Q.NO 1-24 CARRY 2 MARKS EACH

1. Match the following:

OSI Layer	**Responsibilities**
1. Network Layer	p. Encoding & Translation
2. Transport Layer	q. Feedback Messaging
3. Data Link Layer	r. Transmission Modes
4. Session Layer	s. Segmentation and Reassembly
5. Presentation Layer	t. Dialogue Control
6. Physical Layer	u. Access Control

A. 1-s, 2-t, 3-u, 4-r, 5-p, 6-q
B. 1-q, 2-s, 3-u, 4-t, 5-p, 6-r
C. 1-s, 2-u, 3-p, 4-r, 5-q. 6-t
D. 1-q, 2-u, 3-p, 4-t, 5-s. 6-r

Ans: Option B

1. Network layer takes care of feedback messaging through ICMP messages.
2. Application layer sends data of any size to transport layer. Now transport layer will know the MTU(Maximum Transmittable Unit) of the network, so it will segment the data into smaller parts and these segments are reassembled at the transport layer of the receiver. So, Transport Layer takes care of Segmentation and Reassembly.
3. When more than one system is connected to a shared link, Data Link Layer protocols are required to determine which device has the control over the link at a given time. It is implemented by protocols like CSMA/CD, CSMA/CA, ALOHA and Token Passing.
4. Dialogue control is using the full duplex link as half duplex. It sends out dummy packets from the client to the server when the client is ideal. This is done by the session layer.
5. Presentation layer translates a message from common form to encoded format which will be understood by the receiver.
6. Physical layer chooses which type of transmission mode is to be selected for the transmission. The transmission modes are Simplex, Half Duplex and Full Duplex.

2. Let a cluster of stations share 48Kbps of pure Aloha channel. Every station outputs frames of length 1024bits on an average of every 50seconds. Then what is the maximum value of no. of stations?

A. 413 B. 431 C. 453 D. 435

Ans: Option B

Throughput of Pure Aloha = G * $e^{(-2G)}$ where G is the average no. of frames generated by the system during one frame transmission time.

The maximum throughput is achieved when G=1/2. So, max throughput = 0.5(e^{-1}) =0.184

This is the maximum utilization of the bandwidth.

Therefore total utilization of the bandwidth = 0.184 * Bandwidth of channel

No. of stations * capacity of each station = 0.184 * Capacity of channel

N*b = 0.184*B

N = 0.184*B/b

Given Channel capacity is B = 48Kbps = 48*1000bps (Data size is represented in powers of 2 and signal speed is represented in powers of 10)

Capacity of each station is b = 1024bits/50 sec

= 20.48bps

⇨ N = 0.184*48*1000bps/(20.48 bps)

So, No. of stations = 431.25 (431 approximately)

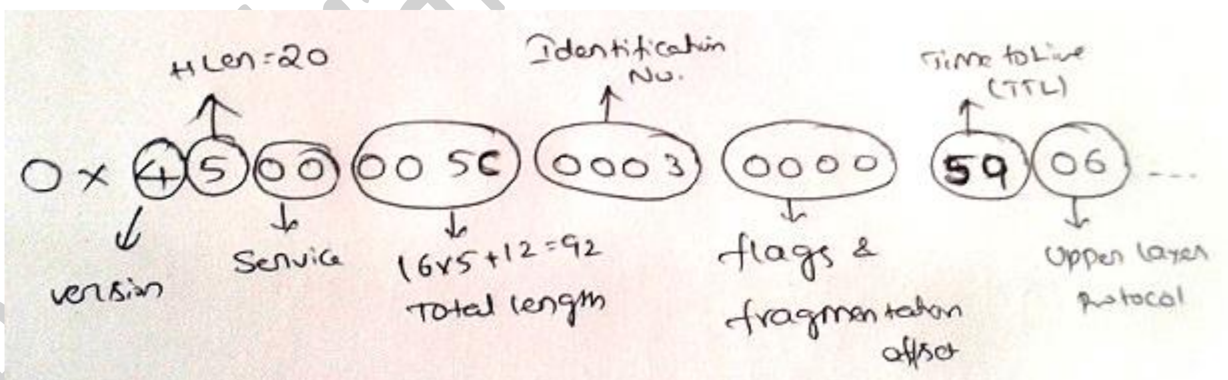
3. An IPv4 packet has the first few hexadecimal digits as shown below.

