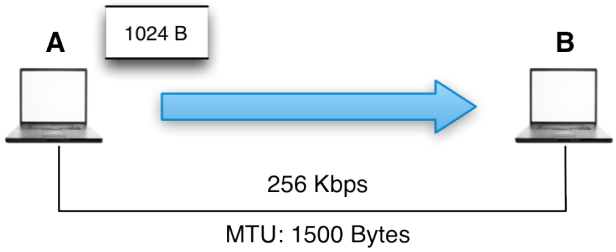
Computer Networks Comprehensive Examination Fall 2013

Read Carefully: Work each of the following problems without any reference material (closed books and closed notes). Calculators are allowed. Please **fully explain** your response, and address the questions asked. If additional space is needed please attach a blank page and clearly indicate the question that it refers to.

Name:_____ Date:_____

Question 1: (20 pts.) Consider the network diagram illustrated in the figure where both nodes are directly connected by a 256 Kbps link (MTU = 1500 Bytes). Assuming that node "A" opens a TCP connection with node "B" to send a single 1024 Bytes file, please answer the following:



a) How many packets overall are exchanged between A and B to establish, use and teardown the TCP connection for this transmission? Please explain your answer.

b) Assuming that the length of the link between A and B is 6 Km, and that the speed of light in the link is $2 \cdot 10^8$ m/s, calculate how long would it take to complete the full transmission of the file, and terminate (i.e. tear-down) the socket. Consider that the socket is terminated immediately after the transmission, and ignore all processing delays. Assume that the TCP/IP header is 40 Bytes (IPv4 with no TCP or IP options). Clearly state any assumptions you make to answer this question.

Question 2: (15 pts) Consider the following 20-bit long message

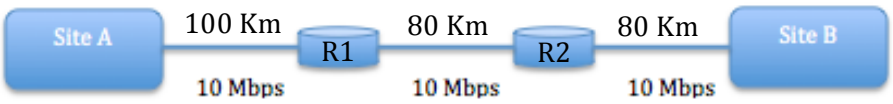
`Message: 10010110101011001101`

Assuming that both the transmitter and the receiver share the polynomial ($x^3 + x + 1$) as a generator for the CRC calculation, answer the following questions:

a) How long (in number of bits) is the full message that will be transmitted by the sender, once the CRC is appended.

b) Calculate the CRC that will be used to transmit the message?

Question 3: (20 pts) Using the network topology illustrated in the figure below, and assuming the speed of light in the links to be $2 \cdot 10^8$ m/s, please answer the following questions, ignoring all processing delays on any of the nodes.



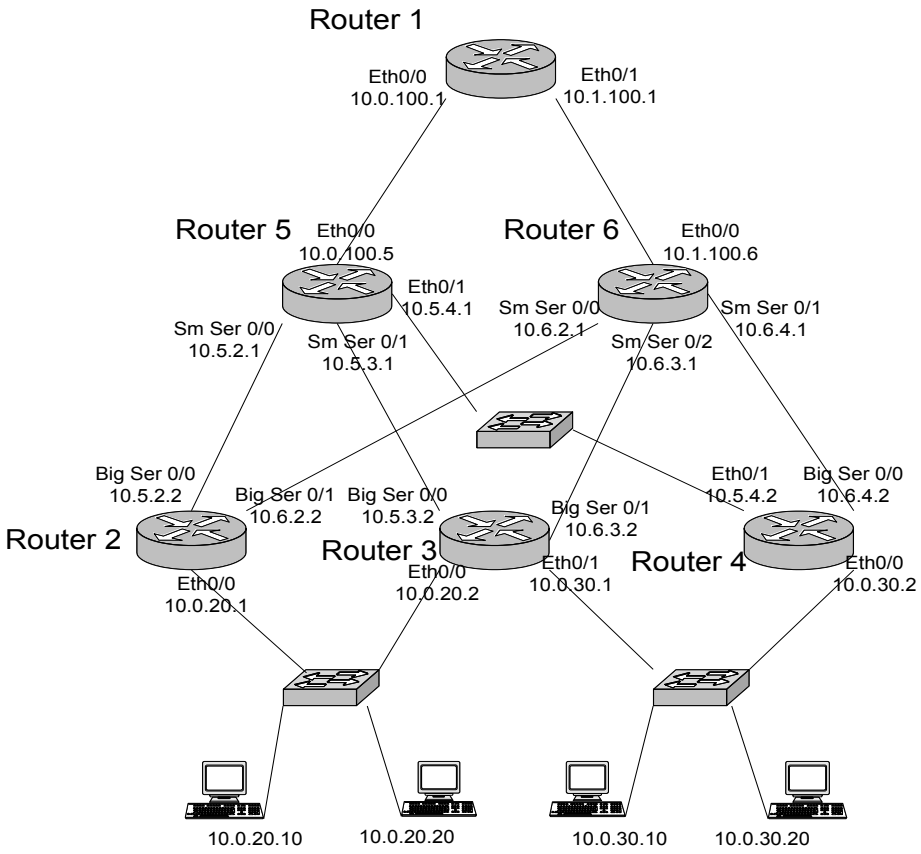
a) Assume that at time zero (T_0), **5** frames (of 5 KB each) are given to A for transmission to B, **1** frame of 5 KB is queued on R1 for transmission to B, and **1** frame of 5KB is queued on R2 for transmission to B. How long will it take for the last frame to arrive on B (i.e., for the last bit of the last frame to arrive at B).

