Student Name: _____
Student ID: _____
Section #: _____

King Fahd University of Petroleum and Minerals
College of Computer Sciences and Engineering
Department of Computer Engineering

COE 344 – Computer Networks (T082)

Final Exam

Date & Time: Saturday June 27, 2009 (07:30 AM – 09:30 AM)

Problem #	Mark	Score
1	20	
2	20	
3	20	
4	28	
5	12	
Total	100	

- **This is a CLOSED books, CLOSED notes exam.**
- **State all your assumptions. Show all your work. NO credit will be given if work is not shown.**
- **Answer ALL problems.**

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Problem # 1 (20 marks)

A. *(1 point each)* Choose only one answer that is the most appropriate.

1) When a TCP segment arrives to a host, the socket to which the segment is directed to depends on:
   a) the destination port number
   b) the source port number
   c) the source IP address of the datagram that encapsulated the segment
   d) all of the above
   e) none of the above

2) In routing among ASs, which of the following issues dominate(s)?
   a) current congestion levels in the ASs
   b) number of ASs traversed
   c) policy
   d) geographical distance between ASs
   e) all of the above
   f) none of the above

3) Isolated ***broadcast*** domains can be achieved by using _____.
   a) hubs
   b) switches
   c) routers
   d) both [A] and [B]
   e) both [A] and [C]
   f) both [B] and [C]
   g) all of [A], [B], and [C]
   h) none of the above

4) In the figure shown, datagrams sent by router *A* and delivered to router *B* _____ .

   a) are guaranteed to be received by router *B* in-order (i.e. same order as sent by router *A*)
   b) are guaranteed to be received by router *B* out-of-order
   c) could be received by router *B* out-of-order dependent on the ATM service model used
   d) are not possible as ATM and IP use different protocols

5) If an Ethernet adapter determines that a received frame is addressed to a different adapter, it takes the following action(s):
   a) It sends a negative acknowledgement to the sending host
   b) It delivers the frame to the network layer
   c) It discards the frame
   d) It sends an ICMP error message
   e) Both [A] and [B]
   f) Both [B] and [C]
   g) Both [C] and [D]
   h) Both [A] and [C]
   i) Both [A] and [D]
   j) All of [A]—[D]
   k) None of [A]—[D]

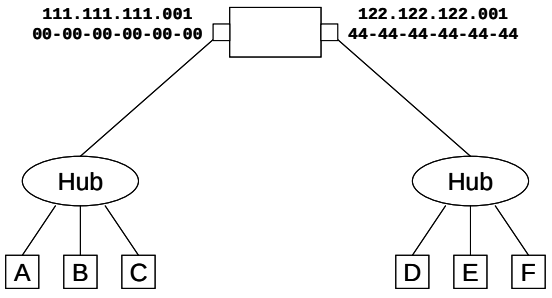
6) A cut-through switch has which of the following properties:
   a) a packet may be leaving and entering the switch at the same time
   b) a packet is forwarded through the switch without a store-and-forwarding delay when the output link is free
   c) does not provide a performance improvement over store and forward if the output links are always congested
   d) all of the above

7) RIP is
   a) an intra-AS protocol
   b) an inter-AS protocol
   c) based on Distance Vector Routing
   d) allows multiple same cost paths
   e) Both [A] and [C]
   f) Both [B] and [C]
   g) [A], [C] and [D]
   h) [B], [C] and [D]
   i) All of [A]—[D]
   j) None of [A]—[D]

8) IEEE 802.11 uses CSMA/CA because_____ .
   a) CSMA/CA resolves the hidden terminal problem
   b) CSMA/CA resolves the issue of fading
   c) unlike CSMA/CD, CSMA/CA does not use acknowledgements for received data
   d) both a. and b.
   e) both a. and c.
   f) both b. and c.
   g) all of a., b., and c.
   h) none of the above

9) Consider sending a 3000-byte datagram (inclusive of a minimum size header) from a host to another host over IPv6–only network. Along the path between the two hosts, the datagram will go over a link whose MTU is 500 bytes (inclusive of a minimum size header). Thus, the number of ***fragments*** generated by the router immediately preceding the specified link is:
   a) 6
   b) 7
   c) no fragments will be generated
   d) cannot be determined from given information

10) The device connecting the two hubs in the figure shown must be a:
   a) hub
   b) switch
   c) router
   d) Both [A] and [B]
   e) Both [A] and [C]
   f) Both [B] and [C]
   g) All of [A]—[C]
   h) None of [A]—[C]



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B. *(1 point each)* Mark the following with T (true) or F (false).

