Roll No: 2022202004

[1x1=1 Marks]

A. The Flow Table has the following three sections?

1. Rule/Action/Stats
2. Flow/Action/Stats
3. Rule/Instruction/Stats
4. Entry/Action/Stats

[0.5x3=1.5 Marks]

B. Consider the following *mininet* python script. Fill in the required commands for the task specified in each of the [ToDo].

```
#!/usr/bin/python

"""
Required header import
"""

class SingleSwitchTopo(Topo):
    #Assume the code to add hosts and links is present.

def ToDo():
    topo = SingleSwitchTopo(n=4)
    net = Mininet(topo=topo,host=CPULimitedHost, link=TCLink)
    net.start()

    print "Testing network connectivity"
    # 1. [ToDo 1] Ping all hosts via single command
    Ans: net.pingAll()

    print "Testing bandwidth between h1 and h3"
    # 2. [ToDo 2] Test bandwidth between host 1 & host 3
    # HINT: First get the names of hosts from network then
iperf them.
    Ans: h1, h3 = net.get('h1'), net.get('h2')
         result = h1.cmd('iperf -c {} -t 5 -u -p 12345'.format(hs.IP()))
    net.stop() print(result)

if __name__=='__main__':
    ToDo()
```

[1x1=1 Marks]

C. The Traditional router can be partitioned into ?

1. Management plane / Decision plane / Data plane
2. Management plane / Control plane / Forwarding plane
3. Management plane / Control plane / Data plane
4. None of these

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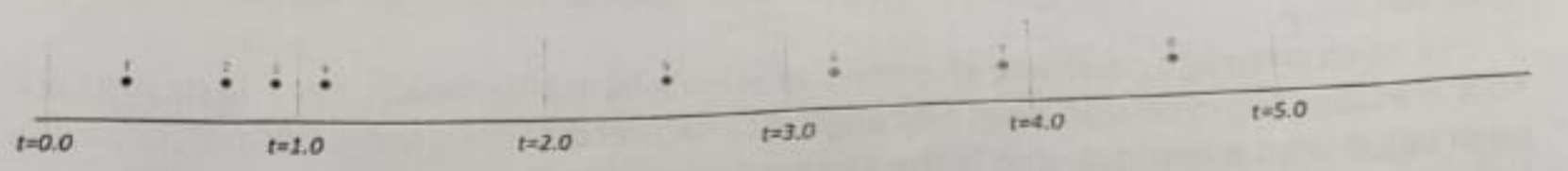
[4+4+6=14 Marks]

B. Consider the figure below, which shows 8 messages for transmission from different multiple access wireless nodes at time t = <0.3, 0.7, 0.9, 1.1, 2.5, 3.2, 3.9, 4.6>. Assume each transmission requires exactly 1 time unit, no message re-transmission is allowed.



PART-B1 [2+2]

Suppose all nodes are implementing the Aloha protocol.

1. For each message, indicate the time at which its transmission begins. Format: separate each value with a comma.

Ans: 0.3, 0.7, 0.9, 1.1, 2.5, 3.2, 3.9, 4.6

4

2. Which messages transmit successfully? Format: comma seperated list using the messages' numbers.

Ans: No messages are transmit successfully.

PART-B2 [2+2]

Suppose all nodes are implementing the Slotted-Aloha protocol.

1. For each message, indicate the time at which its transmission begins. Format: separate each value with a comma.

Ans: 1.0, 1.0, 1.0, 2.0, 3.0, 4.0, 4.0, 5.0

4

2. Which messages transmit successfully? Format: comma seperated list using the messages' numbers.

Ans: 4, 5, 8

PART-B3 [2+2+2]

Suppose all nodes are implementing the Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol.

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[1.5+1.5+1+1=5 Marks]

D. Select the correct option.

1. What is the first address of a block of classless addresses if one of the addresses is 12.2.2.127/28?

a) 12.2.2.0
b) 12.2.2.96
c) 12.2.2.112
d) None of the above

(1.5)

Explanation:
first address of block & class is all zeros in HID,
given /28, first 28 bits are NID & remaing 4 are HID ∴ 12.2.2.0111|1111/28
NID HID
∴ first address : 12.2.2.01110000|28 = 12.2.2.112|28.

2. Which address could be the beginning address of a block of 32 classless addresses?

a) 2.4.6.5
b) 2.4.6.16
c) 2.4.6.64
d) None of the above

(1)

Explanation:
In classless addressing the beginning of address must be divisible by block size (32) ∴ 2.4.6.64.
atleast 5 0's at end

3. The Internet checksum of 0000 and 0000 is 1111 (a).

a) 1111
b) 0000
c) 1110
d) 0111

(1)

4. In the Polling method, all data exchanges must be made through the primary device even when the ultimate destination is a secondary device.

a) Reservation
b) Polling
c) Token passing
d) None of the above

(1)

[0.5x4=2 Marks] Roll No: 2022202004

D. *dpctl* command enables control over an OpenFlow switch. It is also useful for debugging. Fill in the required portions of commands for the tasks specified.

1. Task1: Show currently installed flows in switch

0.5 $ dpctl _____ tcp:127.0.0.1:6634

2. Task2: Install necessary flows for directing packet flows from port 2 to port 1

$ dpctl install _____ tcp:127.0.0.1:6634 in 2 port 2 actions= 1 port 1

[0.5x3=1.5 Marks]

0.75 E. Skype functions can be classified into startup, login, user Connection, call Establishment and ?, media transfer, and presence messages.

