Name: ___________________
Student #: ________________

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College of Computer Sciences and Engineering
Department of Computer Engineering

COE 344 – Computer Networks (T072)

Major Exam # 02

Date & Time: Sunday May 25, 2008 (8:15 PM – 10:15 PM)

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

Problem #	Mark	Score
1	6	
2	6	
3	20	
4	18	
5	24	
6	26	
Total	**100**	

Problem # 1 (6 points; 1 point each): Mark the following with TRUE or FALSE:

	Statement	*TRUE/FALSE*
1.	Consider congestion control in TCP. When the timer expires at the sender, the ***threshold*** is set to one half of its previous value.	
2.	When an IP datagram is being forwarded from the source host to the destination host the datagram's destination IP address keeps changing to match the IP address of the next interface it has to pass through.	
3.	Since TCP is a connection-oriented transport layer, it can only run over a computer network that provides a "connection" service at the network layer.	
4.	With IP datagram fragmentation, the burden of fragmentation and reassembly is put on the Internet routers and the destination hosts, respectively.	
5.	Assuming that there are always data frames ready to be transmitted by the nodes on the network, taking-turns MAC protocols based on polling eliminate collisions and empty slots.	
6.	Using CSMA/CD in a subnet guarantees that a collision will always be detected regardless of the maximum possible propagation delay that could exist in the subnet.	

Problem # 2 (6 points; 1 point each): For each of the following questions select the most appropriate answer:

i. Suppose that host *A* sends two TCP segments back to back to host *B* over a TCP connection. The first segment has sequence number 90; the second segment has sequence number 110, then the size of data in the first segment is:
   a. 200 bytes
   b. 110 bytes
   c. 90 bytes
   d. 20 bytes
   e. cannot be determined from given information

ii. Suppose that the last `SampleRTT` in a TCP connection is equal to 1 sec. Then the current value of `TimeoutInterval` for the connection will be:
   a. less than 1 sec.
   b. equal to 1 sec.
   c. greater than 1 sec.
   d. cannot be determined from given information

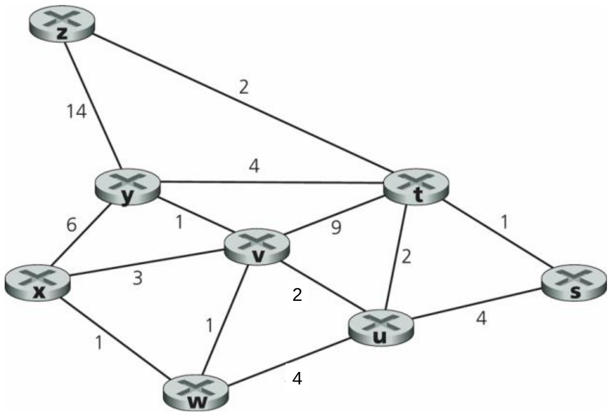
iii. The difference between the TCP *Tahoe* implementation and the TCP *Reno* implementation is related to how each implementation computes the:
   a. `Threshold` of the next round after a loss event due to a triple duplicate ACK
   b. `Threshold` of the next round after a loss event due to a timeout
   c. `Congestion-Window` of the next round after a loss event due to a triple duplicate ACK
   d. `Congestion-Window` of the next round after a loss event due to a timeout
   e. all of the above

iv. Consider a subnet to which ten host interfaces and three router interfaces are attached. Suppose the subnet uses ***CIDR*** addresses. The IP addresses of the 13 interfaces will be identical in the:
   a. most significant 4 bits
   b. most significant 8 bits
   c. most significant 16 bits
   d. most significant 24 bits
   e. most significant 28 bits

v. Suppose there are 3 routers in between a source host and a destination host. An IP datagram moving from the source host to the destination host indexes a total of **____** forwarding table(s).
   a. 1
   b. 2
   c. 3
   d. 4
   e. cannot be determined from given information

vi. The *datagram*-based network layer is responsible for:
   a. path determination
   b. forwarding
   c. call setup
   d. all of the above
   e. both a. and b.
   f. both a. and c.
   g. both b. and c.
   h. none of the above

Problem # 3 (20 points): Consider the following network.



a) **(10 points)** With the indicated link costs, use *Dijkstra*'s shortest-path algorithm, as discussed in class, to compute the shortest path from *w* to all network nodes using the table given below.

N'	*D(s),p(s)*	*D(t),p(t)*	*D(u),p(u)*	*D(v),p(v)*	*D(x),p(x)*	*D(y),p(y)*	*D(z),p(z)*

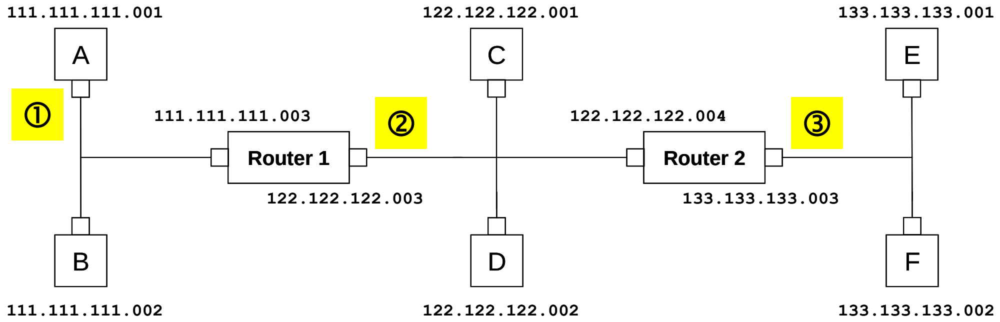
b) **(2 points)** Based on your answer in part a), what is the shortest path to forward traffic from *w* to *s*? What is the total cost of that path?

c) Consider sending a 3000-byte datagram (inclusive of a minimum size header) from a host connected to router *w* to a host connected to router *u* over the least-cost path connecting *w* to *u*. Assume that a link along that path has an MTU of 500 bytes (inclusive of a minimum size header). Find:

   i. **(4 points)** Number of fragments generated.
   ii. **(4 points)** Offsets of the fragments generated.