b) Assume that at time zero (T_0), **5** frames (of 5 KB each) are given to A for transmission to B, **2** frames of 5 KB each are queued on R1 for transmission to B, and **1** frame of 5KB is queued on R2 for transmission to B. How long will it take for the last frame to arrive on B (i.e., for the last bit of the last frame to arrive at B).

c) What are the average queue lengths (in frames, not bits) **on A, R1 and R2**, during the full transmission in the case described on (b), that is, the case where A starts with 5 frames, R1 starts with 2 frames, and R2 starts with 1 frame.

Question 4: (10 pts) Explain what are the ARP and the DNS protocols, and how they are used, provide an example for each case. Be specific in your answer.

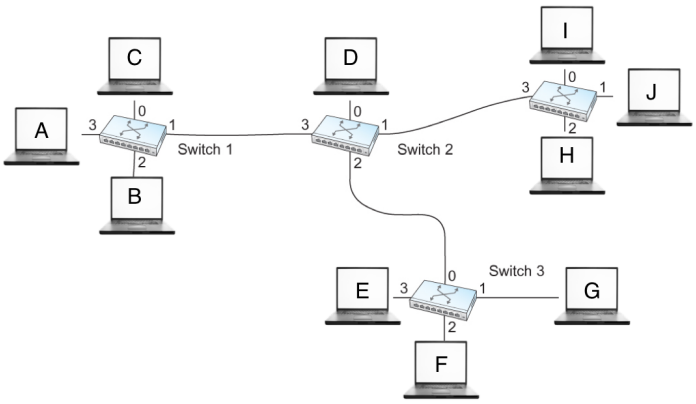
Question 5: (20 pts) Answer the following with reference to this diagram:



a) Build a routing table for Router 6 that supports the routing of datagrams to every IP address shown in the diagram using the minimum number of hops to the destination. (Assume other routers have appropriately defined routing tables.)

b) Most likely in answer (a) you have two route table entries (Router 6) for the routing of datagrams to the 10.0.20 subnet and 10.0.30 subnet. Show how to use address summarizing to reduce these entries to one line in the routing table (for Router 6).

Question 6: (15 pts) Based on the switched network topology shown in the figure, determine the virtual circuit tables for all the switches **after each** of the following connections is established (list below). Assume that the sequence of connections is cumulative; that is, the first connection is still up when the second connection is established, and so on. Also assume that the VCI assignment always picks the lowest unused VIC on each link, starting with 0, and that the VCI is consumed for both directions of a virtual circuit



i. Host B connects to host A

ii. Host C connects to host G

iii. Host C connects to host F

iv. Host B connects to host G