[1x1=1 Marks]

0 F. Keep-alive -timeout removes a flow entry when it has matched no packets in a given number of seconds.

[0.5x8=4 Marks]

G. Fill in the blanks.

1. Internet is a inter-connection of networks.
2. IMP stands for Internet Messaging Protocol. It was the Packet-switching node used to interconnect participant networks to the ARPANET from the late 1960s to 1989. It was the first generation of gateways, which are known today as routers. An IMP requires the connection to a host computer via a special _____ interface.
3. _____ is the principle that Internet service providers (ISPs) must treat all Internet communications equally, and not discriminate on any basis.
4.

1.5

GET /path/to/resource/ HTTP/1.1 Host: www.cs.xyz.edu User-Agent: Mozilla/5.0 CRLF	Request
HTTP/1.1 200 OK Date: Wed, 11 Aug 2021 09:28:28 GMT Server: Apache/2.4.41 Last-Modified: Fri, 06 Aug 2021 04:46:59 GMT Content-Length: 23 CRLF Site under construction	Response

CRLF stands for _____, which is embedded in HTTP headers to signify an _____ marker.

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[1x1=1 Marks]

H. Which of the following statements are true:

a. SDN shortens/minimizes the hardware fabrication cycles

b. SDN provides more flexibility in network management.

c. SDN enables facilitate innovation and testing of new protocols in real network.

1. Only a, b are true.
2. Only b, c are true.
3. Only a, c are true.
4. None of these are true.
5. All statements are true.

(1) ✓

[0.5x4=2 Marks]

I. OpenFlow protocol messages can be classified as:

Type1: Controller-to-Switch messages

Type2: Asynchronous messages

Type3: Symmetric messages

Write the type (Type1/Type2/Type3) for each of the following messages below:

Role Request: Type 1 ✓

Echo Request/Reply: Type 3 ✓

Packet-In: Type 2 ✓

Port Status: Type ~~2~~ 1 ✗

(1.5)

SPACE FOR ROUGH WORK

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Now, suppose that the time from when a message transmission begins until it begins to be received at other nodes is 0.399 time units, and assume that a node can stop transmission instantaneously when a message collision is detected. Thus, if a node begins transmitting a message at t=2.0 and transmits that message until t=3.0, then any node performing carrier sensing in the interval [2.399, 3.399] will sense the channel busy.

1. For each message, indicate the time at which its transmission begins, or indicate that message transmission does not begin as channel is sensed busy. Format: separate each value with a comma, and if the channel is sensed busy, substitute it with 's'.

Ans: (1, 0.3), (2, S), (3, S), (4, S), (5, 2.5), (6, S), (7, 3.9), (8, S) (0.1.

0.3, S, S, S, 2.5, S, 3.9, S

2. Which messages transmit successfully? Format: comma seperated list using the messages' numbers.

Ans: 1, 5, 7

3. At what time did each message stop transmitting due to a collision. Format: comma seperated list using the messages' numbers, and if a message didn't stop, write 'x' for that message.

Ans: x, x, x, x, x, x, x, x

Assume

[1x1=1 Marks]

D. Both the payload and (even) parity bits are shown below. One of these bits is flipped. Indicate the row and column of the flipped bit (in format: <*col,row*>; e.g., top-left bit is <*0,0*>).

```
10111101 00011110 | 0
00110100 01000100 | 0
11100011 01111110 | 1
01100101 10000001 | 0
01010011 01101100 | 0
-------------------
01011100 11000001 | 1
```

Ans: <12, 1>

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[0.5x4=2 Marks]

D. *dpctl* command enables control over an OpenFlow switch. It is also useful for debugging. Fill in the required portions of commands for the tasks specified.

1. Task1: Show currently installed flows in switch

   $ dpctl _____ tcp:127.0.0.1:6634

0.5

2. Task2: Install necessary flows for directing packet flows from port 2 to port 1

   $ dpctl install _____ tcp:127.0.0.1:6634 in 2 port 2, actions= 1 Port 1

[0.5x3=1.5 Marks]

E. Skype functions can be classified into startup, login, user Connection, call Establishment, media transfer, and presence messages.

0.75

[1x1=1 Marks]

F. keep-alive timeout removes a flow entry when it has matched no packets in a given number of seconds.

0

[0.5x8=4 Marks]

G. Fill in the blanks.

1. Internet is a inter-connection of networks.
2. IMP stands for Internet Messaging Protocol. It was the Packet-switching node used to interconnect participant networks to the ARPANET from the late 1960s to 1989. It was the first generation of gateways, which are known today as routers. An IMP requires the connection to a host computer via a special _____ interface.
3. _____ is the principle that Internet service providers (ISPs) must treat all Internet communications equally, and not discriminate on any basis.
4.

1.5

Request	GET /path/to/resource/ HTTP/1.1 Host: www.cs.xyz.edu User-Agent: Mozilla/5.0 CRLF
Response	HTTP/1.1 200 OK Date: Wed, 11 Aug 2021 09:28:28 GMT Server: Apache/2.4.41 Last-Modified: Fri, 06 Aug 2021 04:46:59 GMT Content-Length: 23 CRLF Site under construction

CRLF stands for _____, which is embedded in HTTP headers to signify an _____ marker.

