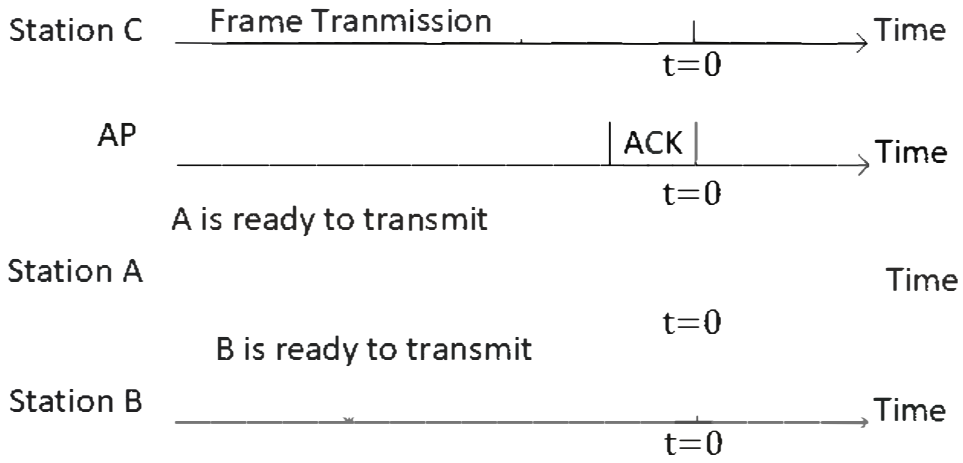
Question 1

4 / 15 points

Stations A, B and C belong to the same wireless LAN operating on the Infrastructure BSS mode with RTS/CTS mechanism.

Consider a scenario where stations A and B each attempted to transmit a data frame of 1000 bytes to the Access Point (AP) before t=0 and found that the channel was busy as shown.



Both stations then scheduled their respective transmission times by using binary exponential backoff; stations A and B generated backoff values of 1 and 6, respectively.

1. **(5 points)** Estimate the total time taken, measured from the time the channel became idle (t=0), for the first successful transmission completion of a RTS frame.
2. **(5 points)** Estimate the total time taken, measured from the time the channel became idle (t=0), for the first successful transmission completion of a data frame.
3. **(5 points)** Estimate the total time taken, measured from the time the channel became idle (t=0), for the second successful transmission completion of a data frame.

Express you answers in terms of DIFS, SIFS, slot time, RTS, CTS, ACK and *T*. RTS, CTS and ACK are the times to transmit RTS, CTS and ACK frames, respectively. *T* is the time to transmit a data frame (for both stations A and B).

Use the following assumptions in your answers:

- Propagation delay is negligible;
- No transmission error;
- Only stations A and B are competing for the access of the wireless channel after t=0.

1. RTS completion: DIFS+(4*slot time)+RTS

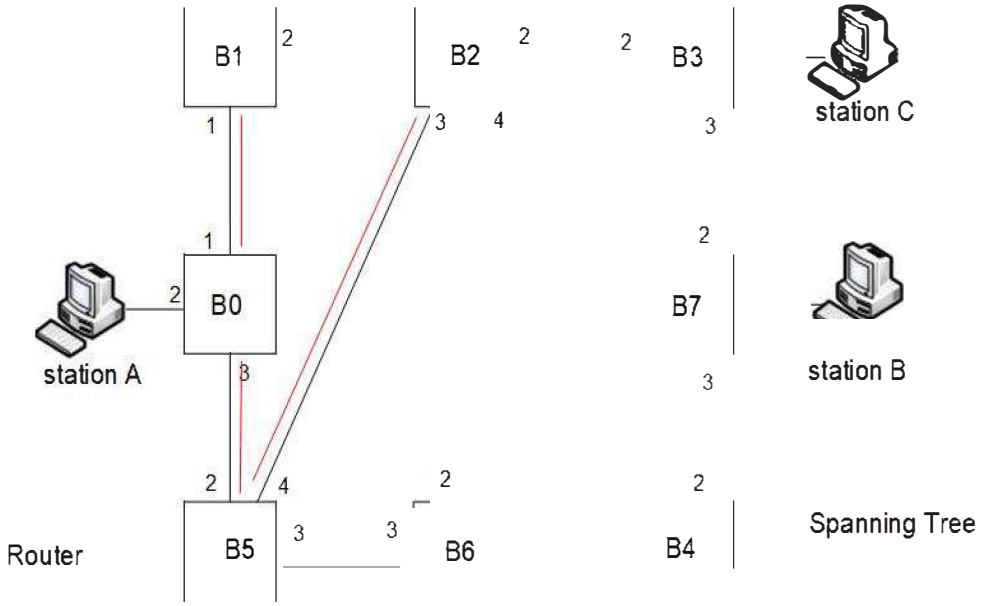
2. First complete transmission: DIFS+(4*slot time)+RTS+SIFS+CTS+SIFS+T