0X4500005C000300005906….

How many hops can this packet take before being dropped?

A. 30 B. 59 C. 89 D. 90

Ans: Option C



From the above figure, the time to live (TTL) field is 0X59 in hexadecimal = 5*16 + 9 = 89 in decimal. Therefore, the packet will be dropped after taking 89 hops from the source.

4. Consider a 8Mbps token LAN with a ring latency of 256µsec. A host need to transmit seizes the token, and then it sends a frame of 1024 bytes removes the frame after it has circulated all around the ring and finally releases the token. This process is repeated for every frame. Assuming that only a single host wishes to transmit, then the effective data rate (in Mbps) is?

A. 4.53 B. 5.36 C. 6.7 D. 9.4

Ans: Option B

Given B = 8Mbps

Ring Latency or propagation delay = 256 μsecs

Length of the frame L = 1024bytes

No. of stations N = 1

Given that token is held until the frame reaches the source and then releases the token.

So, this is delayed token reinsertion strategy.

Therefore,

Effective data rate = Efficiency * Bandwidth

$$\text{Efficiency} = \frac{\text{N}*\text{Transmission delay}}{\text{N(Transmission delay + Ring Latency)+Ring Latency}}$$

$$= \frac{N}{\text{N+(N+1)a}}$$

Where a = propagation delay/Transmission delay

T_{trans} = L/B

= 1024*8bits/(8*10^6bits/sec)

= 1024 μsec

a = T_{prop} / T_{trans} = 256μsec/1024μsec = 0.25

$$\text{Efficiency} = \frac{N}{\text{N+(N+1)a}} = \frac{1}{1+(1+1)0.25} = 1/1.5 = 0.67$$

Therefore Effective data rate = Efficiency * Bandwidth

= 0.67 * 8Mbps

= 5.36Mbps

5. In an IPv4 packet, the value of HLEN is 15, and the value of the total length field is 0X0064. How many bytes of data are being carried by this packet?

A. 85bytes B. 49bytes C. 40bytes D. 20bytes

Ans: Option C

The HLEN value is 15, which means the total number of bytes in the header is 15*4 = 60 bytes (this is the maximum possible header length). Given the total length is 0X0064 in hexadecimal = 100bytes including header size. So, the data carried by this packet = total length – header length = 100 – 60 = 40 bytes.

6. An IPv4 datagram has arrived in which the offset value is 800, the value of HLEN is 8, and the value of the total length field is 500 and the M bit is 0. What are the numbers of the first byte, the last byte and the position of the datagram?

A. 6400, 6887 and Last fragment
B. 6400, 6867 and First fragment
C. 6400, 6867 and Last fragment
D. 801, 1268 and First fragment

Ans : Option C

M bit is 0, means this datagram is the last fragment, there are no datagrams after this

Offset is 800 i.e., there are 800*8 bytes = 6400 bytes before this fragment.

Total length field is 500 bytes

Given HLEN is 8, so header length is 8*4 =32bytes

Therefore the data present in this fragment is 500 – 32 = 468 bytes

The sequence no. of the first byte of this fragment is 6400, since there are 6400 bytes before this datagram and sequence no. starts from 0.

The sequence no. of the last byte of this fragment is 6400+468-1 = 6867.

7. A Sliding window protocol of 4Mbps point to point link has propagation delay of 0.5sec. Assume that each frame carries 2KB of data. What is the minimum no. of bits used for sequence number field?

(A) 10 (B) 9 (C) 12 (D) 8

Ans: Option D

Propagation delay 1-way latency = 0.5 sec

RTT (2-way latency) = 2*0.5 = 1 sec

B = 4Mbps

L = 2KB of data

$T_{trans} = L/B = \frac{2*1024*8\text{bits}}{4*10^6\text{bits/sec}} = 4.096*10^{-3}$ sec

RTT = 1 sec = $1000 * 10^{-3}$ sec

Window size = $\frac{\text{Ttrans} + 2*\text{Tprop}}{\text{Ttrans}} = \frac{(4.096*10^{-3})+(1000*10^{-3})}{4.096*10^{-3}} = 245.14$

Therefore, no. of sequence bits = ceil($\log_2$ Ws) =ceil($\log_2$ 245.14) = 8

8. The following is a dump of UDP header in hexadecimal format

5EFA00FD001C3297

What is the total length of user datagram? Is the packet from client to server or vice versa?