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[2+2+2+4=10 Marks]

A. An organization is granted the block 131.32.0.0/16. The administrator wants to create 1024 subnets. For the 512th subnet, compute:

1. Find the prefix size. Show computations.

Ans: Initially NID is 16 bits, next we want to create 1024 subnets, so we need $\lceil \log_2(1024) \rceil = 10$ bits.
∴ total prefix size is $16+10 = 26$ bits. (NID+SID).

2. Find the subnet mask. Show computations.

Ans: Subnet mask is all 1's in NID+SID and all 0's in HID.
∴ Subnet mask = 11111111.11111111.11111111.11000000
= 255.255.255.192

3. Number of maximum hosts possible in it. Show computations.

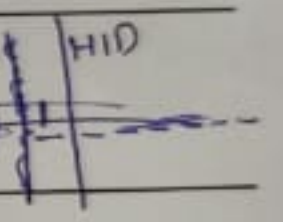
Ans: No. of bits in HID = ~~26~~ 32-26 = 6
∴ No. of maximum hosts possible = $2^6 - 2 = 62$.

10

4. Its first and last addresses (in slash notation). Show computations.

Ans: Given 512th Subnet

NID	HID
131.32.01111111.11	------



we know first address is all 0's in HID part
⇒ first address = 131.32.01111111.11000000
= 131.32.127.192/26

⇒ first address = 131.32.127.192/26

	NID	HID
last address =	131.32.01111111.11	111111 /26 (all 1's in HID).

= 131.32.127.255/26.

21. Jahnvi shifted to the US for her studies. Just before leaving India, she learned driving. She found it confusing to learn driving on the US roads. When she returned to India after 2 years, adjusting back to the left side was again a challenge. Describe what has occurred here? (2)

22. What is the role of different sleep stages in learning and memory? (3)

23. While preparing for an important presentation you listen to instructions on headphones while trying to understand a complex flowchart on slides so that you can design a simpler version of the flowchart. Can you explain the sub-components of Baddley's model in this example? (2)

24. Give an example of negative reinforcement and negative punishment? DO NOT give examples discussed in the class or from the textbook. (2)

25. Ranjini is a theater artist. The lights come on and the auditorium is cheering. When the curtains begin to open, Ranjini becomes super charged to performed and her acting flows naturally. Even on radio, while listening to auditory plays, whenever she hears lights and sounds of clapping, she gets her adrenaline rush as though she is about to perform. Can you decode this example in the context of classical conditioning? (2)

26. Which physical changes in a neuron indicate that learning took place? (2)

27. What is the difference between delay discounting vs delayed gratification? Use examples (2)

28. Give an example of stereotyping, not discussed in the class. Explain which learning mechanism leads to stereotyping and what will help to overcome it? (3)

29. Name the cognitive abilities that are primarily assessed by the Stroop test? (1)

30. Give an example of sensitization and habituation? DO NOT give examples discussed in the class or from the textbook. (2)

31. A detective solved a case of serial robbery by observing the pattern of robbery and concluded that only houses of old people living alone were robbed. What is the S_D, R, and O in this case? (2)

32. Imagine you went for an interview to a well-known IT company. You nervously opened the door, sought permission to enter the interview room and sat on a chair in front of the committee and greeted them. The interviewer remarked that your technical skills do not need to be tested since you have a degree from IIITH. However, they asked you to describe your experience of working on a project-related to your job position. Later that week, you told a friend what happened during your interview. Analyze this interview experience and decode all possible types of learning and memory mechanisms that we have covered in class so far. (5)

Roll No: 2022202015

2. Block host '3' from browsing to any HTTP websites in network 3.3.3.0/24.

Source	Destination	Protocol	Action (Drop/Accept)
2.2.2.3 : *	3.3.3.0/24 : 80	TCP	Drop
* : *	* : *	*	Accept

3. Block all hosts in network 3.3.3.0/24 from accessing any of your internal servers, except host '6' should be able to access the SSH on host 1.

Source	Destination	Protocol	Action (Drop/Accept)
3.3.3.6 : *	1.1.1.1 : 43	TCP	Accept
3.3.3.0/24 : *	1.1.1.0/24 : *	*	Drop
* : *	* : *	*	Accept

2. hosts 3 & 4?

SPACE FOR ROUGH WORK

134 : 10000110

160 : 101 00000

128 : 100 00000

192 : 110 00000

13×5 = 65
13×6 = 78
13×7 = 91
13×8 = 104
13×9 = 117

1000 B. Data

104 + 20 = 124

13×1 = 124
13×2 = 124
13×3 = 39 124
13×4 = 52 124
13×T = 124 + 20 = 84

1 2 3 4
P R N T
P N T

MTU = 128 B

~~108~~ 100
104 H.

104 × 10
1040
104 × 9
936
1000 64
1000

SSH
HTTP 80

Roll No: 2022202015

2. Block host '3' from browsing to any HTTP websites in network 3.3.3.0/24.

Source	Destination	Protocol	Action (Drop/Accept)
2.2.2.3 : *	3.3.3.0/24 : 80	TCP	Drop
* : *	* : *	*	Accept

3. Block all hosts in network 3.3.3.0/24 from accessing any of your interna servers, except host '6' should be able to access the SSH on host 1.

