1 **Note: This question is not about TCP.**

Consider a sender and receiver communicating over a sliding-window reliable transfer protocol (could be either Go-Back-N or Selective Repeat), where the size of the sender window is 4 segments. Assume that all segments are of the same size. Assume that the sequence number space is very large and the starting sequence number is 0. At a certain instant of time, you know that the receiver has only received and acknowledged all segments with sequence numbers lower than and including segment number 7. Which of the following is definitely not in the window of the sender?

Select one alternative:

- ○ Segment number 10
- ○ Segment number 8
- ○ Segment number 6
- ○ Segment number 7
- ◉ Segment number 3

Maximum marks: 1.5

2 One endpoint of a TCP connection is in the FIN_WAIT_1 state. What are all of the possible states the other endpoint can be in? Explain why. You may assume that neither endpoint of the TCP connection has encountered any unexpected behaviour.

Fill in your answer here

1. ESTABLISHED: The other endpoint is still actively exchanging data with the endpoint in FIN WAIT 1 state, and has not yet initiated the shutdown process.
2. CLOSE_WAIT: The receiver receives the request from FIN_WAIT1 and changes its state to CLOSE_WAIT.
3. LAST_ACK: The other end sends a FIN after receiving the FIN.

LAST_ACK is also a choice.

Maximum marks: 2

3 A TCP connection has been established between hosts A and B.

Host A receives a TCP segment from host B that has a 52 byte TCP payload and the following TCP header field values shown below:
Sequence Number: 1001, Acknowledgement Number: 5001, Receiver Window Size: 4000.

Assume that host B has not sent any acknowledgements beyond 5001 and that the congestion window is very large.

Below are listed the relevant TCP header field values and the payload size for potential TCP segments sent by Host A in response to the received segment noted above. Select the choices that you think could be valid responses.

Select one or more alternatives:

- [ ] Sequence number: 6001, Acknowledgement number: 1053, TCP Payload: 4000 bytes
- [ ] Sequence number: 1053, Acknowledgement number: 5001, TCP Payload: 2000 bytes
- [x] Sequence number: 5001, Acknowledgement number: 1053, TCP Payload: 2000 bytes
- [ ] Sequence number: 8001, Acknowledgement number: 1053, TCP Payload: 1000 byt

Maximum marks: 2

4 Assume that a sender wishes to transfer a file of size 19KB to a receiver over a TCP Reno connection. Assume that the slow start phase begins with a window size of 1KB, and that the initial value of ssthresh is set at 8KB. Assume that all TCP segments contain 1KB of data, which is also the MSS. Assume that the receiver window is very large. Assume that a time-out always occurs during the RTT in which the window size is 8KB and none of the segments sent during this RTT are successfully received. How many RTTs does it take before the entire file is successfully transmitted and acknowledged? Ignore connection setup and teardown. **Explain your answer. Answers without explanations will not receive any marks.**

Fill in your answer here

No	Size	ssthread	successfully transmitted	
1	1	8	1	
2	2	8	3	
3	4	8	7	
4	8	8	7	
5	1	4	8	
6	2	4	10	
7	4	4	14	
8	5	4	19	

The answer is 8RTT

Words: 41

Maximum marks: 2

5 Suppose that a 5700-byte IPv4 datagram (including IP headers) arrives at a router R1. R1 determines that the datagram is to be forwarded on an outgoing link with MTU of 2020 bytes. R1 creates the necessary IPv4 fragments and forwards them on the outgoing link. All fragments arrive in the correct order at the next hop router R2. R2 determines that all fragments are to be forwarded on an outgoing link with MTU of 1220 bytes. How many IPv4 fragments does R2 forward on the outgoing link? For each transmitted fragment indicate the following IPv4 header fields: length, MF flag and offset. No explanation is required.