(A) 30 bytes and packet is going from client to server
(B) 28 bytes and packet is going from client to server
(C) 30 bytes and packet is going from server to client
(D) 28 bytes and packet is going from server to client

Ans: Option (B)

UDP header is 64 bits has 4 parts each containing 16 bits.

1^{st} 16 bits for source port number
2^{nd} 16 bits for destination port number
3^{rd} 16 bits for total length
last 16 bits for checksum.

Given header is 5EFA00FD001C3297 in hexadecimal form.
0X5EFA is source port number and the value is 24,314 in decimal
0X00FD is destination port number and the value is 253 in decimal
0X001C is for total length
0X3297 is for checksum.

Datagram total length is 001C H bytes which is 28 bytes.

Now if port value is >1023 then it's a client and if <1023 then it's server.
Clearly source port number is 5EFA H which is 24314 >1023. So it's a client.
Destination port number is 00FD H i.e. 253 <1023. So it's a server.
So, packet is going from client to server

9. If size of a TCP segment is 1KB and header length value is 6, the sequence number = 3500. Given that URG flag = 1 and URG pointer = 45. Then what is the total size of data. How many of them are urgent, Give the sequence numbers of urgent data.

(A) 45 bytes of urgent data, sequence no. 3500 – 3544
(B) 45 bytes of urgent data, sequence no. 1024 – 1069
(C) 46 bytes of urgent data, sequence no. 1024 – 1070
(D) 46 bytes of urgent data, sequence no. 3500 – 3545

Ans: Option D

(Given Size of TCP segment = 1KB = 1024 Bytes

Header Length field is 6, so header size = 6*4 = 24 bytes

Total data size = size of Segment – Header size = 1024 – 24 = 1000bytes of data)

Starting Sequence no. is 3500

So the range of sequence no. of the data is 3500 to 4499

URG pointer = 45 so data from 0^{th} byte till 45^{th} byte are urgent so 46bytes are urgent data.

Therefore, the urgent data is 1000 to 1045 and its sequence no. range is 3500 – 3545.

10. If the initial sequence number is 1 and it increment the counter by 2,56,000 for every 2 sec, how long does it take for the counter to wrap around?

(A) 33,554 seconds
(B) 44,554 seconds
(C) 33,455 seconds
(D) 44,455 seconds

Ans: Option A
Given for every 2 secs, counter is incremented by 2,56,000
So for every 1 sec, counter increments by 2,56,000/2 = 1,28,000
The sequence no. is 32 bit long and it can hold only $2^{32} - 1$.
So it takes $(2^{32} - 1)/(128000) = 33,554.431$seconds

11. If IRTT = 45 sec, NRTT = 60 sec, $\alpha = 0.9$ and Initial deviation is 8sec then calculate Time out.
(A) 80.5 (B) 81.3 (C) 82.5 (D) 80.0

Ans Option B
From the Jacobson's algorithm,
Next Deviation D_N = | IRTT – NRTT | = | 45 – 60 | sec = 15 sec
Expected deviation $D_E = \alpha D_I + (1 - \alpha)D_N$
$= 0.9*8 + 0.1*15$
$= 8.7$
Expected Roundtrip time ERTT = α * IRTT + $(1 - \alpha)$ NRTT
$= 0.9 * 45 + (1 - 0.9)*60$
$= 46.5$
Time out T_O = ERTT + 4 *D_E
$= 46.5 + 4*8.7$
$= 81.3$

12. Which of the following is true about TCP?
(i) It is a byte oriented port to port communication
(ii) It uses a combination of SR and Go – Back N for flow control
(iii) It connections are link to link and full duplex
(iv) It uses piggybacking whenever possible

(A) i, iii and iv are correct
(B) i, ii and iv are correct
(C) ii, iii and iv are correct
(D) All are correct

Ans: Option B
TCP connections are end to end. Data Link layer is Link to Link

13. What is the value of symmetric key in the Diffie – Hellmen protocol if A and B want to exchange the key. Given that A chooses X_A= 3 and B chooses X_B = 7, α = 7, p = 23?
(A) 17 (B) 21 (C) 13 (D) 10

Ans: Option D

$\alpha = 7$ and $p = 23$

Given that A selected X_A=3 so A calculates $Y_A = \alpha^{Xa}$ mod p and sends Y_A to B

X_A is private and Y_A is public to A.

