A

1. **Each of two hosts A and B, connected to an Ethernet network has one frame pending of transmission, F_a and F_b, respectively.** So far, host A has undergone a total of 2769 collisions, 3 of which were as a result of attempting the transmission of F_a. Host B has undergone a total of 4890 collisions, 2 of which happened as a result of Host B attempting the transmission of F_b. Respond to the following questions all of which are based on the explained context (Don't consider any Inter Frame Gap):

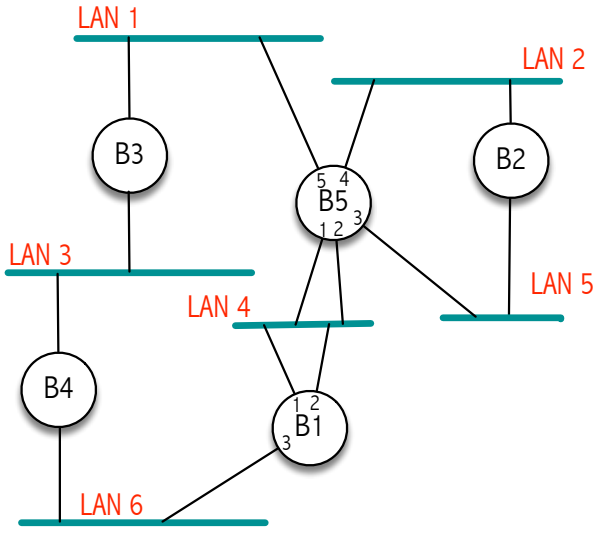
    a. Calculate the probability that either host wins the backoff (Either, Host A wins or Host B wins)
    b. Calculate the probability that host A takes a time greater than 100 μs in initiating a new transmission attempt

2. **The round trip time of a full-length (2500 m) Ethernet is 51,2 μs, using this fact, respond to the following two questions:**

    a. How many bits can be vulnerable to a collision involving two stations located at a distance of 2500 m from each other?
    b. What is the minimum Ethernet frame length that guarantees that a collision will be detected regardless of the location of each host in a coaxial cable Ethernet that has a maximum length of 2500 m.

3. **Is dividing a valid IP address block of size S into two equal-sized IP address blocks possible in general? (Assume S is at least 2^2)**

    ☐ a. Yes, that is possible only if S is even
    ☐ b. Yes, that is possible only if S is odd
    ☐ c. None of the above options is true
    ☐ d. Yes, that is always possible
    ☐ e. No, that is never possible



4. **Spanning Tree Protocol**

    a. Apply the Spanning Tree Algorithm on the Extended LAN diagram on the side of this question. Depict the resulting spanning tree.
    b. Explain the contents of the Destination MAC and Source MAC fields in IEEE 802.1D frames.
    c. Explain the encapsulation of IEEE 802.1D frames.
    d. Explain how each Ethernet Switch generates its ID (The label that uniquely identifies the switch across the Extended Lan)

5. **Explain how you would program a Learning Switch that supports STP in the C language running under the Linux Operating System. You don't have to program anything but only explain your overall analysis of the task and the programming challenges that you expect to meet.**

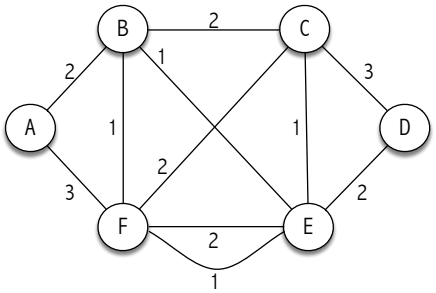
6. **An IP packet is fragmented into 4 fragments as it travels the route path to its destination host. Of the following statements about IP fragmentation, mark the true ones:**

    ☐ a. The MF field in each fragment identifies the fragment itself
    ☐ b. The Offset field in each fragment marks a 2-byte position in the original IP packet payload

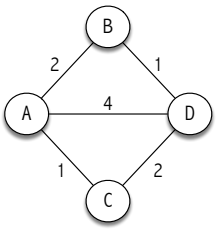
- c. The Offset field in each fragment marks a 4-byte position in the original IP packet payload
- d. The Offset field in each fragment marks a 8-byte position in the original IP packet payload
- e. The four fragments will be defragmented by the each router on the path
- f. In general, the number of fragments can increase as each fragment travels the path toward the destination host

7. An IP router receives an IP packet which size is 1500 Bytes and it decides to forward it on another interface which MTU is 576. Has this situation a solution based on the IP protocol? If that is the case, solve it by computing all the resulting IP packets along with their relevant fields.

8. The internetwork diagram included in this question represents a routing domain based on the OSPF protocol (The circles represent IP routers)
   a. Apply the Dijkstra's algorithm at node F to obtain its Shortest Path Tree
   b. Obtain node F's FIB (Routing Table).
   c. Depict the resulting Shortest Path Tree of node F
   d. Explain the essential differences between the DV and the Dijkstra's routing algorithms



9. Distance Vector Algorithm/Bellman-Ford formula
   a. Briefly explain the DV routing algorithm
   b. The adjoining diagram represents a routing domain based on the RIP protocol (DV). Calculate the state of each node's Distance Vector after a few vector transmissions have occurred.



10. The table below represents the routing table of an IP router. An IP packet is received by the router which destination address 193.146.97.254. Determine the next-hop selected by the IP router for forwarding the IP packet.
    a. Explain the process you followed in computing it with as much detail as necessary so that the *logic* behind it is clear and faithfully represents the LPM algorithm.
    b. Depict an internetwork diagram that correctly represents the contents of the forwarding table.

Prefix	Next hop
193.146.96.0/22	192.168.1.2
193.146.96.128/23	Eth3
192.168.97.192/26	Eth0
0.0.0.0 (default)	192.168.2.2
193.146.97.192/26	Eth1
192.168.2.0/24	Eth2

11. An organization O has four departments containing the following numbers of internet hosts:
A = 40, B = 62, C = 130 and D = 300. Obtain a correct IP numbering scheme that uses a single CIDR block that encompasses the IP addresses for the four CIDR blocks. One of the IP addresses contained in the global address (CIDR) block is 190.44.55.66.

12. Consider the internetwork included in the internetwork diagram that appears below:
    a. Explain the process that allows an IP packet sent by host comp0 to be delivered to host comp1. Detail the field contents of the relevant PDUs. Consider the richest network context that you can imagine of. The router's forwarding table is fully populated with the two network numbers that correspond to the two networks appearing on the diagram.

    b. Do the hosts have a *forwarding table?* How can you obtain its contents at any of the hosts assuming that they're executing the Linux operating system. Write down their most reasonable contents given the internetwork topology.