3. Second complete transmission: DIFS+(4*slot time)+RTS+SIFS+CTS+SIFS+T+SIFS+ACK+DIFS+(3*slot time)+RTS+SIFS+CTS+SIFS +T

The correct answer is not displayed for Written Response type questions.

Question 2 **10 / 10 points**

Consider the following bridged-LAN running spanning tree protocol. All the links are 100 Mbps.



Given that BID B0<BID B1 < BID B2 < BID B3 < BID B4 < BID B5 < BID B6 < BID_B7, where BID_B*n* is the Bridge ID of B*n*, and *n* is between 0 and 7, inclusively. Determine the port roles (root port, designated port or alternate port) of the ports of bridge B2. Put role of port 1 in the first box, role of port 2 the second, etc. In your answer, use letter **'R', 'D' and 'A'** to represent root, designated and alternate ports, respectively.

Answer for blank # 1: R ✔(25 %)

Answer for blank # 2: D ✔(25 %)

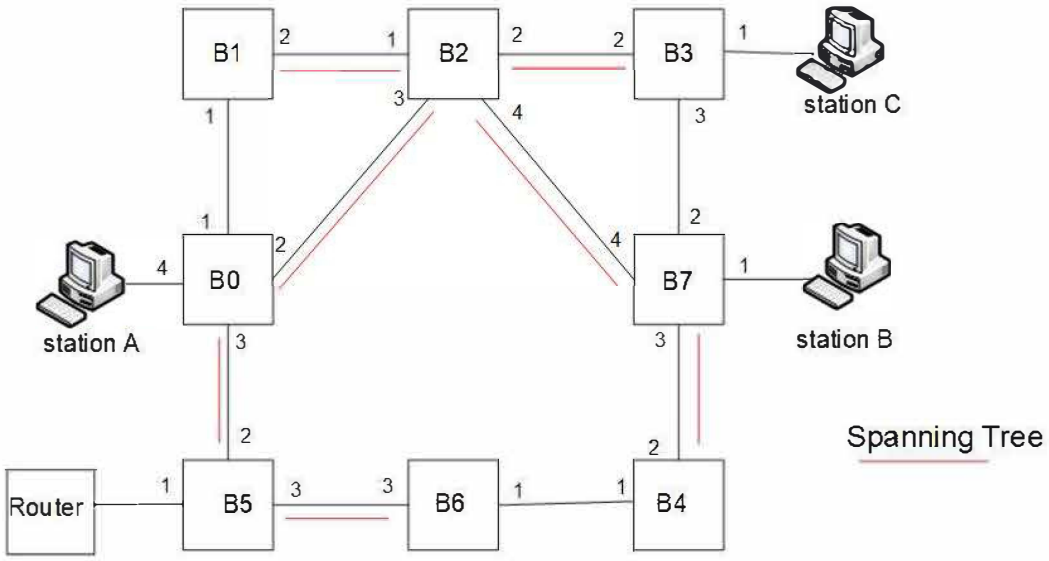
Answer for blank # 3: A ✔(25 %)

Answer for blank # 4: D **(This answer was used in another blank.)**

(R, D, A, D)

Question 3 **4 / 10 points**

The figure below illustrates a bridge LAN. The red lines in the figure constitute a spanning tree.