So $Y_A = 7^3$ mod 23 = 21 => $(X_A, Y_A) = (3, 21)$

B selected $X_B = 7$ and calculates $Y_B = \alpha^{Xb}$ mod p and sends Y_B to A.

X_B is private and Y_B is public to B.

So $Y_B = 7^7$ mod 23 = 5 => $(X_B, Y_B) = (7, 5)$

Now the key is computed at A as $(Y_B)^{XA}$ mod p or at B as $(Y_A)^{XB}$ mod p

Key calculated at A, $K_A = (Y_B)^{XA}$ mod p

= 5^3 mod 23 = 10

Key calculated at B, $K_B = (Y_A)^{XB}$ mod p

= 21^7 mod 23 = 10

14. IP packets whose total length (data plus header) is 16Kb basting out of a router live for 15 seconds. The maximum line speed (in MBPS) of the router can operate at without cycling through the IP datagram identification number space is?

(A) 68.266 (B) 57.233 (C) 8.533 (D) 10.333

Ans: Option C

IP datagram identification number space is 16 bits.

So number of packets = 2^{16}

Packet life time = 15 sec

So 2^{16} packets will be sent in 15 secs

In 1second, $2^{16}/15$ will be sent

since each packet size = 16Kbits = 2KBytes

So line speed = $2^{16} * 2048 /15$ bytes/sec = 8.533 MBps

15. A building running CSMA – CD protocol is having a bandwidth of 512Mbps and distance of 2 kilometres then determine the minimum data size in order to detect a collision. Assume that the signal speed is 2,00,000km/s

(A) 1000bytes (B) 1250bytes (C) 1280bytes (D) 1024bytes

Ans: Option C

Bandwidth B = 512Mbps = $512*10^6$ bits/sec

Distance d = 2km

Speed of signal V = 2,00,000 kmps = $2 * 10^5$km/s

For CSMA – CD, to detect collision, Ttrans >= 2Tprop

Propagation delay T_{prop} = Distance/Speed of signal

$= 2km/(2X10^5 km/sec)$

$= 10^{-5}$ sec

Transmission delay T_{trans} = Size of data/Bandwidth

$= L/ (512*10^6 bits/sec)$

Since Ttrans >= 2Tprop

$L = 2 * 10^{-5} sec * 512 * 10^6 bits/sec$

= 10240 bits = 1280 bytes

16. A system uses the Sliding window Protocol is having a bandwidth of 10Mbps with a window size of 100. What is the size of data if the distance between the sender and receiver is 72000km and the propagation speed is 3×10^8 m/sec? Given utilization is 0.5

(A) 2048 bytes
(B) 3015 bytes
(C) 4096 bytes
(D) 3072 bytes

Ans: Option B

Given Bandwidth B = 10Mbps

Distance between sender and receiver d = 72000km = $72 * 10^6$ m

Speed of signal V = 3×10^8 m/sec

Window size = 100

Utilization or efficiency = $\frac{W}{1+2a}$

Where a = T_{prop}/T_{trans}

Therefore, utilization = $\frac{W*Ttrans}{Ttrans+2Tprop}$

- ⇨ $\frac{1}{2} = \frac{W*Ttrans}{Ttrans+2Tprop}$
- ⇨ $T_{trans} + 2T_{prop} = 2W* T_{trans}$
- ⇨ $T_{trans}(2W – 1) = 2T_{prop}$
- ⇨ $L/B = 2T_{prop}/(2W – 1)$
- ⇨ $L = 2B*T_{prop}/(2W – 1)$

$T_{prop} = d/V = (72 * 10^6 \text{ m})/(3 \times 10^8 \text{ m/sec})$

$= 24*10^{-2}$ sec = 0.24 sec

Therefore, L = $2*(10*10^6 bits/sec)*(0.24sec)/(2*100 – 1)$

$= 0.48 * 10^7 bits / 199$

= 24120.60302bits

= 3015.075 bytes

= 3015 bytes (approx)

17. Given the maximum lifetime of a segment is 30 sec and link capacity is 500Mbps, find the no. of bits required to avoid wrap around during this time?