Fill in your answer here

1.mf
2.算offset的时候要除以8
3. payload + header = MTU

Length, MF, offset:

1220 1 0

820 1 150

1220 1 250

820 1 400

1220 1 500

500 1 600

220 0 667

Words: 24

Maximum marks: 3

6 Datagram P1 has destination IP address 155.130.5.129. Datagram P2 has destination IP address 155.130.5.160. IP router R receives P1 and P2 in that order. There is no change in R's forwarding table between when it processes P1 and P2. Will P1 and P2 match the same or different entries in R's forwarding table and why?

Select one alternative:

Different, because they have different IP addresses.

The same, because they belong to the same /25 address block, 155.130.5.128/25.

It depends on the contents of R's forwarding table.

It depends on the application layer data in the packets.

Maximum marks: 1

7 An IPv4 datagram with destination IP address 144.16.68.117 arrives at a router with the following forwarding table.

Destination IP Address	Outgoing Interface
144.16.0.0/16	1
144.16.64.0/19	2
144.16.68.0/24	3
144.16.68.64/27	4

Which outgoing interface is this datagram forwarded on?

Select one alternative:

- 2
- 4
- 3
- 1

Maximum marks: 1

8 Suppose UNSW is allocated a block of public IP addresses: 217.125.112.0/20. Based on your knowledge on IP addressing, address the following questions.

1) Suppose there are 6 Faculties (A, B, C, D, E and F) that UNSW needs to distribute the IP addresses to. Two of the Faculties (A and B) request twice as much IP addresses as the other 4. What will be the block of IP addresses allocated to each Faculty? You MUST use up the entire block of IP addresses available to UNSW in your allocation. Faculties A and B should be allocated addresses first (i.e. must receive the smallest IP addresses in the block allocated to UNSW). Simply represent the block allocated to each Faculty in the CIDR (a.b.c.d/x) notation. (3 marks)

2) How many hosts can each Faculty supply with public IP addresses? (1 mark)

3) What is the subnet mask for each Faculty (represent in a.c.b.d format)? (1 mark)

Fill your answer for all 3 questions here. No explanations are necessary.

217.125.112.0/20. A total of 32 bits, 32-20=12. There are 2^12 IP addresses.

A and B are twice as much, so they are divided into 8 parts on average. 2^12 / 8 = 2^9 = 512.

So A, B can be divided into twice: 1024 IP

The rest are allocated to 512

from 217.125.112.0/20.

A: 217.125.112.0/22

B: 217.125.116.0/22

C: 217.125.120.0/23

D: 217.125.122.0/23

E: 217.125.124.0/23

F: 217.125.126.0/23

subnet mask:

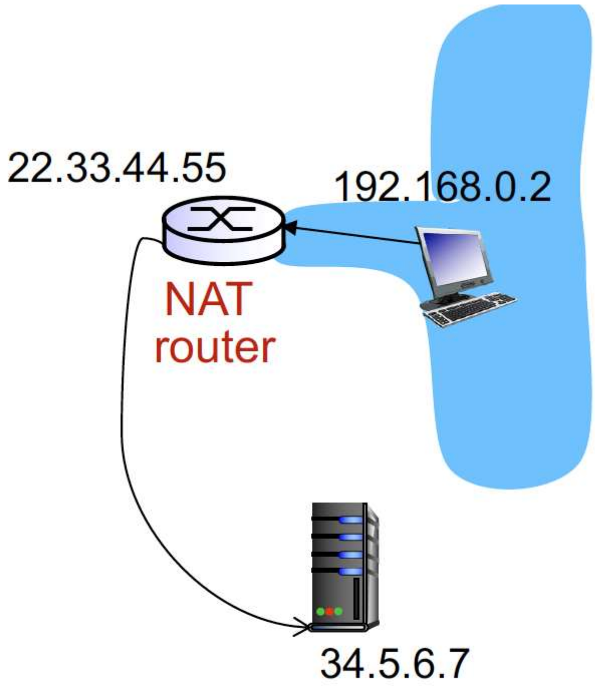
A,B: 255.255.252.0/22

others: 255.255.254.0/23

Words: 61

Maximum marks: 5

9 Consider the network topology shown in the figure below. A host with a private IP address 192.168.0.2 opens a TCP socket on its local port 6700 and connects to a web server at 34.5.6.7. The NAT Router's public IP address is 22.33.44.55. Suppose the NAT router creates the following mapping (WAN -> LAN): [22.33.44.55, 4001] -> [192.168.0.2, 6700] for this connection.