	Statement	T / F
1.	Assuming a proxy server is <u>not</u> used; two distinct web pages (*www.kfupm.edu.sa* and *www.hotmail.com*) can be sent over the same persistent connection.	
2.	Suppose that host A wants to send data over TCP to host B, and host B wants to send data to host A over TCP. Two separate TCP connections, one for each direction, must be established.	
3.	Network congestion has ***no*** impact on the process of IP fragmentation.	
4.	If a mobile node wishes to transmit a datagram to a stationary correspondent, then, from an efficiency point of view, the direct routing approach is preferred over the indirect routing approach.	
5.	With CDMA, two concurrent (simultaneous) senders in the same network must use the same chipping code.	
6.	Consider a twisted-pair Ethernet in which all nodes are 50 meters from the hub. The time it takes for a bit to propagate from hub to node for a 10BaseT Ethernet is ten times longer than for a 100BaseT Ethernet.	
7.	CSMA/CD is more restrictive than the CSMA in the sense that it puts restrictions on the cable lengths and frame sizes.	
8.	Pure ALOHA results in higher peak channel utilization compared to the slotted ALOHA.	
9.	In CSMA/CD, after the 4^{th} collision, the probability that a colliding node chooses $K = 0$ in the exponential backoff algorithm is zero (i.e., $P\{K=0\} = 0$).	
10.	In wireless networking, TCP congestion control does ***not*** decrease the congestion window size when a loss event occurs due to a lost segment caused by RF conditions.	

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Problem # 2 (20 marks)

Assume that TCP *Reno* is used in a network, and that the following events are taking place:

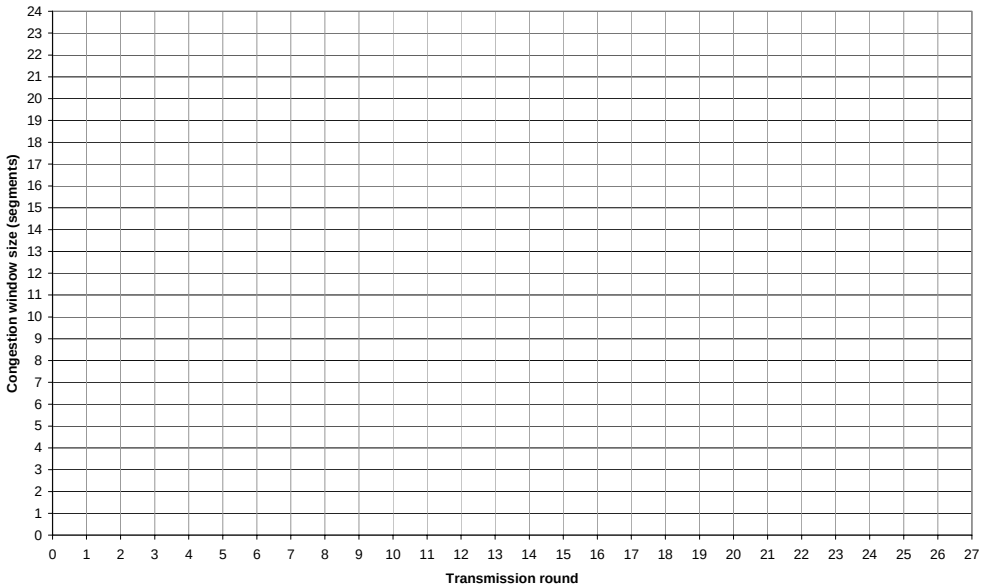
- At transmission round 1 a new round of transmissions begins.
- At transmission round 5 the `Threshold` is reached.
- *After* transmission round 7, a segment loss was detected by a triple duplicate ACK.
- *After* transmission round 15, a segment loss was detected by a timeout.
- *After* transmission round 23, a segment loss was detected by a timeout.
- *After* transmission round 26, the transmission is completed.