(A) 10bits (B) 23 bits (C) 30 bits (D) 31 bits

Ans: Option D

Given time = 30sec

B = 500 Mbps

1sec ➔ 500 Mb

30 sec ➔ $30 * 500 * 10^6/8$ bytes = $1.875 * 10^9$

No. of bits required to avoid wrap around = ceil($\log_2$ ($1.875*10^9$)) bits

= ceil(30.807) bits

= 31 bits

18. Determine the efficiency of a token ring with a data rate of 250Mbps, a ring latency of 120 µsec and 5000 bit packets. Assume M hosts want to transmit and each host holds the token for a maximum of frame transmission time.

(A) $\frac{N}{7N+6}$ (B) $\frac{50N}{7N+6}$ (C) $\frac{50N}{N+6}$ (D) $\frac{N}{N+6}$

Ans: Option D

Given B = 250Mbps

RL = 120 µsec

L = 5000 bits

No. of hosts present is M

In early token reinsertion or multi token operation,

Efficiency = $N * \frac{Trans}{N*(Trans)+RL}$

Trans delay = L/B = 5000bits/($250*10^6$ bits/sec)

= 20 µsec

Therefore Efficiency = 20N/(N(20)+120) = N/(N + 6)

19. If bandwidth of a token ring is 48Mbps and token holding time is 5ms then find the minimum and maximum payload in bytes?

(A) 46, 240000 (B) 0, 30000 (C) 21, 19982 (D) 0, 29979

Ans: Option D

Given B = 48Mbps

Token Holding Time (THT) = 5ms

In token ring, minimum frame size can be anything since there are no collisions. So, it is applicable to interactive applications. In order to avoid monopolization, there is a limit on the time for which a station should hold a token, Token Holding Time (THT)

Therefore max frame size = B * T

= 48 Mbps * 5 ms = 240000bits

= 240000/8 bytes

= 30000bytes

Data size or payload = frame size – 21

= 29979 bytes

20. A 40 Mbps broadcast network that controls medium access using polling has 20 hosts and time required for polling the next host is 80 μsec. whenever a node is polled, it is allowed to transmit 4000bytes. Find the efficiency of the broadcast channel

(A) 100/9 (B) 100/11 (C) 80/7 (D) 10/11

Ans: Option D

Given B = 40Mbps

L = 4000 bytes

T_{trans} = L/B = $\frac{4000*8\text{bits}}{(40*106\ \text{bits/sec})}$ = 800 μsec

Efficiency = $\frac{Trans}{Trans+Polling\ Time}$

= $\frac{800\ \mu sec}{(800+80)\mu sec}$

= 10/11

21. An Internet Service Provider (ISP) is granted a block of addresses starting with 145.75.0.0/16. The ISP needs to distribute these addresses to three groups of customers as follows:

(a) The first group has 128 customers; each needs 256 addresses.

(b) The second group has 128 customers; each needs 64 addresses.

(c) The third group has 64 customers; each needs 128 addresses.

Find the first address of 128^{th} customer of 2^{nd} group and how many addresses are still available with ISP after these allocations.

(A) 145.75.127.128/24, 32768 (B) 145.75.159.192/26, 16384

(C) 145.75.159.192/26, 32768 (D) 145.75.191.128/25, 16384

Ans: Option B

Given 145.75.0.0/16 is the starting address. So, we have 2^{16} = 65,536 addresses with the ISP initially.