In the IP datagram that encapsulates the SYN-ACK response sent from the web server what is the source IP address and destination IP address? Note down the answers in the spaces provided below. No explanation is required.

Source IP address: 34.5.6.7

Destination IP address: 22.33.44.55

Maximum marks: 1

10 In a certain 6-node network with nodes A through F, assume that we are using distance-vector routing. Assume that poisoned reverse is disabled.

Node D receives the following distance vectors simultaneously from its two neighbours - from B: (4, 0, 5, 2, 7, 1) and from F: (4, 5, 2, 4, 4, 0) where the elements of the vectors corresponds to the current estimated costs to get to nodes A through F in that order. For example, the estimated cost from B to A is 4, from B to C is 5 and from F to A is 4.

The cost of the links D-B and D-F are 2 and 4, respectively.

Assume that node D executes the distance vector algorithm using these two new vectors. What is the current estimated cost from node D to each of the other nodes (A, B, C. E and F) and what is the next hop node for node D to get to that node. Fill in the cost in the first space provided and the id of the node in the second space, for each destination.

Cost to A: [ ] Next hop node (from D) to get to A: B

Cost to B: [ ] Next hop node (from D) to get to B: [ ]

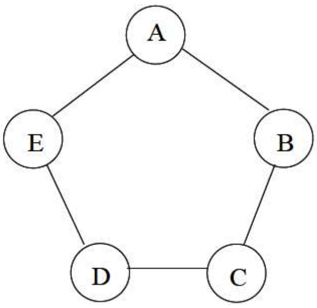
Cost to C: 6 Next hop node (from D) to get to C: F

Cost to E: 8 Next hop node (from D) to get to E: F

Cost to F: [ ] Next hop node (from D) to get to F: [ ]

Maximum marks: 4

11 Consider a 5-node ring network as in the figure below. The link costs are all the same and are equal to 1. Suppose each node sends its link state advertisement (LSA) to all the outgoing links and then the LSAs are further propagated using the algorithm in the figure below to reach the entire network. Suppose each LSA is of size 25 bytes. In order for all nodes to receive LSAs from all other nodes, how much cumulative LSA traffic (in bytes) is transmitted over the entire network?



if (LSA received on incoming link && the LSA has not been received before) ***then*** flood LSA onto all but the incoming link

Select one alternative:

