- **READ THESE INSTRUCTIONS CAREFULLY.**
- Before you begin, **write your USC ID**.
- The exam is closed book and closed notes, all ELECTRONICS should be put away
- Answer the questions *only* in the spaces provided on the question sheets. If you run out of room for an answer, your answer is probably incorrect.
- Your answers do not need to be complete, grammatically correct sentences.
- For some multiple-choice questions, **more than one choice may be correct**. You will receive credit for partial answers.

USC ID: _____

Question:	1	2	3	4	5	Total
Points:	15	6	8	4	12	45
Score:						

1. (a) (2 points) Explain why the timeout value in TCP is not set to RTT.

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Solution: To allow for some packet delay on the network.

(b) (2 points) What is the difference between flow control and congestion control

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Solution: Flow control is the receiver controlling the sender based on the size of the receiver buffer , whereas Congestion Control is the sender sensing congestion on the network by timing ACKs and controlling its sending rate.

(c) (2 points) UDP and TCP are both transport protocols. Name one transport layer feature/role they both provide.

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Solution: Demultiplexing to destination and ports

(d) (2 points) Explain the phrase ”the internet is dynamic” by listing at least two causes for the dynamic behavior.

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Solution: The network is dynamics indicates that the number to active flows and the network path can constantly change with time on the network.

(e) (3 points) A TCP sender uses *implicit* feedback from the network to adjust the sending rate. Give two examples of the implicit feedback.

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Solution: sender get delayed ACKs to indicate congestion or high load on the network sender gets no ACK to indicate sever packet loss sender gets duplicate ACK to indicate loss

(f) (2 points) UDP is a connection-less protocol. True or False? Explain?

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Solution: True, does not maintain any state for the active follows

(g) (2 points) Only one flag can be set in the TCP header of a valid packet. True or False? Explain?

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Solution: False, for connection setup and teardown , SYN and ACK, or FIN and ACK are frequently set together.

2. (6 points) List three types of errors/pathologies created due to a best-effort network layer and briefly explain how each can be corrected by a reliable transport layer.

Solution: Any three: a packet is corrupted (checksum) a packet is lost (retransmitted after timeout) a packet is delayed (retransmitted after timeout) packets are reordered (buffered at received and delivered inorder) a packet is duplicated (ACKed ignored at receiver)

3. An *elephant* flow is an is an extremely large (several MBytes) continuous TCP flow over a network link. Elephant flows are usually compared to *mice* flows that are short (few bytes or KB) TCP connections. Elephant flows usually occupy a disproportionate share of the total bandwidth on a link.

   (a) (2 points) Give one example of an application/application level protocol that generates an elephant flow

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   Solution:
   (a) video/ftp any thing large

   (b) (2 points) Give one example of an application/application level protocol that generates a mice flow

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   Solution: b) any thing small http/short scp/short image/ embedded ads in webpage

   (c) (4 points) Give two reasons why TCP favors elephants over mice.

Solution: (2 pt) connection setup and tear down cost
(2pt) estimating RTT for short flows is not good,

4. (4 points) The white and blue nations are fighting with each other. The White army, WA, is strategically located in a valley that partitions the blue army into two parts namely BA1 and BA2. All communication agents between BA1 and BA2 have to traverse the valley. The communication agent can be captured by the white army when passing through the valley.

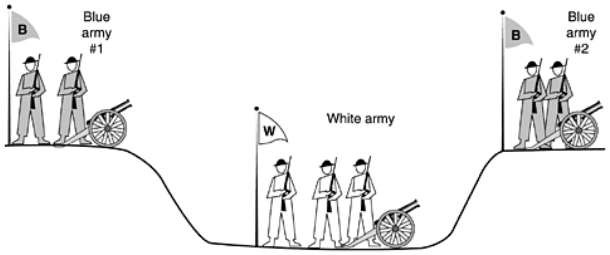
   If both the blue armies can attack together, at the same time, the white army will be defeated.

   Do you think the three-way handshake protocol used in TCP can be used to coordinate and synchronize BA1 and BA2 to attack WA together?

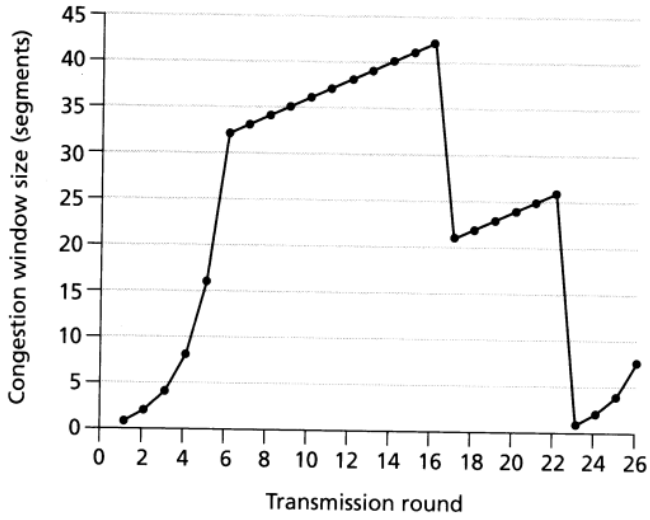
   (**Hint**: Structure the message exchanges between the blue armies. Identify the scenarios and reason out what would happen when each of the messages in the three way handshake is lost)

   Solution:

   4pts No , it would not help since we can never confirm the reception of the messages... How long should we wait for the messages to be received at the other end.



5. For the next set of questions please refer to the diagram below.



(a) (2 points) Identify time intervals where TCP slow-start is operating.

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Solution: TCP slow start is operating in the intervals [1,6] and [23,26]

(b) (2 points) Identify time intervals where TCP congestion-avoidance is operating

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Solution: TCP congestion advoidance is operating in the intervals [6,16] and [17,22]

(c) (3 points) After the 16th transmission round, what causes the drop in the congestion window? Explain.

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Solution: After the 16th transmission round, packet loss is recognized by a triple duplicate ACK.

(d) (2 points) What is the ssthreshold value at the 18th transmission round?

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Solution: The threshold is set to half the value of the congestion window when packet loss is detected. When loss is detected during transmission round 16, the congestion windows size is 42. Hence the threshold is 21 during the 18th transmission round.

(e) (3 points) After the 22nd transmission round, what causes the drop in the congestion window? Explain

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Solution: After the 22nd transmission round, segment loss is detected due to timeout, and hence the congestion window size is set to 1