Answer the following based on the behavior discussed above:

1. ***(4 points)*** What is the initial value of `Threshold` at the first transmission round?

2. ***(1 point)*** After transmission round 7, is TCP "slow start" operating or TCP "congestion avoidance" operating?

3. ***(10 points)*** Use the following figure to plot the TCP congestion window size as a function of the transmission rounds up to and including round 26.



4. ***(3 points)*** Based on the plot obtained in part 3, during what transmission round is the 60^{th} segment sent?

5. ***(2 points)*** Suppose that the size of each transmitted segment is fixed and is equal to 200 bytes. Furthermore, suppose that the bytes transmitted are numbered starting from 0. What is the sequence number of the last segment transmitted in transmission round 3?

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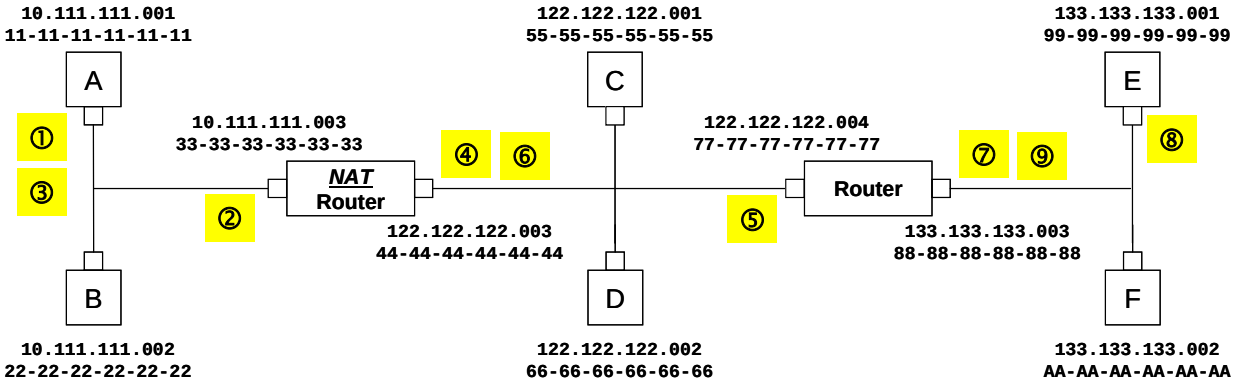
Problem # 3 (20 marks)

Consider the following network. Hosts *A* and *B* belong to a private network hidden behind the **NAT** router, whereas hosts *C*, *D*, *E*, and *F* belong to the Internet network. Suppose that host *A* wants to send a TCP segment to host *E*. Assuming that all ARP tables are *empty*, complete the following table regarding the nine data link frames shown in the figure (i.e. frames ①,②,③,④,⑤, ⑥, ⑦, ⑧, and ⑨) pertaining to the TCP segment sent from *A* to *E*. Note that the possible frame types are ***ARP Query***, ***ARP Response***, and ***data***.



Frame	*Frame type*	*Source MAC*	*Destination MAC*	*Source IP*	*Destination IP*
①					
②					
③					
④					
⑤					
⑥					
⑦					
⑧					
⑨					

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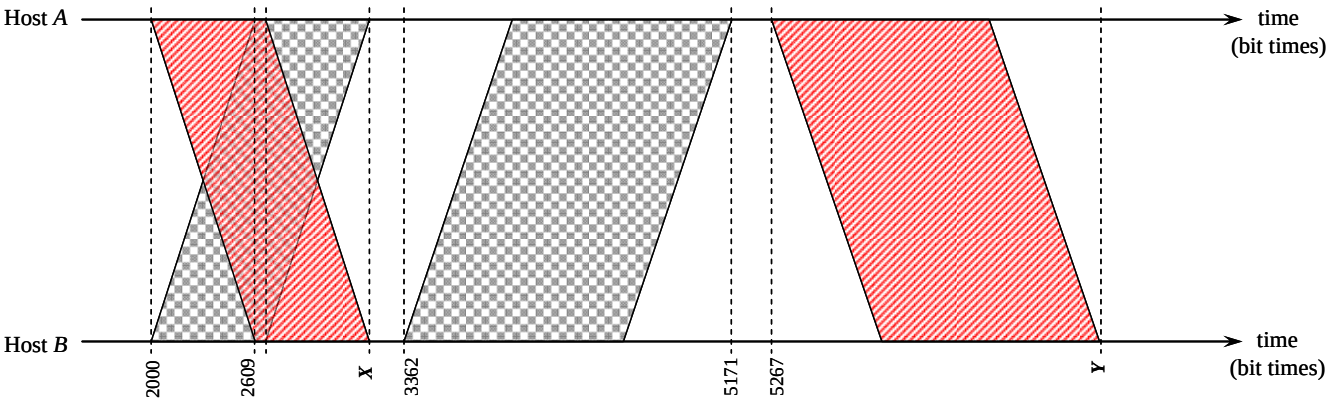
Problem # 4 (28 marks)