- 750
- 250
- 1000
- 500
- 500

Maximum marks: 1.5

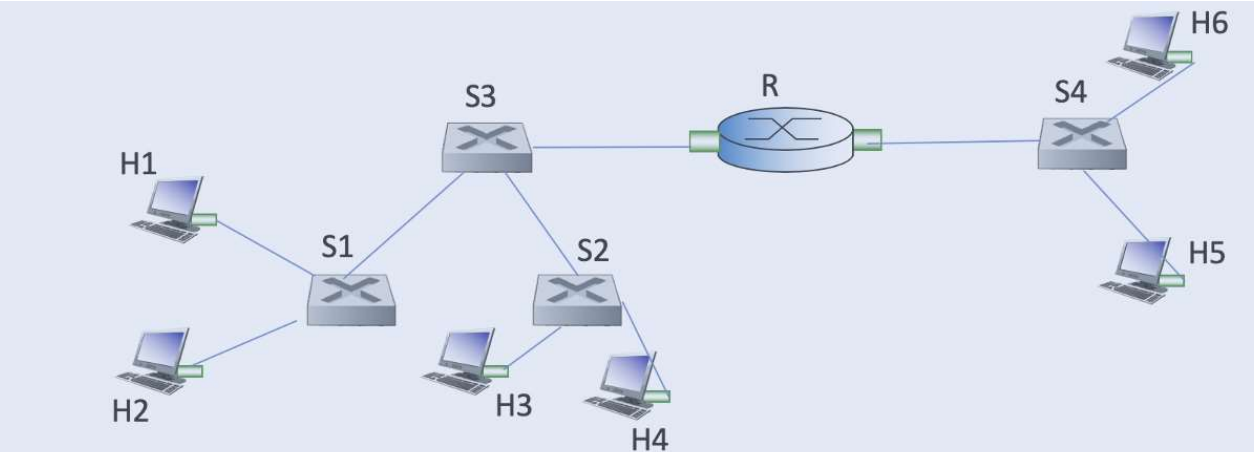
12 Consider a host H that is on a shared Ethernet network where CSMA/CD is enabled. Recall that, after the mth successive collision, a host chooses **K** at random from {0,1,2, …, 2^m-1} as per the exponential backoff algorithm employed by the Ethernet CSMA/CD protocol. Assume that host H has a frame to transmit but encounters 3 successive (i.e. back-to-back) collisions. Which of the following is an **invalid** sequence of values of K that host H may have chosen during this sequence of 3 collisions.

Select one alternative:

- 1, 2, 0
- 1, 1, 1
- 1, 0, 6
- 1, 3, 7
- 1, 7, 5

Maximum marks: 1.5

13 Consider the network shown in the figure below which comprises 6 hosts (H1-H6), 4 Ethernet switches (S1-S4) and a router R. Suppose that the switch tables in all switches are empty and that the router forwarding tables are correctly configured. Once an entry is added to a switch table, you may assume that it persists forever.



Answer the following questions.

(1) Suppose H3 sends a frame to H1. Which switches learn where H3 is? The Ethernet adapters of which hosts other than H1 receive this frame? Explain your answer. (1.5 marks)

(2) Next, suppose H6 wants to send an IP datagram to H1 and knows H1's IP address. Must H6 also know H1's MAC address to send the datagram to H1? If so, how does H6 get this information? If not, explain why not. (1.5 marks)

(3) When Router R sends the frame encapsulating the datagram (being sent from H6 to H1) from question 2 to H1, the Ethernet adapters of which hosts other than H1 receive this frame? Which switches (in the entire network) learn where H6 is? (1.5 marks)

Fill in your answer for all 3 questions here

(1) S1、S2、S3、S4,

H2、H4、H5、H6 .

(2) Yes, we should know the mac address.

H6 can search for H2's port number through arp. And because H1's mac has not been saved, we we use arp to find. It can not be found directly in the forwarding table.

(3) None of hosts will receive the datagram.

S1、S3、S4 could learn where H6 is.

Words: 59

Maximum marks: 4.5

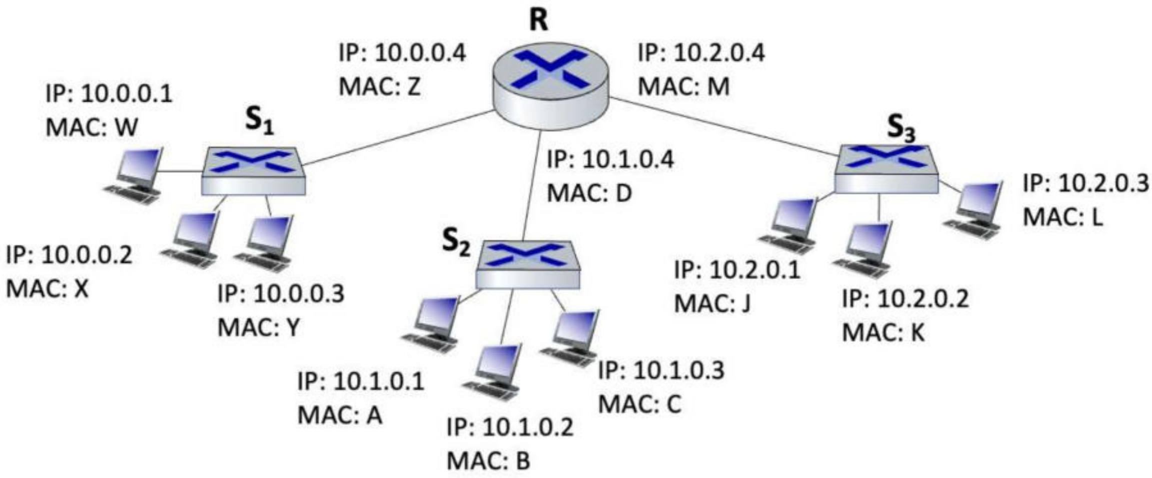
14 In which of the following multiple access (MAC) protocols can a packet collision never happen between two simultaneously transmitting nodes? Note that, all the nodes on the network are correctly following the MAC protocol and there is no malicious behaviour.

