1. (10 pts.) Consider a TCP connection with an initial threshold of 16, in which packets time out on the 6th and 8th transmission round. Explain how big a segment and the threshold are transmitted on each of the first 9 steps. (You might want to draw a graph, and then explain what happens on each individual or group of rounds).

   • step 1: start with a congestion window of 1 and a threshold of 16, hence in slow start mode.
   • step 2-5: doubles the size of the congestion window each step until it reaches 16 (slow start)
   • step 6: congestion window increases by 1 to 17
   • step 7: congestion window reduced to 1, threshold to 8.5 (8 or 9 OK), slow start
   • step 8: congestion window at 2, threshold to 8.5
   • step 9: threshold cut in half (4.5) and congestion window set to 1.

2. (6 pts.) How many steps are there and what happens on each step during the TCP setup handshake.

   ans. TCP uses a 3-way handshake (see figure 3.38)

   (a) SYX bit is set and a sequence number, client.isn, is chosen
   (b) SYN bit is set, client.isn + 1, server initial sequence number is sent server.isn
(c) SYN bit is cleared, client.isn + 1, server.isn + 1

3. (4 pts.) What is flow control and how is it handled in TCP.

ans.

- Flow control ensures that the sender does not overwhelm the receiver.
- Receiver uses field in the TCP packet to advertise the size of its receive buffer. Sender uses this information, subtracts the number of bytes sent beyond the byte the receiver is acking and thus computes a bound on the receive buffer size.

4. (12 pts.) What are the packet errors that can occur in a packet switched network, and how can each error be detected and the compensated for at the transport level?

ans.

- Lost packets: detected with timeouts at the sender because ACKs were never received.
- Corrupted packets: detected with checksums
- Out-of-order packets: detected with sequence numbers
- Duplicate packets: detected with sequence numbers

5. (15 pts.) Write a Java program which has a monitor which will count the number of timer events (expiration of the timers) that have occurred. After each timer event occurs a new timer should be started.

6. (10 pts.) In the algorithm given in assignment 2, in what cases does the algorithm have faster recovery than selective repeat which acknowledges each packet separately.

- If an ACK is lost, successive ACKs can substitute for missing ACKs.
- Reduced ACK traffic

7. (10 pts.) Write a Java server program which will accept a TCP connection, print out the data on the connection, and then close the TCP connection.

8. (10 pts.) In distance vector routing:

(a) What are the types of messages communicated between routers?
(b) Under what conditions are new messages generated?

(a) Minimum know difference between two nodes has changed
(b) When the minimum in a row changes, a message is sent to to each adjacent router

9. (8 pts.) Consider a roundtrip time to a satellite of 1 second. What effect does this have on transport level protocol design?
• Window size
• Receive buffer

10. (8 pts.) What are the components of latency, and how do they effect overall performance.

(a) Processing delay: amount of time to process a packet  
(b) Queuing delay: waiting time  
(c) Transmission delay: use of the interface  
(d) Propagation delay: speed of light issue

Processing delay and transmission delay effect both bandwidth and latency. Queuing and Propagation delay are pure latency issues.

Processing delay and transmission delay are bandwidth consuming. Queuing delay and propagation delay are pure latency, they have no effect on bandwidth.

11. (8 pts.) When would you use an iterative vs. recursive domain name server (DNS).

Iterative servers are used for very busy servers such as the root servers since they decrease load.