- (**6 points**) Assume the MAC tables of all the bridges are empty, determine the contents of the MAC tables of bridges B1 and B2 after station A sent a frame to station B and received a frame back from station B. Assuming that stations A and B belong to the same VLAN. Let the MAC addresses of stations A and B be MA and MB, respectively. Enter the contents of the tables of B1 and B2 in the first and second answer boxes, respectively. Use a semicolon to separate the table entries.
- (**4 points**) Suppose two VLANs (VLAN 1 and VLAN 2) are configured. Stations A and C belong to VLANs 1 and 2, respectively. A router is attached at B5 to provide internetworking. All the links connected between bridges and the link between B5 and the router are trunk links that support both VLANs 1 and 2 traffic. If station A sends a IP datagram to station C, determine the path, expressed in the sequence of bridges, that the datagram traverses to reach C. Answer the question based on the following assumptions:
  - All the bridges know the locations of the router and stations A and C;
  - The spanning tree is used by both VLANs.

Enter the answer In the third answer box.

Answer for blank # 1: MA 1 ✖

Answer for blank # 2: MA 3; MB4 ✖

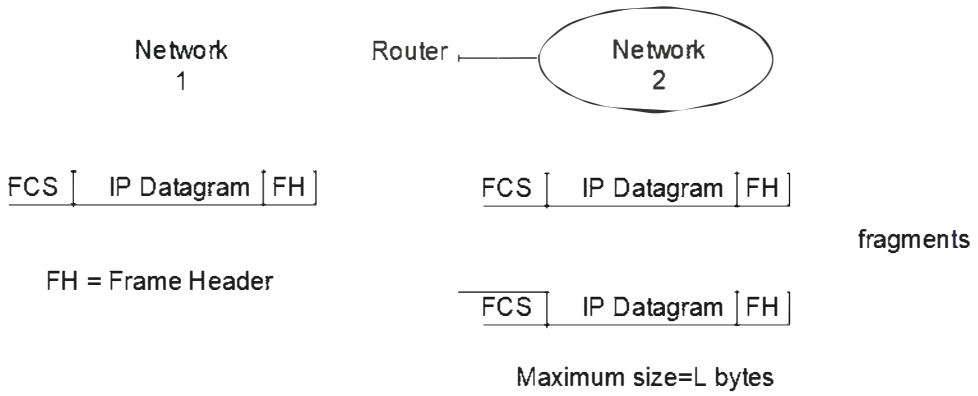
Answer for blank # 3: B0; B5; B2;B3 ✖

(/A-2 ?&?/, A-3; B-4 ?&?, B0-B5-B5-B0-B2-B3)

Question 4

1 / 10 points

(10 points) A router receives a frame carrying an IP datagram from Network 1. It breaks the datagram into two fragments and forwards them to Network 2 as shown:



The size of the IP datagram received by the router, including the IP header which is 20 bytes, is 900 bytes.

The maximum data field size of the data frame defined in Network 2 is L=640 bytes as shown in the above figure. Determine the total size in bytes of each fragment (the total size is the size of the IP header plus the size of the IP data field).

900-20 =880

num of fragments = 2

fragment 1 value = 640 Bytes + 20 Bytes = 660 Bytes

fragment 2 value = 240 Bytes + 20 Bytes = 260 Bytes

The correct answer is not displayed for Written Response type questions.

Question 5 **4 / 5 points**

Summarize the following addresses: 10.1.76.0/24, 10.1.77.0/24, 10.1.78.0/24 and 10.1.79.0/24. Determine if the summarized address is a true summarization or over summarization.