Problem # 4 (18 points):

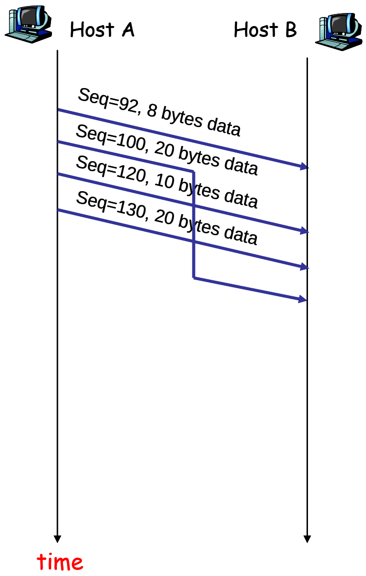
a) **(10 points)** Consider the following IP-based network with the assigned IP addresses as shown.



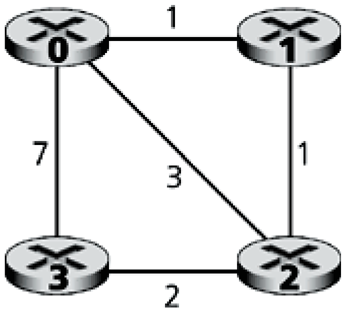
Assume that host A sends an IP datagram to host E, complete the following table for all 3 points shown in the figure (i.e. ①, ②, and ③):

	Source IP address	Destination IP address	IP address that was passed down to Data Link layer
①			
②			
③			

b) **(8 points)** For the following TCP Reno scenario, show the remainder of the traffic exchange (e.g. acknowledgements with sequence numbers, retransmissions with sequence numbers and size of data field, …) assuming that no timeout takes place, time between any two received TCP segments is larger than 500 msec, all segments are received before a retransmission is received.



Problem # 5 (24 points): Consider the following network.



Starting with the initialization step, compute the distance tables for nodes *0*, *1*, *2*, and *3* after each iteration of a synchronous version of the distance vector algorithm using as many of the following tables as needed. Start with the leftmost column of the tables.

cost to

	D^0	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^0	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^0	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^0	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^0	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^1	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^1	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^1	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^1	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^1	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^2	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^2	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^2	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^2	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^2	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^3	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^3	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^3	0	1	2	3
from	0				
	1				
	2				
	3				

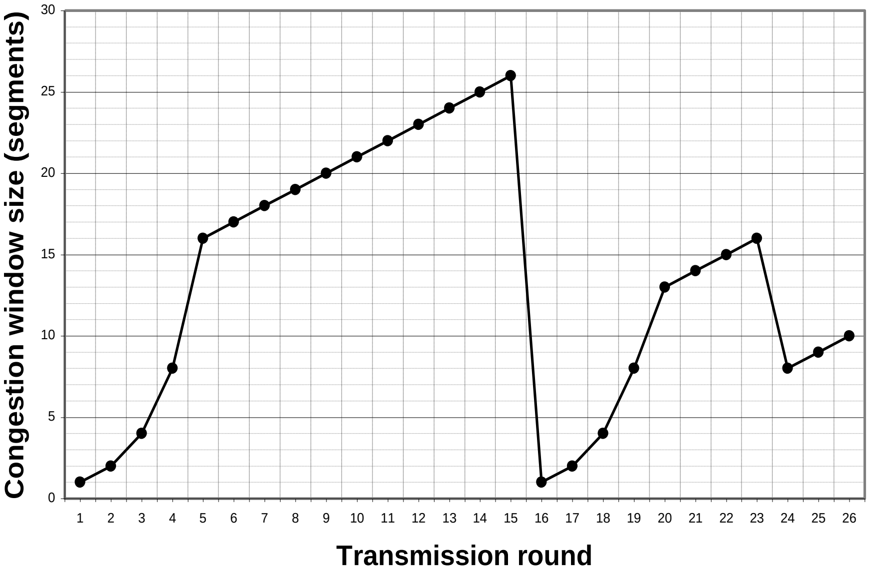
cost to

	D^3	0	1	2	3
from	0				
	1				
	2				
	3				

cost to

	D^3	0	1	2	3
from	0				
	1				
	2				
	3				

Problem # 6 (26 points): Consider the following plot of TCP window size as a function of time.



a) **(2 points)** Identify the intervals of time when TCP *slow start* is operating.

b) **(2 points)** Identify the intervals of time when TCP *congestion avoidance* is operating.

c) **(2 points)** After what transmission round(s) is segment loss detected by a triple duplicate ACK?

d) **(2 points)** After what transmission round(s) is segment loss detected by a timeout?

e) **(2 points)** What is the initial value of `Threshold` at the first transmission round?

f) **(2 points)** What is the value of `Threshold` at the 11th transmission round?

g) **(2 points)** What is the value of `Threshold` at the 18th transmission round?

h) **(2 points)** What is the value of `Threshold` at the 26th transmission round?

i) **(5 points)** During what transmission round is the 70th segment sent?

j) **(5 points)** Assuming a packet loss is detected after the 26th round by a <u>timeout</u>, what will be the values of the congestion-window size <u>and</u> of the `Threshold`?