Source	Destination	Protocol	Action (Drop/Accept)
3.3.3.6 : *	1.1.1.1 : 43	TCP	Accept
3.3.3.0/24 : *	1.1.1.0/24 : *	*	Drop
* : *	* : *	*	Accept

2. hosts 3 & 4 ?

SPACE FOR ROUGH WORK

1000 B. Data   MTU = 128 B

128 64 32 16 8 4 2 1
134 : 1 0 0 0 1 0 0 0
1 0 0 0 0 1 1 0

160 1 0 1 0 0 0 0 0
128 1 0 0 0 0 0 0 0
192 1 1 0

0 0 0

13×1 124
13×2 124
13×3 39 124
13×4 52 124
13×5 = 65
13×6 = 78
13×7 = 91
13×8 = 104
13×9 = 117
13× 7   84+20 = 84

104 + 20   124   ~~108~~ 1 2 0   104

104 × 10
1040
104 × 9   936

1000   6   1 0 0

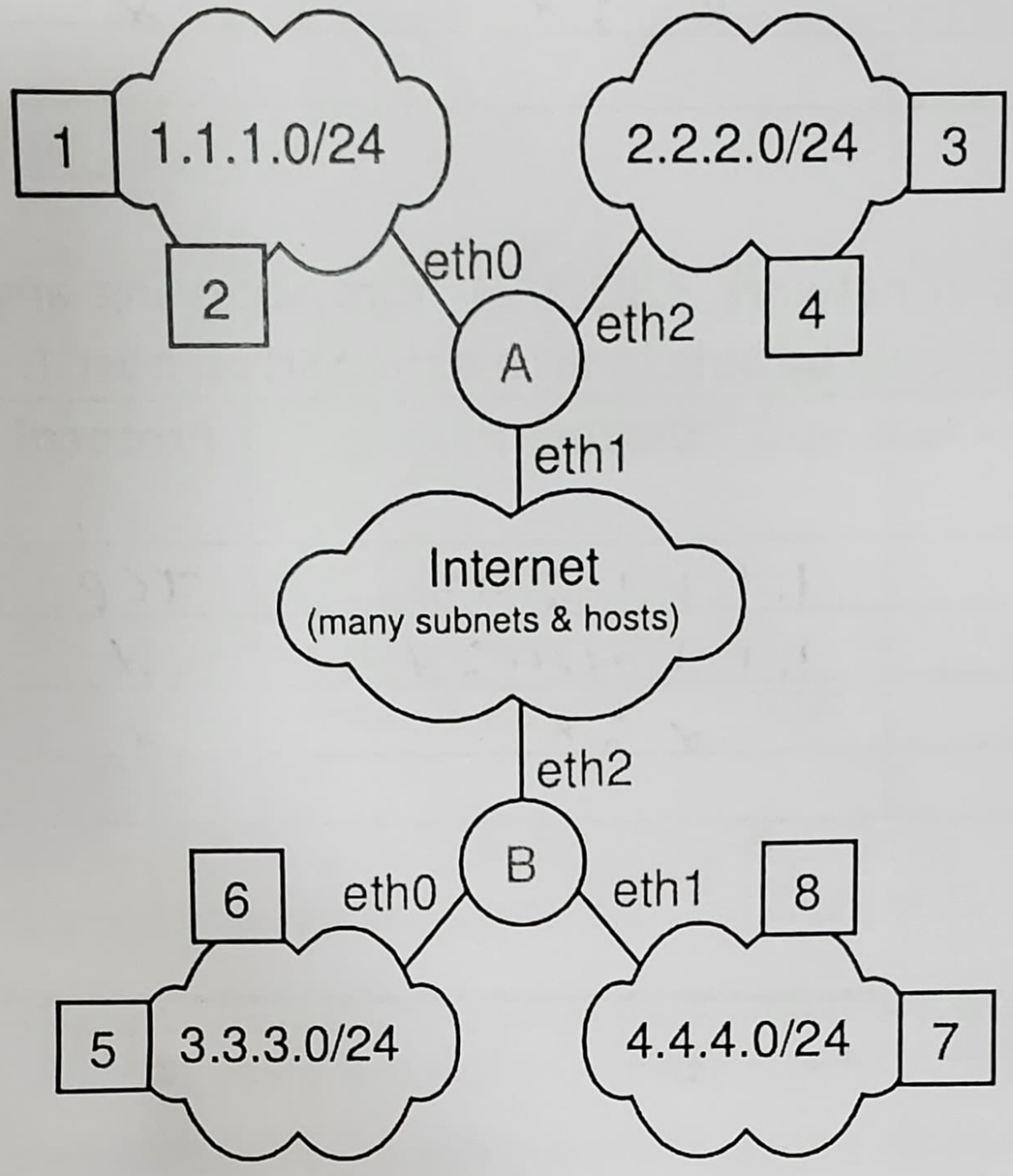
SSH
HTTP 80

1 2 3 4
P R N T

[1+1+3=5 Marks]

Roll No: 2022202015

Q4. Consider the internet topology in the figure below. In the 4 subnets shown, assume there are many hosts (although only two hosts are shown for each subnet due to space). The host IP addresses are obtained from the subnet address and the host number, e.g., host 2 has IP 1.1.1.2. The two routers have three interfaces.



