Name _____

Number _____

Signature _____

> Dear Students, you have **80 minutes**. Please note that there are 20 questions for a total of 20 points on 4 pages. An incorrect multiple-choice answer cancels 0.3 points. One-double-sided A4 cheat sheet is allowed. Please do not leave your sheets unattended. Fill the attached answer sheet clearly. Success.
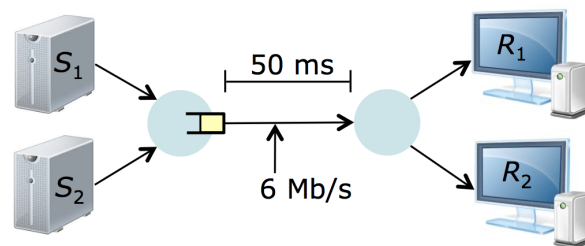

Figure 1: Assume there are two TCP sender/receiver pairs ($S_1 - R_1$ and $S_2 - R2$) as shown in this topology. Notice that TCP counts bytes. The first sender uses **TCP Tahoe**, the second **uses Reno**. Assume that the maximum segment size, **MSS is 1 KB**, that the **one-way propagation delay** for both connections is 50 ms and that the link joining the two routers has a **capacity** of 6 Mb/s. Let cwnd1 and cwnd2 be the values of the senders' **congestion windows**. Assume the receivers have unlimited buffer. Neglect transmission delays.

1. [1 point] Consider the topology given in Figure 1 and the information given in its caption. What is the smallest value of cwnd1+ cwnd2 for which the link joining the two routers stays busy all the time?
   A. 75KB   B. 150KB   C. 37.5KB   D. 300KB

2. [1 point] Consider the topology given in Figure 1 and the information given in its caption. Assume that the link buffer overflows when cwnd1+cwnd2 $\geq$ 150 KB and the latest values of congestion windows were cwnd1=30 KB and cwnd2 = 120 KB where all losses are detected by triple duplicate ACKs. Approximately, what is the value of **cwnd1** one RTT later?
   A. 4KB   B. 0KB   **C. 1KB**   D. 2KB

3. [1 point] Consider the topology given in Figure 1 and the information given in its caption. Assume that the link buffer overflows when cwnd1+cwnd2 $\geq$ 150 KB and the latest values of congestion windows were cwnd1=30 KB and cwnd2 = 120 KB where all losses are detected by triple duplicate ACKs. Approximately, what is the value of **cwnd2** one RTT later?
   A. 30KB   B. 120KB   **C. 60KB**   D. 1KB

4. [1 point] Consider the topology given in Figure 1 and the information given in its caption. Assume that the link buffer overflows when cwnd1+cwnd2 $\geq$ 150 KB and the values of congestion windows were cwnd1=30 KB and cwnd2 = 120 KB where all losses are detected by triple duplicate ACKs. Approximately, what is the value of **ssthresh2** after the triple duplicate ACKs event is detected?
A. 15KB   B. 120KB   **C. 60KB**   D. 1KB

5. [1 point] Consider the topology given in Figure 1 and the information given in its caption. Assume that the link buffer overflows when cwnd1+cwnd2 $\geq$ 150 KB and the values of congestion windows were cwnd1=30 KB and cwnd2 = 120 KB where all losses are detected by triple duplicate ACKs. Assume three duplicate ACK event is detected at t_0 approximately what is the value of **cwnd1** after 8 more RTTs?
A. 15KB   B. 30KB   C. 16KB   **D. 19KB**

6. [1 point] Consider the topology given in Figure 1 and the information given in its caption. Assume that the link buffer overflows when cwnd1+cwnd2 $\geq$ 150 KB and the values of congestion windows were cwnd1=30 KB and cwnd2 = 120 KB where all losses are detected by triple duplicate ACKs. Assume three duplicate ACK event is detected at t_0 approximately what is the value of **cwnd2** after 8 more RTTs?
A. 127KB   B. 120KB   C. 60KB   **D. 68KB**

7. [1 point] The combination of a fast network and long delay is called as **long fat networks**. The statements ... are true for long fat networks.

