an IT administrator at FASTNU, your task is to register a new web server name: www.faculty.edu.pk (IP: 172.168. 122.10) so that It can be accessed over the Internet. The University also manages an authoritative server (auth.fast.edu.pk, IP: 172.168.52.2) which provides authoritative responses for all its servers. The University also has a mail server (x1.mail.Islamabad.fast.edu.pk, IP: 172.168.58.7) with an alias name of mail.fast.edu.pk. Assume the root DNS server and the TLD servers are available with the following information. There will be negative marking for providing information other than the required.

Root	Name: Root-Servers.Net	IP: 198.41.0.4
TLD	Name: GTLD-Servers.Com	IP: 192.5.6.30

Given the space provided below, list all the **resource records ONLY** that are needed to add the new web server and where i.e., **which DNS server. Write concrete values using the IPs and Host Names provided**.

Root Name: County Name: County-servers.pk TLD : Name : GTLD-servers.pk	IP: 172.168.122.10 IP: 172.168.122.11
Auth : Authoritative.pk TLD : Name : Authoritative-Servers.pk	IP: 172.168.52.2 IP: 172.168.52.4
Email : Email-server.pk TLD : Name = HTTP-servers.pk	IP: 172.168.58.7 IP: 172.168.58.3

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ion 3: [20 points]

er Host A in Network-X is sending a datagram having total size of 5020 bytes (e.g., header is 20 and payload is 5000 bytes) to Host B in Network-Z as shown in Figure 1 below.

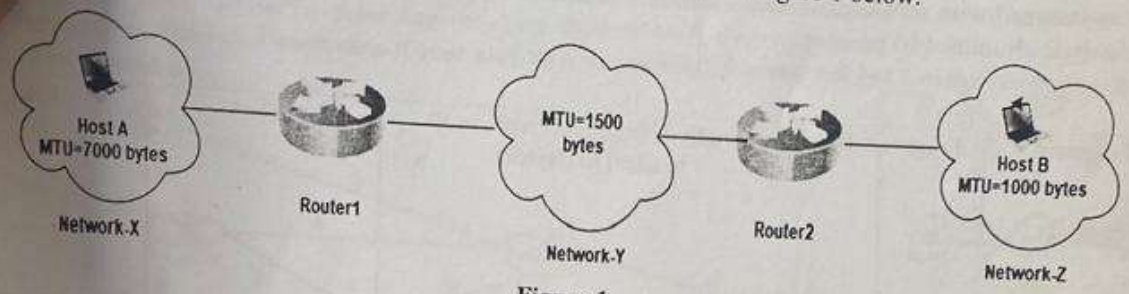

Figure 1

a. Where the datagram will be fragmented first time in the given scenario (Figure 1)?

Datagram is fragmented at router but according to condition datagram > MTU so it will be fragmented at Router 2. [1 point]

b. Which part of the datagram will be fragmented?

The payload part will be fragmented [1 point]

c. Where re-fragmentation will be required in the given scenario from host A to host B (Figure 1)?

Re-fragmentation will occur at network Y when it will be sedig datagrams to network Z [1 point]

d. Where will be the defragmentation for the first time in the given scenario from A to B (Figure 1)?

Defragmentation will occur at the destination's IP address. i.e first time it will occur on network Y. [1 point]

e. Consider Host B in Network-Z sending a datagram of the same size as received from Host-A (e.g., in the form of re-fragmented packet), then how many times it will be fragmented while sending from host B to host A.

It will be the same as it is done for sedig from host A to Host B. [1 point]

f. Please fill out the values in the following table for the fragmentation if the original datagram is stamped with an identification number 455 and the offset value has specified in the units of 8-byte chunks. [10 points]

Fragment #	Fragment ID	Length of fragment (without IP header) in (Bytes)	Offset	Flag
1	455	1496 +20 (header)	0	1
2	455	1496 +20 "	187	1
	455	1496 +20 "	374	1
	455	512 +20 "	748	0
...				

g. Is re-fragmentation of the fragmented packet required in the given scenario (Figure 1)?

Yes, re-fragmentation will occur [1 Point]

h. If your answer is **Yes** for part (h) then fill out the re-fragmented values in the following table for the first fragmented packet (consider offset value specified in the units of 8-byte chunks). [4 points]

Fragment #	Fragment ID	Length of fragment (without IP header) in (Bytes)	Offset	Flag
1	455	2496 [redacted] +20 (header)	0	1
2	455	2496 [redacted] +20 "	312[redacted]	0 1
[redacted]3	[redacted]455	8 +20 "	624	0

Question 6: [20 points]

Subnet the network address of "192.168.10.0" by using a subnet mask (255.255.255.192) or a CIDR value of 192.168.10.0/26, and then answer the following questions accordingly.

1. How many subnets? Use a formula or justify your answer to show the total number of subnets.

$2^5 = 32$ subnets [2 Points]

2. How many valid/usable hosts per subnet? Use a formula or justify your answer to show the total number of valid/usable hosts per subnets.

$2^5 = 32 - 2 = 6$ [2 Points]

3. What are the valid subnets? List down the Network addresses of each subnet.

255.255.255.0
255.255.255.70
255.255.255.168 [2 Points]

4. What is the broadcast address for each subnet?

192.168.10.1
192.168.10.2
192.168.10.3 [2 Points]

5. What are the valid hosts? List down the first and last two IP addresses from the range of the valid hosts in each subnet. [12 Points]

IP address of Subnet# 192.168.10.0
First valid/usable host IP: 192.168.10.1
Second valid/usable host IP: 192.168.10.2

Second last valid/usable host IP: 192.168.10.3
Last valid/usable host IP: 192.168.10.4

IP address of Subnet_# 192.168.10.5
First valid/usable host IP: 192.168.10.6
Second valid/usable host IP: 192.168.10.7

Second last valid/usable host IP: 192.168.10.8
Last valid/usable host IP: 192.168.10.9

IP address of Subnet_# 192.168.10.10
First valid/usable host IP: 192.168.10.11
Second valid/usable host IP: 192.168.10.12

Second last valid/usable host IP: 192.168.10.13
Last valid/usable host IP: 192.168.10.14

IP address of Subnet: 192.168.10.15
First valid/usable host IP: 192.168.10.16
Second valid/usable host IP: 192.168.10.17

Second last valid/usable host IP: 192.168.10.18
Last valid/usable host IP: 192.168.10.19

IP address of Subnet# 192.168.10.20
First valid/usable host IP: 192.168.10.21
Second valid/usable host IP: 192.168.10.22

Second last valid/usable host IP: 192.168.10.23
Last valid/usable host IP: 192.168.10.24

Question 7: [5 Points]

a) Consider a datagram network using 32-bit host addresses. Suppose a router has five links, numbered 0 through 4, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	Link Interface
11100000 00000000 000000000 00000000 through 11100000 00000000 11111111 11111111	0
11100000 00000001 000000000 00000000 through 11100000 00000001 11111111 11111111	1
11100000 00000010 000000000 00000000 through 11100000 11111111 11111111 11111111	2
11100000 000000 000000000 00000000 thro 11 11111 11111111 11111111	3
	4

. rovide a forwarding table that has FIVE entries, uses longest prefix matching, and forwards packets to the correct link interfaces.

Address	Interface
11100000 00000001	1
11100000 00000000	0
11100000	2
11100001	3
otherwise	4