Consider the following exchange of Ethernet frames between nodes *A* and *B* over the same Ethernet segment.



Suppose that prior to the beginning of the given exchange, nodes *A* and *B* had a single collision. Suppose further that at time t = 2000 bit times, nodes *A* and *B* each **retransmit** the previously collided frame at the same time. Both *A*'s frame and *B*'s frame are of equal size. Find the following:

1) **(4 points)** The *propagation delay* of the Ethernet segment.

2) **(5 points)** The value of ***X*** in the diagram.

3) **(5 points)** Node *A*'s *transmission time* needed by *A* to successfully retransmit its frame.

4) **(4 points)** The value of ***Y*** in the diagram.

5) **(10 points)** The possible value(s) of K in the CSMA/CD algorithm that node *A* selects (i.e. the possible value(s) of K_A) at the end of the collision shown at the beginning of the given exchange (i.e. after time ***X***).

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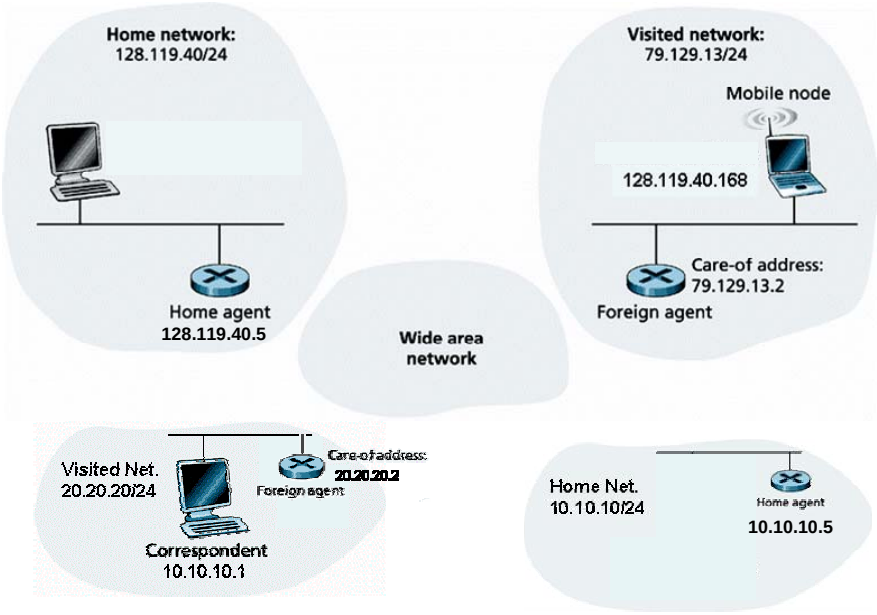
Problem # 5 (12 marks)

Consider the ***Mobile IP*** setup shown in the figure where the correspondent node and mobile node wish to communicate with each other.



Find the following:

1. **(3 points)** The *source* and the *destination* IP addresses included in the **header** of the datagram sent from the correspondent node to the HA of the mobile node.

2. **(3 points)** The *source* and the *destination* IP address included in the **header** of the datagram sent from the HA of the mobile node to the FA of the network visited by the mobile node.

3. **(3 points)** The *source* and the *destination* IP addresses included in the **header** of the reply datagram sent from the mobile node to the HA of the correspondent node.

4. **(3 points)** The *source* and the *destination* IP address included in the **header** of the reply datagram sent from the HA of the correspondent node to the FA of the network visited by the correspondent node.