You are the IT administrator for the two subnets attached to **router A** and need to add a rule to the firewall running on router A. The default policy for the firewall is accept. Stateful Packet Inspection (SPI) is enabled on the firewall.

For each of the following policies asked below, write a rule (in the table) that implements it. You may use 1 or more rows, but the rules should be as simple as possible. You **MUST** show both "*IPAddress:PortNumber*" in the "*Source*" and "*Destination*" columns. You may also use "*IP/prefix*" format to show a range of IPs. Use * to indicate "all". For each part, assume initially there are no firewall rules; i.e., your answer in part (x) is independent of your answer in part (y) and vice-versa.

1. Block all hosts on network 3.3.3.0/24 from accessing any SSH servers on network 1.1.1.0/24.

Source	Destination	Protocol	Action (Drop/Accept)
3.3.3.0/24 : *	1.1.1.0/24 : 43	TCP	Drop
* : *	* : *	*	Accept

[1Qx2=2 Marks]

Q1. What output port will a router select for packets containing DST IP 68.211.134.120?

1) 68.208.0.0/12 A
2) 68.211.0.0/17 B
3) 68.211.128.0/19 C
4) 68.211.160.0/19 D
5) 68.211.192.0/18 E

(2)

[6Qx0.5=3 Marks]

Q2. Fill in the number of broadcast and collision domains for the following devices:

Device type	Number of ports	Broadcast domain(s)	Collision domain(s)
Hub	3	1	1
Switch	4	1	4
Router	1 WAN + 2 LAN	3	3

(3)

[4+1=5 Marks]

Q3. 1000 bytes of data (i.e., 1020 byte long packet) must be routed through an interface with an MTU of 128 bytes. Assuming the smallest possible IP header size (i.e., 20 bytes), fragmentation is required for the transmission.

1. Fill in the following fields for each fragment:

Fragment number	Identification	Flags (show all three bits) Res. DF MF	Fragment offset (decimal)	Total length (bytes, in decimal)
0	x	0 0 1	0	124
1	x	0 0 1	13	124
2	x	0 0 1	26	124
3	x	0 0 1	39	124
4	x	0 0 1	52	124
5	x	0 0 1	65	124
6	x	0 0 1	78	124
7	x	0 0 1	91	124
8	x	0 0 1	104	124
9	x	0 0 0	117	84

(4)

2. Based on the field values computed for the last fragment, show that these fragments contain all the original data bytes.

Ans: fragment offset is : 117, Total length is 84 B.
so data Bytes = 84 - 20 (Header Bytes) = 64.
⇒ total Bytes received till now,
= 117 x 8 + 64 Bytes
= 936 + 64 Bytes
= 1000 Bytes

which is equal to original packet length. Hence all these

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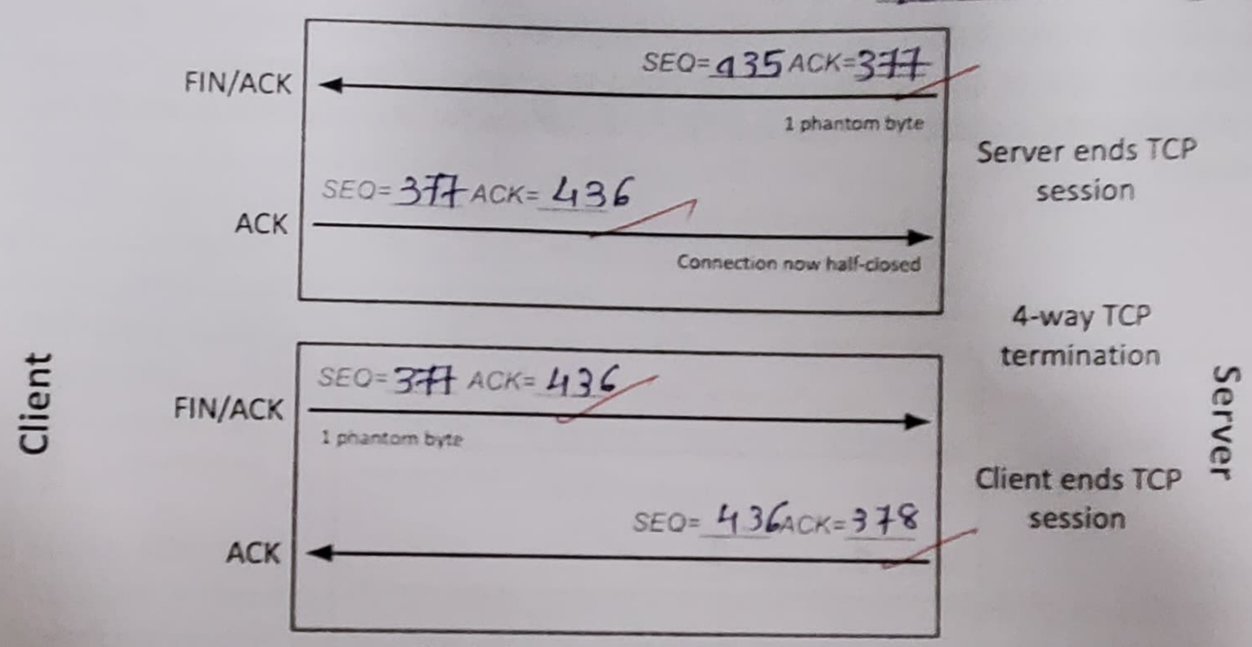

Fig 4: Connection termination

[3+3+1+1+1+1=10 marks; COs: 2, 5]

F. Explain the followings with regards to translation of network address:

1. Network Address Translation (NAT)

Translates (what to what): Private IP to Public IP and Public IP to Private IP

Affects (which layers' attributes): Network layer

Modifies (which headers): IP addr in IP Heads

2. Port Address Translation (PAT)

Translates (what to what): Private IP, Port to Public IP, Port and Public IP, Port to Private IP, Port.