Select one alternative:

- Aloha
- CSMA/CD
- FDMA
- Slotted Aloha

Maximum marks: 1

15 The figure below shows 3 Ethernet subnets each with a link-layer switch (Si, S2, S3). The subnets are interconnected by Router R. The IP and MAC addresses of various interfaces (for each host and the router) are indicated in the figure. The MAC addresses are indicated in a simplified format using letters. Assume that the forwarding tables at all hosts and the router R are correctly configured.



Initially the ARP tables for all interfaces are empty. You may assume that any ARP replies received by an interface will be cached (i.e., can be used, if relevant, for subsequent questions).

Answer the following three questions. Each question is worth 1 mark.

(1) The host 10.2.0.1 wants to send a message to host 10.2.0.2. Specify the MAC addresses of all the host and/or router interfaces (if any) that will receive an ARP request packet.

(2) Next, the host 10.2.0.3 wants to send a message to host 10.2.0.2. Specify the MAC addresses of all the host and/or router interfaces (if any) that will receive an ARP request packet.

(3) Finally, the host 10.2.0.1 wants to send a message to host 10.0.0.2. After all the appropriate ARP queries and replies occur, what destination MAC address should the sending adapter on 10.2.0.1 insert into the Ethernet frame header that encapsulates the message being sent to 10.0.0.2?

Fill in your answer for all questions below.

This ARP request is broadcast to all devices on the same subnet. Therefore, ARP requests will be received by hosts 10.2.0.2, 10.2.0.3 and router interface 10.2.0.4.

(2) S3 can use the cached MAC reply requested by 10.2.0.2 before. Therefore, it is not received by other host or interface.

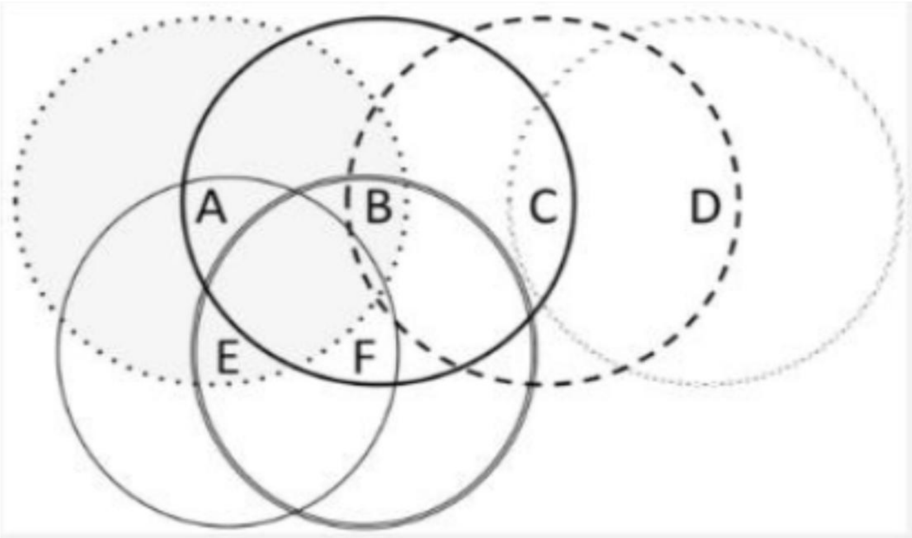
(3) Host 10.2.0.1 will recognize that 10.0.0.2 is not on its local subnet. After the ARP query and reply has occurred, host 10.2.0.1 already knows the MAC address of the default gateway interface on its subnet, ie io.2.o.4(M). Then,

