1. 
   (a) The sequence number is 409, the source port number is 1028, and the destination port number is 80.
   (b) The acknowledgement number is 409, the source port number is 80, and the destination port number is 1028.
   (c) The acknowledgement number is 359, the source port number is 80, and the destination port number is 1028.

2. 
   (a) Receiver expects $k$, so last 3 ACKs are $k-1$, $k-2$, $k-3$. If none of these ACKs are received by the sender, then the window of sender is $(k-3,k-2,k-1)$. ACK $k-4$ must be received by sender because if it isn’t, packet $k-1$ would not be sent. If all these ACKs are received by the sender, then the window of sender is $(k,k+1,k+2)$. So all possible sets of window are: $(k-3,k-2,k-1)$, $(k-2,k-1,k)$, $(k-1,k,k+1)$, $(k,k+1,k+2)$.
   (b) By the same argument in (a), we know they are $k-1$, $k-2$, $k-3$.

3. 
   (a) 1’s complement sum of the words is 10010010. 1’s complement of the sum = 01101101
   (b) To detect errors, the receiver adds the four words (the three original words and the checksum). If the sum contains a zero, the receiver knows there has been an error.
   (c) All one-bit errors will be detected, but two-bit errors can be undetected (e.g., if the last digit of the first word is converted to a 0 and the last digit of the second word is converted to a 1).
4.

Solution:
   a. GoBackN:
      A sends 9 segments in total. They are initially sent segments 1, 2, 3, 4, 5 and later re-sent segments 2, 3, 4, and 5. B sends 8 ACKs. They are 4 ACKS with sequence number 1, and 4 ACKS with sequence numbers 2, 3, 4, and 5.

      Selective Repeat:
      A sends 6 segments in total. They are initially sent segments 1, 2, 3, 4, 5 and later re-sent segments 2. B sends 5 ACKs. They are 4 ACKS with sequence number 1, 3, 4, 5. And there is one ACK with sequence number 2.

      TCP:
      A sends 6 segments in total. They are initially sent segments 1, 2, 3, 4, 5 and later re-sent segments 2. B sends 5 ACKs. They are 4 ACKS with sequence number 2. There is one ACK with sequence numbers 6. Note that TCP always send an ACK with expected sequence number.

   b. TCP. This is because TCP uses fast retransmit without waiting until time out.

5.

Host A sends data into the receive buffer faster than Host B can remove data from the buffer. The receive buffer fills up at a rate of roughly 50Mbps. When the buffer is full, Host B signals to Host A to stop sending data by setting RcvWindow = 0. Host A then stops sending until it receives a TCP segment with RcvWindow > 0. Host A will thus repeatedly stop and start sending as a function of the RcvWindow values it receives from Host B. On average, the long-term rate at which Host A sends data to Host B as part of this connection is no more than 50Mbps.