Affects (which layers' attributes): Network layer & transport layer

Modifies (which headers): IP address in IP heads and Port address in TCP heads.

3. Why static translation is referred to as "One-to-One translation"?

Ans: Static translation is explicitly defined so ~~each~~ time one private IP/Port maps to a fix public IP/Port that it referred as one-to-one translation

4. Why dynamic translation is referred to as "One-to-Many translation" as well as "Many-to-One translation"?

Ans: Dynamic translation is not explicitly define instead, IP/Port are dynamically choosen by router from

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It may possible that a Private IP/port translate to different public IP/port during translations. Hence it is one to many translation. Also ~~vice versa~~ it is true ~~means~~ that many private IP addresses translate to ~~same~~ one public IP address with different port (e.g. In Dynamic PAT) hence it is many to one translation.

5. What is Policy NAT?

Ans: Simply any of four types of NAT. But, it requires to translate based on destination address as well as source address. In port translation ~~of~~ address done based on rule defined on source address & destination address both.

(1)

6. What is Twice NAT?

Ans: Simply any of four types of NAT. But, it involves translating both source address as well as destination address, In port it can change source and destination both during translating.

(1)

EXTRA SPACE FOR WORK

Roll No: 2022202015

[20x0.5=10 Marks; COs: 1, 6]

E. The four figures shown below correspond to a series of sequential (and related) events between a client and a server. Fill in the values for SEQ and ACK in the figures below.

