Name: _____ Student ID: _____

Section A

1. Briefly explain what is meant by Network Address Translation (NAT). List **two** advantages and **two** disadvantages of the NAT solution. Identify and describe **three** strategies used for a NAT router to translate incoming packets. *[11%]*

2. The OSI reference model defines seven protocol layers, each one responsible for a range of specific functions. Considering this model, list the **three** main functions performed by a protocol operating at: *[9%]*
    a. The physical layer
    b. The transport layer
    c. The presentation layer

3. List **three** deficiencies that make IPv4 unsuitable for the fast-growing Internet. Which of these are valid IPv6 addresses? (Choose **three**). *[6%]*
    a. 2001:0db8:0000:0000:0000:0000:1428:57ab
    b. 2001:0db8::1428:57ab
    c. 2001::1685:2123::1428:57ab
    d. 2001:99:ab:1:99:2:1:9
    e. 2001:1428:57ab:1685:2123:1428:57ab

4. Describe **three** causes of transmission impairment and shows with an illustration their effect on a signal. *[3%]*

5. Compare and contrast simplex, half-duplex and full duplex transmission modes. Give an example of each one. *[6%]*
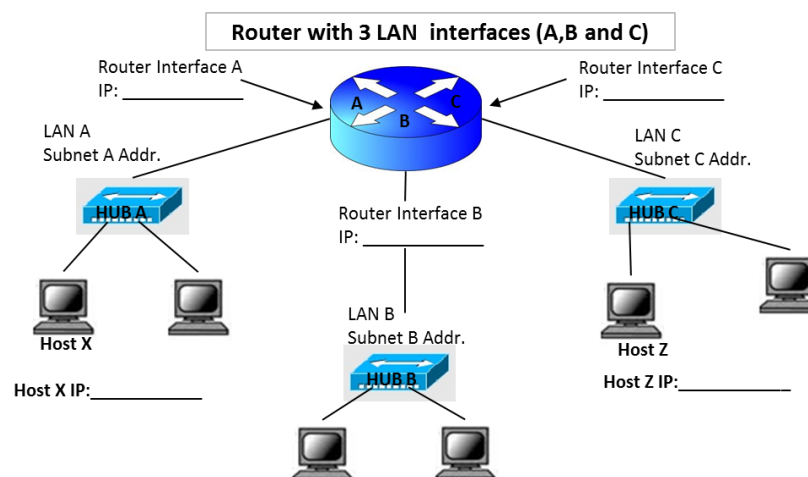
Section B

6. Consider the picture below. Suppose Host **A** sends a datagram to host **B**. Assume that the datagram sent is small enough to fit into one link-layer frame. *[12%]*

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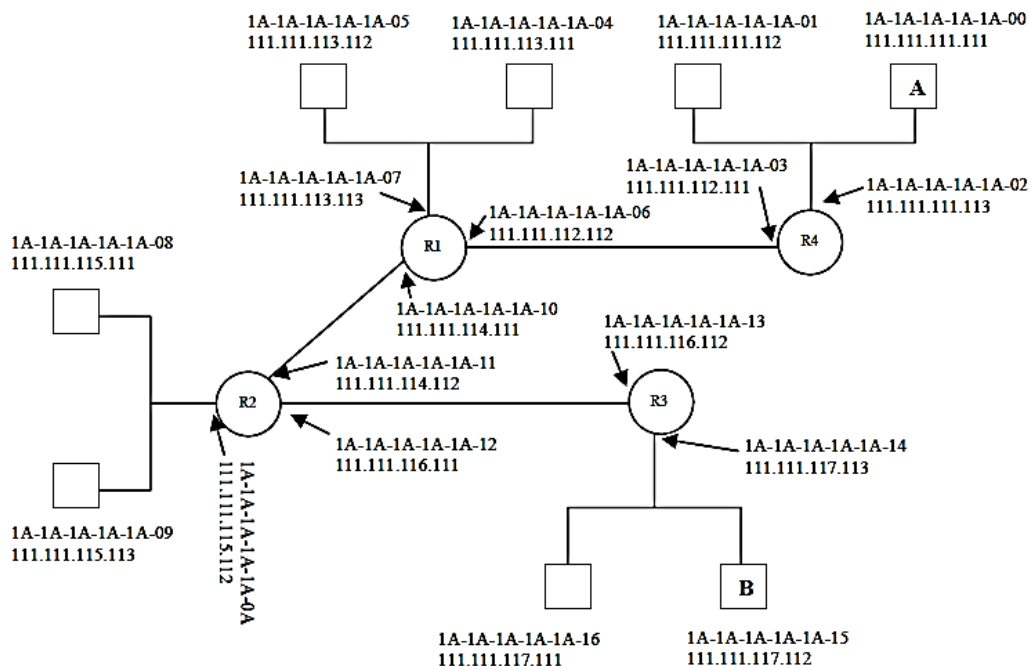
During the transmission of this datagram from A to B a frame is sent from R4 to R1, a frame is sent from R1 to R2 and a frame from R2 to R3. (Other frames might be sent as well but in this question we are not concerned with them).Each of these frames contains a (1) frame source (MAC) address, (2) a frame destination (MAC) address and an encapsulated datagram containing a (3) source IP address and a (4) destination IP address. In the table below the diagram **fill** in the values of **these four** items for each of the **three** frames indicated.

Frame sent on link from	Frame source (MAC address)	Frame destination (MAC) address	IP datagram source address	IP datagram destination address
R4 to R1				
R1 to R2				
R2 to R3				

7. Assume that you are the network administrator of these organizations:
    a. A large organization has been assigned a Class A network address. Currently, the company has 1000 subnets in offices around the world. Eventually, it will be needed to add 100 new subnets over the next three years, and the largest possible number of host addresses per subnet must be allowed. Which subnet mask would the network administrator choose? *[8%]*
    b. An organization has the network ID 165.121.0.0. The network administrator is responsible for creating subnets on the network, and each subnet must provide at least 900 host IDs.
        i. Which subnet mask meets the requirement for the minimum number of hosts IDs and provides the greatest number of subnets? *[8%]*
        ii. If the first **three** subnets: A, B and C are chosen, how should the administrator assign the right IP addresses in the following blank spaces: *[8%]*

Router with 3 LAN interfaces (A,B and C)

Router Interface A
IP: _____

Router Interface C
IP: _____

LAN A
Subnet A Addr.

LAN C
Subnet C Addr.

HUB A

HUB C

Router Interface B
IP: _____

Host X

LAN B
Subnet B Addr.

Host Z

Host X IP:_____

HUB B

Host Z IP:_____

8. For a 2-km long channel, with a 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%]*
9. Draw the signal encoding of the given bit-stream: 1101011010 using Differential Manchester, and NRZ-I schemes. What is the main disadvantage of NRZ-I? How does Differential Manchester overcome this problem? *[10%]*
10. Two neighbouring nodes (A and B) use Selective-Repeat ARQ protocol, with 3-bit long sequence numbers. Assume A sends frames 0-3 to B, but frame 2 never reaches B. Show the exchange of frames and the content of both, the sending window at A and receiving window at B. *[9%]*

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