    I 32-bit sequence numbers wrap quickly.
   II 64-KB flow control window is small.
  III Go-back-N protocol performs poorly on lines.
  IV Lines are delay limited rather than bandwidth limited.

A. I and II only   B. II only   C. 1 and II only   **D. All of them**

8. [1 point] Duplicate ACK in TCP is caused by ...

    I a lost segment.
   II a reordering of segments.
  III uncorrectable (bit) errors in segments.

A. only I   B. only I and II   C. only II and III   **D. All of them**

9. [1 point] Consider a datagram network using 8-bit host addresses. The network administrator assigns addresses from 128/6 to a subnet. About this subnet, the statement that ... is true.

     A. There are 64 interface addresses and the subnet broadcast address is 191

     B. There are 62 interface addresses and the subnet broadcast address is 255

     C. There are 62 interface addresses and the subnet address is 128

     D. None of above

10. [1 point] Which one is not a contiguous mask?
A. 255.255.255.254   B. 255.255.224.0   **C. 255.148.0.0**   D. 255.192.0.0

11. [1 point] ... of the following statements are true.

    I All nodes connected to the Internet must implement UDP.
    II Flow control prevents overflowing the receiver's buffer
    III One RTT is the minimum value of timeout of a reliable transport protocol.
    IV Congestion control prevents overrunning buffers in a network

    A. All of them   B. IV only   **C. II, III and IV only**   D. II and IV only

12. [1 point] Assume that the TCP segments carry the same number of bytes, the receiver has infinite buffer and **other than data packet failures no errors occur**. A data packet fails uniform randomly and independent of others with probability p. If the congestion window size of a TCP sender is 4 segments and the application layer pushes only 4 segments, the probability of receiving three duplicate acknowledgments is ....
    A. $p(1-p)^3$ B. $p^2(1-p)^3$ C. p D. $4p(1-p)^3$

13. [1 point] DNS is **not** used to ....

    A. define alias hostnames

    B. balance server loads

    C. indicate mailservers of domains

    D. associate given IP addresses with their users' names

14. [1 point] 100 Kbit segments are transmitted using stop-and-wait over a **single** 100 Mbps link with one-way propagation delay of 5 ms. Ignore the transmission delay of the acknowledgments, and the processing and queuing delays. Assuming that there are no errors, losses or delays, the link **utilization** is ....
    A. 1/10   **B. 1/11**   C. 1/6   D. 10/11

15. [1 point] In a Go-Back-N protocol, the **oldest** correctly-transmitted segment without ACK has a sequence number equal to 100. The sender has already sent 5 segments from its window. If the timer expires, the sender should retransmit ....

    A. segments 96 to 100

    B. segments 100 to 104

    C. segment 100 only

    D. segments 100 to 109

16. [1 point] In TCP, the **timeout interval** is a function of ....

    A. sample RTT values measured at the sender

    B. the size of buffer at the sender

    C. maximum segment size

    D. the size of buffer at the receiver

17. [1 point] A TCP sender has received an **acknowledgment** with the sequence number 75. This means that . . ..

     A. the sender should send 75 bytes in the next segment

     B. the receiver can accept 75 bytes without overflow in its buffer

     C. the receiver has successfully received the 74th byte with no gap

     D. the receiver has successfully received the 75th byte with no gap

18. [1 point] In **network-assisted** congestion control . . ..

     A. end systems detect congestion only based on observed congestion in the network

     B. end systems use UDP to detect congestion

     C. network core components provide explicit feedback to the sender regarding the congestion state in the network

     D. network edge components provide explicit feedback to the sender regarding the congestion state in the network

19. [1 point] A network on the Internet has a subnet mask of 255.255.240.0. The maximum number of IP-assignable interfaces it can handle is . . .?
A. 2^{20} B. 2^{12} **C. $2^{12} - 2$**   D. $2^{12} - 1$

20. [1 point] The Internet Protocol (IP) is a . . . protocol.

     I reliable
     II connection-oriented
     III best-effort

     A. only (I)   **B. only (III)**   C. only (II)   D. only (I) and (II)