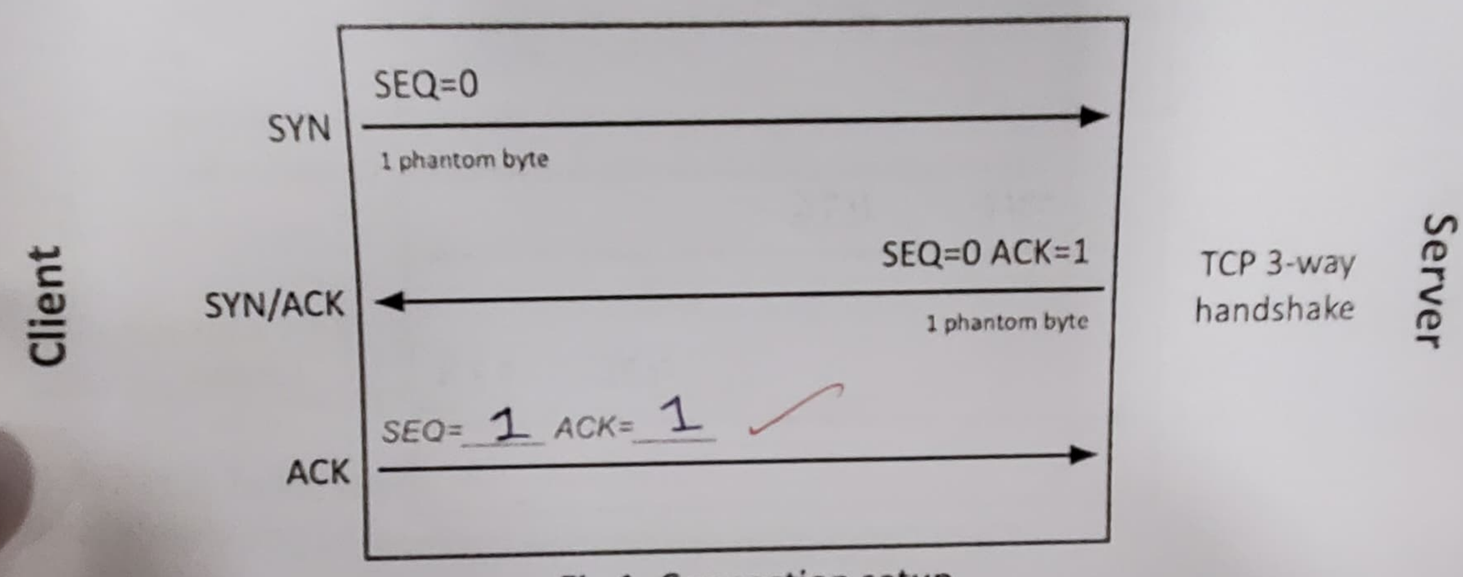

Fig 1: Connection setup

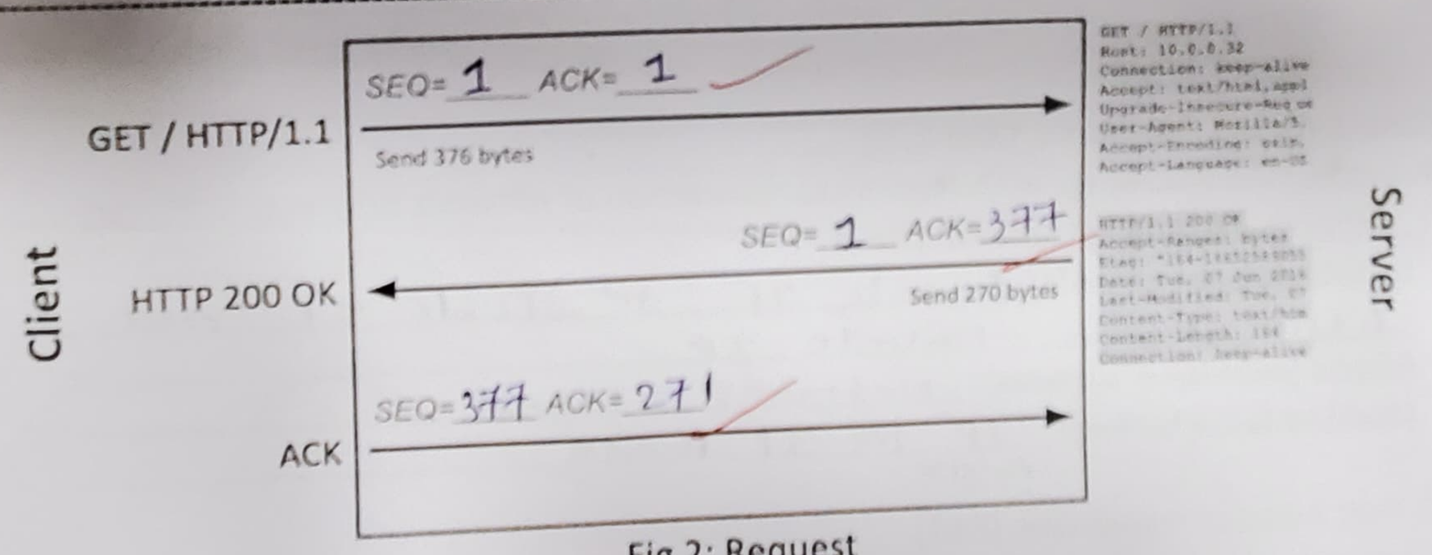

Fig 2: Request

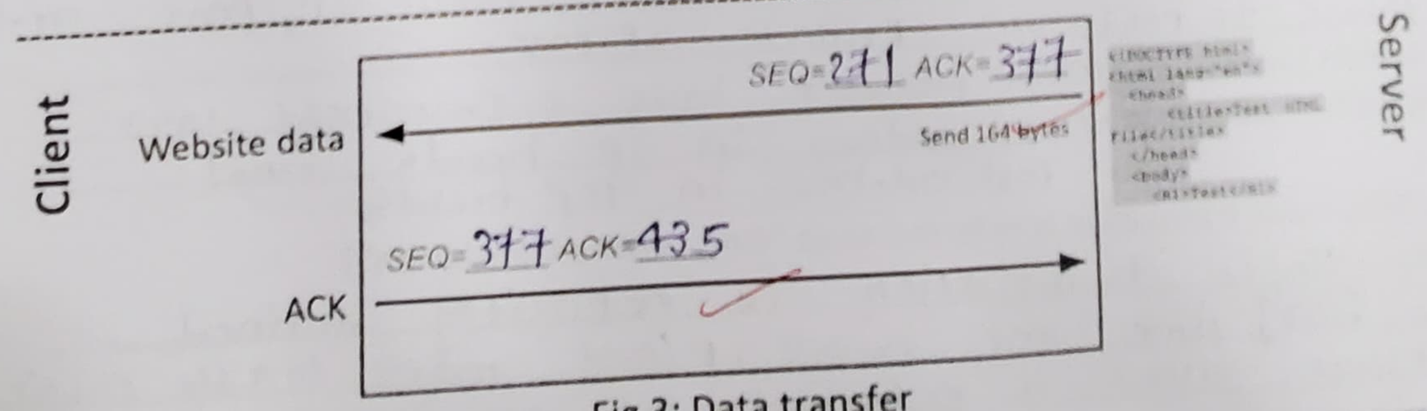

Fig 3: Data transfer

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3. Which of the layer-3 broadcast-options is considered a security risk and why?

Ans:

→ Directed broadcasting of layer-3 broadcast option is considered risky & hence blocked by ISP.

→ Using directed broadcast, one can ping all the hosts of some foreign network. So the attacker can use this fact and potentially violate security of all hosts of foreign network hence it is blocked.

(2)

e.g. attacker can do ping attack using directed broadcasting to slow down link connected to foreign NW

[5 Marks; COs: 1, 4]

D. Consider a client-server scenario, where the server has sent bytes up to 202, the network congestion window (cwnd) = 20. The client has sent an ACK = 200 and receive window (rwnd) = 9. For the current sliding window, clearly highlight the followings:

ⓐ **the position of the *"Sliding window"***

ⓑ **the last byte *"Sent and acknowledged"***

ⓒ **the *"Next byte to be sent"***

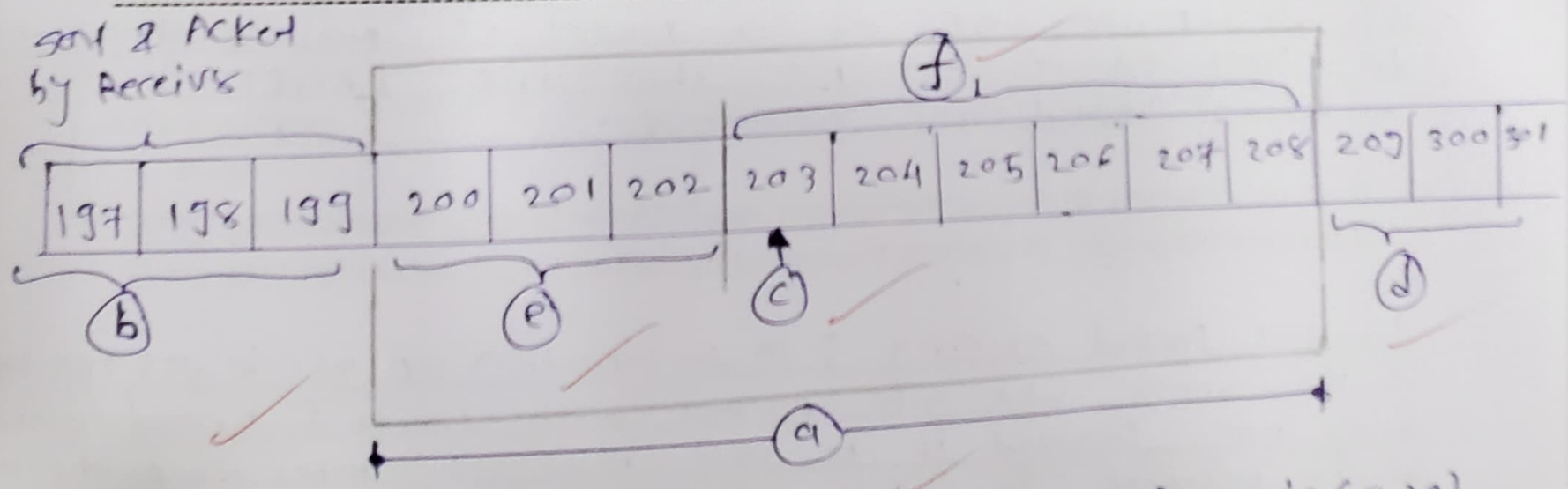
ⓓ bytes that *"Can't be sent until window opens"*

ⓔ bytes *"Sent, not acknowledged"*

ⓕ bytes that *"Can be sent immediately"*

(5)

Ans:



window size = min(cwnd, rwnd) = min(9, 20)

= 9

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2. Why cannot we just use IP addresses for communicating across different networks? Give at least two reasons.

Ans:

1 ⟹ Intermediate devices such as Layer-2 device (e.g. switch/ bridges (mac)) does not works on IP addresses, so they will fail to operate if only IP is used.

2 ⟹ During Assignment of IP using DHCP we need to uniquely identify the device to which it is assigning IP, And we are using MAC address for identification.

3 ⟹ IP addresses (total 2^{32}) are lesser than addresses (so it will exhaust if only IP addresses are used. (IPv6)! ✗

(1.5)

[1+2+2=5 Marks; COs: 1]

C. Broadcasting

1. What do you understand by layer-2 and layer-3 broadcast addresses?

Ans:

If destination MAC is FF:FF:FF:FF:FF:FF then it is LAYER-2 Broad cast address. All the receive device will accept this frame

If destination IP of a packet is 255.255.255.255 then it is LAYER-3 limited Broadcast address

If destination IP of a packet is Network id or it is host id is all 1's then this LAYER-3 directed broad cast address.

2. How do different broadcasting-options available in layer-3 broadcasting differ from each other (i.e.., IP address, treatment by router, target network/hosts, etc.)?

Ans:

Limited Broad casting : ① destination IP will be 255.255.255.25

② the routes who gets packet with limited Broad casting will not forward it to other N/W, it simply drop the packet

③ the Network in which broadcasting host is present it self is the target Network & all other hosts of this network is target host.

(1.5)

Directed Broad casting : ① Destination IP's Network IP part will be as it is, but Host IP part contains All ones. what about own network

② A route with Directed broad cast packet will simply forward it toward target Network. Once the packet reaches target Network it will be sent to all host in this N/w.

③ Target Network can be 3 or 8 derived from Network IP part of destination IP.

& All Host present in target Network, for the target hosts

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[5x1=5 Marks; COs: 1, 6]

A. Fill in the table below for the different classful-addressing classes indicated in the header row. Note: No need to solve powers.

Class	A	B	C
Leading bits	0	10	110
NetID bits	8	16	24
HostID bits	24	16	8
No. of networks	$2^7 = 128$	2^{14}	2^{21}
Hosts per network	$2^{24} - 2$	$2^{16} - 2$	$2^8 - 2$
Total addresses in class	2^{31}	2^{30}	2^{29}
CIDR Notation (/?)	/8	/16	/24
Default subnet mask	255.0.0.0	255.255.0.0	255.255.255.0

[2+3=5 Marks; COs: 1]

B. Reasoning

1. Why cannot we just use MAC addresses for communicating across different networks? Give at least one reason.

Ans:

1 → We can not group MAC Addresses as we can group IPs by doing subnetting & supernetting. So routing table must contains the entries for each host explicitly so size of routing table would be very large.

2 → physical address (MAC) is private address and it should not be exposed outside the own NW but only using MAC for communicate violate this

3 → If one device's physical location change then all the routers routing entry need to be Updated.