host 10.2.0.1 encapsulates the IP packet in an Ethernet frame, placing M in the destination MAC address field of the Ethernet frame header.

Words: 108

Maximum marks: 3

16 Consider the wireless topology shown below, comprised of 6 nodes which are all currently active. Circles around each node illustrate their transmission range, e.g. A's range is shown by the dotted, shaded circle. Assume that the transmissions of two nodes' will interfere at a receiver if and only if they transmit at the same time and their transmission areas overlap. In these questions, assume that losses only occur due to collisions.



Answer the following questions.

(1) When node D transmits to node C, list the potential hidden nodes from D (in either direction, i.e. those who might interfere with D's transmission or those who D's transmission might interfere with)? For answering this question neglect the MAC protocol. Explain your answer. (1.5 marks)

(2) Assume that all nodes are using the 802.11 MAC protocol with RTS/CTS enabled. Assume that node C is currently transmitting to node B and has reserved the channel as per the RTS/CTS protocol. Assume that node F wishes to transmit to node E while node C is transmitting to node B. Is this possible? Explain why or why not? (1.5 marks)

Fill in your answer here

1. Node B is the only potential hidden node in this scenario. This is because although node C is within the transmission radius of node B and D, but B is not within the radius of D. Consequently, if both nodes transmit simultaneously, node B may interfer with node D's transmission on node C.

2

The RTS/CTS mechanism is in place to prevent collisions under the 802.11 MAC protocol. Node F, therefore, must have received the CTS from node B, signaling it not to transmit. Consequently, it would be impossible for node F to send data to node E while node C is transmitting to node B.

Words: 106

Maximum marks: 3

17 Greta Thunberg wants to make a statement on the Internet such that everyone in the world could verify that the statement was made by her. She must use:

Select one alternative:

- ○ Either digital signature or message authentication code
- ◉ Digital signature
- ○ Nonce
- ○ Message authentication code
- ○ Cipher Block Chaining

Maximum marks: 1

18 Assume that Captain Kirk is sending a message to Lieutenant Uhura. Kirk first attaches his digital signature to the message and then encrypts it using public key cryptography such that only Uhura can decrypt it. He sends the encrypted message to Uhura, who decrypts the message and verifies Kirk's signature. Which of the following is the current sequence in which the various keys are used by Kirk and Uhura for the above described end-to-end operations.

Select one alternative:

- ○ Kirk first uses his private key followed by Uhura's private key. Uhura first uses her public key followed by Kirk's private key.
- ○ Kirk first uses his private key followed by Uhura's public key. Uhura first uses Kirk's public key followed by her private key.
- ◉ Kirk first uses his private key followed by Uhura's public key. Uhura first uses her private key followed by Kirk's public key.
- ○ Kirk first uses his private key followed by Uhura's private key. Uhura first uses Kirk's public key followed by her public key.

Maximum marks: 1

19 Assume that you are an hacker and have intercepted the following ciphertext sent by Bruce Wayne to Nathasha Romanoff: 001101110.

Assume that you know that Bruce and Nathasha are using a block cipher scheme for encryption/decryption that follows the table below for mapping plaintext to ciphertext.

Plaintext	**Ciphetext**
000	101
111	011
001	111
010	110
011	100
100	001
101	010
110	000

What is the plaintext that corresponds to the above received ciphertext. Simply enter your answer in the space provided: 100000010 .

Maximum marks: 1