*Name: _____ Student ID: _____*

Section A

1. Assume a CSMA system. What is the behaviour of a station that has a frame to send and finds the channel idle under the following **three** carrier sense protocols: *[12%]*
    a. 1-persistent
    b. p-persistent
    c. non-persistent

2. Which of the following is considered a connection-oriented protocol? *[2%]*
    a. UDP
    b. TCP
    c. ICMP
    d. ARP

3. List **three** private key ciphers and briefly explain **two** different block cipher operation modes. Which of these ciphers would you recommend to use? Name **one** public key cipher and **three** cryptographic hash functions. Which of them would you recommend to use? *[5%]*

4. Information security is not built on which of the following? *[2%]*
    a. Confidentiality
    b. Availability
    c. Accessibility
    d. Integrity

5. What is an URL and what are its components? *[4%]*

Section B

6. For a 2-km long channel, with the data rate of 1 Gbps, determine the minimum frame length when IEEE 802.3 is being used. Speed of propagation is 200 km/millisecond *[10%]*

7. A company has bought new servers. It has decided to run a distance-vector protocol for routing between these servers (even though it is a rather small network). They are currently configured as the picture below, with respective edge costs. *[15%]*
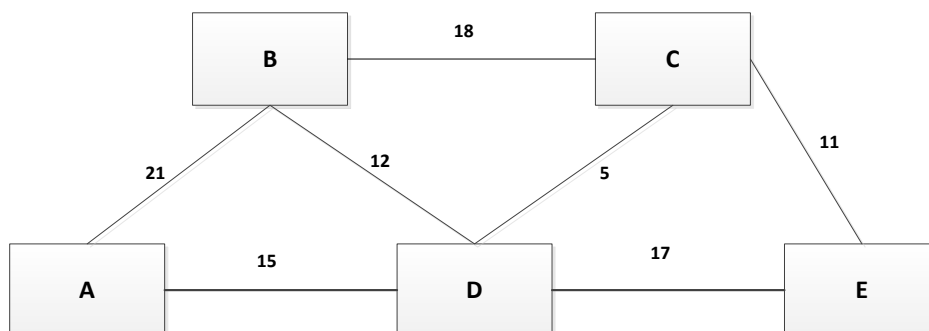

Write down each step to build the distance vector routing table for **E**.

8. A company is able to allocate host addresses from the range **104.13.240.1** to **104.13.243.254**. What is the network address of the company (including the network prefix) and what network mask should it use? What is the maximum number of hosts that it could allocate? *[10%]*

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9. Show how byte 11010010 can be coded using an even Hamming Code to support single bit error detection and correction. **[5%]**

Another even Hamming coded byte was received with one bit corrupted and the bit received were 111001101101. Show how the error can be detected and then corrected. What was the byte that was encoded originally? **[5%]**

10. Consider the network depicted in the figure below. The IP addresses and MAC addresses of individual interfaces are as denoted in the figure. **[18%]**
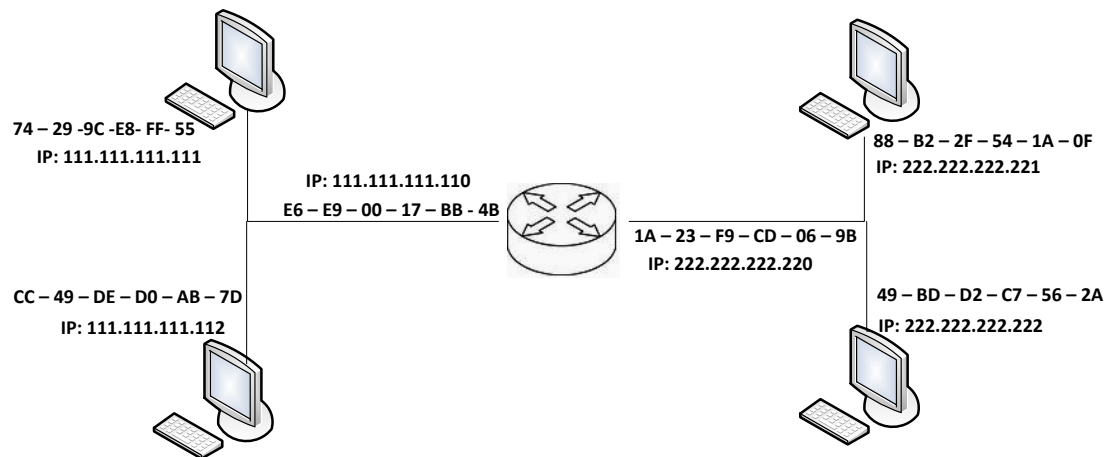
Suppose that the sender host with the IP address 111.111.111.111 wants to send an IP datagram to the receiver host with IP address 222.222.222.222. Answer the following questions:

   a. How many subnets are there in this network? Which IP addresses belong to which subnet?

   b. What is the destination IP address of the datagram when it leaves the sender host? What is the destination IP address of the datagram when it leaves the router?

   c. What is the destination MAC address of the frame when it leaves the sender host? What is the destination MAC address of the frame when it leaves the router? Which protocol is used to determine the destination MAC address?

11. Alice and Bob would like to communicate securely over a network using certificates. Assume that an intruder (Trudy) somehow obtained the private key of a Certificate Authority (CA). Describe in detail (including messages exchanged by Trudy) what kind of an attack can take place in this situation. How can the intruder intercept messages exchanged between Alice and Bob? Assume that Alice is the one who tries to initiate communication with Bob. **[12%]**

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