Put the summarized address in the first answer box and the answer of whether the summarized address is true or over summarization in the second answer box. Type letter T to the second box if your answer is "True summarization"; letter O if "Over summarization.

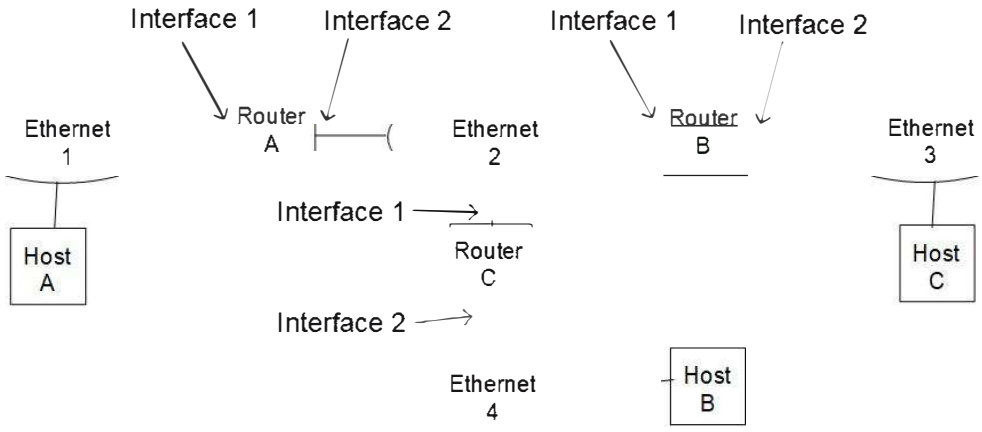
Answer for blank # 1: 10.1.76.0/22 ✔(80 %)

Answer for blank # 2: O

(10.1.76.0/22, T)

Question 6 **0 / 8 points**

Consider the following internet.



The IP and MAC addresses of the hosts and routers in the diagram are given below.

- Host A: IP address=10.1.1.2/24; MAC address=AA
- Host B: IP address=10.1.4.2/24; MAC address=BB
- Host C: IP address=10.1.3.2/24; MAC address=CC
- Router A (Interface 1): IP address=10.1.1.1/24; MAC address=A1
- Router A (Interface 2): IP address=10.1.2.1/24; MAC address=A2
- Router B (Interface 1): IP address=10.1.2.2/24; MAC address=B1
- Router B (Interface 2): IP address=10.1.3.1/24; MAC address=B2
- Router C (Interface 1): IP address=10.1.2.3/24; MAC address=C1
- Router C (Interface 2): IP address=10.1.4.1/24; MAC address=C2

Suppose all the routers are properly configured such that they know how to reach all the subnets of this internet. If Host A sent a datagram to Host C, determine the source and destination MAC addresses in the corresponding Ethernet frame sent by Router A.

Put the source address in the first box and destination address in the second box.

Answer for blank # 1: C1

Answer for blank # 2: A1

(A2, B1)

Question 7 **0 / 7 points**

Router R1 has the following routing table:

Routing table of router R1

Network	Next Hop	Interface
145.10.32.0/19	191.10.0.1	Ethernet-0
145.10.48.0/20	191.10.1.1	Ethernet-1
145.10.40.0/21	191.10.2.1	Ethernet-2
145.10.56.0/21	191.10.3.1	Ethernet-3

145.10.64.0/21	191.10.4.1	Ethernet-4
145.10.52.0/22	191.10.5.1	Ethernet-5
145.10.60.0/22	191.10.6.1	Ethernet-6
145.10.54.0/23	191.10.7.1	Ethernet-7
145.10.64.0/22	191.10.8.1	Ethernet-8

Suppose router R1 received an IP datagram with the following IP addresses:

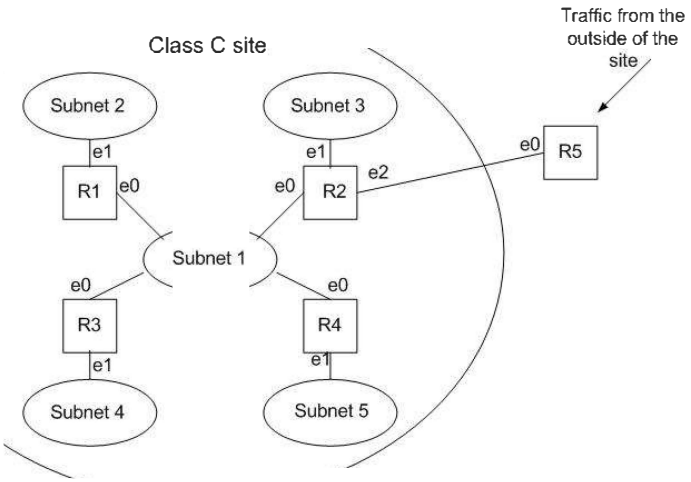
- Source/Destination IP addresses = 194.12.4.1/145.10.68.10

Determine the IP address of the next hop.

Answer: 0.0.0.0 **(191.10.4.1)**

Question 8 **10 / 25 points**

Consider a Class C address site with the address of 200.5.1.0/24. The site has five subnets and these subnets are inter-connected by routers R1, R2, R3 and R4 as shown.



The sizes of the address blocks (including Network ID and broadcast address) of these subnets are given below:

- Subnet 1: size of address block is 128
- Subnet 2: size of address block is 16
- Subnet 3: size of address block is 32
- Subnet 4: size of address block is 64
- Subnet 5: size of address block is 16

a. **(10 points)** Design an appropriate Network ID for each subnet.
b. **(8 points)** Based on your design in part a), assign appropriate IP addresses to interfaces e0 and e1 of the routers (R1, R2, R3 and R4).

c. **(7 points)** Based on the answer in parts a) and b), derive entries of the routing table of router R1 such that hosts in Subnet 3 can communicate with hosts in any other subnets. Each entry of the table has three elements: the subnet address/mask, the outgoing interface and the IP address of the next hop.

a.

Subnet 1: 200.5.1.0/25

Subnet 2: 200.5.1.64/28

Subnet 3: 200.5.1.128/27

Subnet 4: 200.5.1.160/26

Subnet 5: 200.5.1.192/28

b. R1: e0: 200.5.1.1; e1: 200.5.1.65

R2: e0: 200.5.1.2; e1: 200.5.1.129

R3: e0: 200.5.1.3; e1: 200.5.1.161

R4: e0: 200.5.1.4; e1: 200.5.1.193

c.

Net ID	Interface	Next Hop
200.5.1.0/25	e0	d c
200.5.1.64/28	e1	dc
200.5.1.128/27	e0	
200.5.1.160/26	e0	
200.5.1.192/28	e0	

The correct answer is not displayed for Written Response type questions.

Question 9 — 0 / 25 points

Implement an online chatting program involving two users, called caller and callee, with the following requirements.

a. The callee uses the callee program to wait for a call from a callar. Essentially, the callee program listens to the TCP socket descriptor, sde, for connection request from the caller program.
b. After the caller and callee program established the first TCP connection, the caller program will create a new TCP socket, sdr, and send the port number of this socket to the callee program via the first TCP connection.
c. The callee program uses the port number information to make a second TCP connection with the caller program.

d. After the two TCP connections were established, the caller and the callee can send chat messages to the other using the first and second TCP connections, respectively. The received message is written to the stdout. You can assume the maximum message size is 100 bytes.
e. Only the caller can terminate the chatting session. When the session ends, the caller program should delete all the sockets and exit, while the callee program will keep the first socket (sde) for the future chat sessions with other callers.

Show the code of the callee program. You can assume that the first socket, sde, has already set up properly. Do not assume that the callee knows the IP address of the caller before the establishment of the first TCP connection.

You need to provide sufficient comment to explain the logic of your code.

- No text entered -