For the 1st group, each customer needs 256 addresses. So, 8 bits are needed to define each host. The prefix length is 32 – 8 = 24. Therefore the addresses of 1st group are:

1st customer ➔ 145.75.0.0/24 to 145.75.0.255/24

2nd customer ➔ 145.75.1.0/24 to 145.75.1.255/24

128th customer ➔ 145.75.127.0/24 to 145.75.127.255/24

So, for 1st group the ISP has allocated 128*256 = 32768 addresses

For the 2nd group, each customer needs 64 addresses. So, 6 bits are needed to define each host. The prefix length is 32 – 6 = 26. Therefore the addresses of 2nd group are:

1st customer ➔ 145.75.128.0/26 to 145.75.128.63/26

2nd customer ➔ 145.75.128.64/26 to 145.75.128.127/26

3rd customer ➔ 145.75.128.128/26 to 145.75.128.191/26

4th customer ➔ 145.75.128.192/26 to 145.75.128.255/26

128th customer ➔ 145.75.159.192/26 to 145.75.159.255/26

So, for 2nd group the ISP has allocated 128*64 = 8192 addresses

For the 3rd group, each customer needs 128 addresses. So, 7 bits are needed to define each host. The prefix length is 32 – 7 = 25. Therefore the addresses of 3rd group are:

1st customer ➔ 145.75.160.0/25 to 145.75.160.127/25

2nd customer ➔ 145.75.160.128/25 to 145.75.160.255/25

64th customer ➔ 145.75.191.128/25 to 145.75.191.255/25

So, for 3rd group the ISP has allocated 64*128 = 8192 addresses.

Hence the total no.of addresses available after allocating is 65536 – (32768 + 8192 + 8192) = 16384 addresses

22. Calculate the effective throughput for transferring a 1000KB file assuming TCP using slow start congestion control technique. Given the round trip time 100 ms, and maximum segment size is 1460bytes. Assume there are no losses and both the bandwidth and the receiver window size is infinite.

(A) 5MBPS (B) 10Mbps (C) 1MBPS (D) 1Mbps

Ans: Option C

Given Slow start congestion protocol, so size of the sender window starts from 1MSS and increases exponentially.

So, for the 1^{st} transmission, 1MSS = 1*1460

2^{nd} transmission, 2MSS = 2*1460

3^{rd} transmission, 4MSS = 4*1460

4^{th} transmission, 8MSS = 8*1460

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Nth transmission, N MSS = N*1460

Sum of all the data sent in N transmissions should be equal to 1000KB

1460(1+2+4+8+....+N)bytes = 1000KB

1+2+4+8+....+N = 1024000B/1460B

1+2+4+8+....+N = 701.369

It is in Geometric progression so sum of N terms in G.P is

$1(2^N - 1)/(2 - 1) = 701.369$

$2^N - 1 = 701.369$

$2^N = 702$ (approx) ➔ $N = \text{Ceil}(\log_2 702) = 9.45$

N = 10

So we need to transmit 10 times to send all the 1000KB data file.

Therefore we need 10RTTs time

10*100ms ➔ 1000KB

1sec ➔ 1000KB/1000ms = 1MBPS

Common Data Questions: Q. 23 and Q. 24 Carry Two Marks Each
Statement for Common Data Questions

An organization is granted the block 150.36.0.0/16.The administrator wants to create 512 subnets.

23. What is the subnet mask?

(A) 255.255.255.128/25 (B) 255.255.255.192/26

(C) 255.255.255.224/27 (D) 255.255.255.240/28

Ans: Option A

Given address is Class B, we need 512 subnets so we require 9 bits to be borrowed from host id i.e., 8bits from 3rd octet and 1bit from 4th octet.
so the subnet mask is 255.255.255.128/25.

24. Find number of hosts in each subnet. Find the first and last host in the first subnet.

(A) 128, 150.36.0.1 and 150.36.0.127
(B) 128, 150.36.0.129 and 150.36.0.255
(C) 126, 150.36.0.1 and 150.36.0.126
(D) 126, 150.36.0.129 and 150.36.0.254.

Ans: Option C

Given 150.36.0.0/16 and we need to create 512 subnets. So we require 9 bits to be borrowed from host id and we are left with 7 bits in host part. So, practically we have 2^7-2 = 126 hosts per subnet.

The first subnet is 150.36.0.0. So the first host in subnet 1 is 150.36.0.1 and last host is 150.36.0.126.