# MID-TERM EXAM

**Your Name:** _____

**Your student ID number:** _____

## _Instructions_
- _Allowed_
  - _A single 8 ½"x11" (front and back) study sheet, containing any info you wish_
  - _Calculators_
- _Not allowed_
  - _Books or notes (other than the study sheet)_
  - _PDAs, cellphones, headphones, MP3 players, laptop computers, etc._
- _Length is 75 minutes (entire class period); answer all questions for full credit_
- _A "Yes" or "No" question usually requires a brief (few words or one sentence) explanation_

## THE INTERNET   (7)

1. If you sent a packet across the Internet from Raleigh to California (a distance of about 3000 miles or 5000 kilometers), and an acknowledgment was immediately sent back, roughly how long would you expect this round-trip time to be?

2. What's the difference between an RFC and an Internet Draft? [one sentence answer]

## IPv4  (12)

1. Compute the four-bit Internet checksum of the following two four-bit words:
   1010 and 1011

2. An IP packet, without options, is to be sent across a link with MTU = 560. Some of the fields of this packet's header, before fragmentation, are shown below.  Show what the fields Total Length, MF, and Fragment Offset are for each fragment.

   - Header length = 5, Total length = 1000, Identification = 998
   - Flags: DF=0, MF=0, Fragment offset = 0, TTL = 64

3. Indicated below is a path through a network from host A to host B. Show what is recorded in the IP Record Route options header after receiving this packet. The path is:

- Host A = 192.168.10.25
- First router incoming interface = 192.168.10.26, outgoing interface = 192.168.22.90
- Second router incoming interface = 192.168.22.91, outgoing interface = 192.168.35.70
- Host B = 192.168.35.71

## ARP/RARP  (7)

1. Why does a host making an ARP Request include its *own* MAC and IP addresses in the Request? [one sentence answer]

2. On a computer with IP address 152.14.62.38, I purged the ARP cache (using the "arp -d *" command). Then I "ping"ed host 132.151.6.75, while monitoring network traffic. I observed that my host first used ARP to get the MAC address for IP address 152.14.62.65, and then sent an ICMP Echo Request to 132.151.6.75. Why was the ARP packet necessary? [one sentence answer]

## CLASSFUL ADDRESSES  (6)

1. For each of the following, indicate whether the address shown is a Class A, B, C, or D type class-based address.
   a. 18.18.18.18

   b. 200.200.200.200

   c. 225.225.225.225

2. Networks size
   a. What range of IP addresses are in class B?

   b. How many class B networks are there?

## DATAGRAM FORWARDING  (9)

1. For a host with classful address 192.168.2.205, what destination IP addresses in a datagram on the network will result in this host receiving (and processing) this datagram?

2. Host 192.168.2.15 wishes to send a packet. The entries in host 192.168.2.15's forwarding table are:

| Destination | Next Hop IP Address |
|---|---|
| 192.168.2.0 | (directly connected) |
| 192.168.3.55 | 192.168.2.80 |
| 192.168.3.0 | 192.168.2.40 |
| Default | 192.168.2.50 |
| 192.168.3.35 | 192.168.2.60 |

   a. To what next hop address will 192.168.2.15 send a datagram with destination address 192.168.3.55?

   b. To what next hop address will 192.168.2.15 send a datagram with destination address 192.168.3.65?

   c. To what next hop address will 192.168.2.15 send a datagram with destination address 192.168.3.35?

## ICMP  (10)

1. To what are the Identifier and Sequence Number fields commonly set in Echo Request messages (sent, for instance, by the ping program)?

2. How much of the "offending" IP datagram is included in an ICMP error message?  Is this enough to uniquely identify the offending IP datagram? [one sentence answer]

3. A host receives back an ICMP Timestamp Reply message with values (in decimal):

   - Originating Timestamp = 29,550,000
   - Received Timestamp = 29,542,000
   - Transmitted Timestamp = 29,542,040

   The Timestamp Reply message is received by the host at a time which it records as 29,550,085. What is the sending time, what is the receiving time, and what is the roundtrip time?

## UDP  (9)

1. Would you consider UDP or TCP "better" for the following functions, and why? [one sentence or less for each]
   a. A chat (instant messaging) protocol



   b. Transmission of (interactive) voice calls over IP, with datagram payload size of 40 bytes



2. Suppose you wanted to use UDP to transmit some data to a receiver, with the following modifications:

   - ensure that each datagram is received reliably
   - duplicates are not required to be removed
   - correct delivery order is not needed
   - neither flow control nor congestion control is necessary

   What would need to be added to the UDP header to provide just the reliable delivery, and what behavior would you need to add to the sender and receiver? [one or two sentence answer]




## TCP_I (9)

1. Under what conditions is the persist timer started? [one sentence answer]



2. A and B have established a connection.
   a. B sends Acknowledgment Number 5000 and Window Size 4000.  What sequence numbers (bytes) is A allowed to send at this point?



   b. If B next sends Acknowledgment Number 6000 and Window Size 2000, is there anything wrong with that? Explain. [one sentence answer]



   c. If, instead of the previous, B next sends Acknowledgment Number 5000 and Window Size 12000, is there anything wrong with that? Explain.  [one sentence answer]

**TCP II (9)**

1. After each of the following steps, show what the state of the Server connection and the Client connection are. Initially, the Server connection is in the SYN_RCVD state and the Client is in the ESTABLISHED state.
    a. The server receives an ACK segment


    b. The server sends a data segment


    c. The client receives the data segment


    d. The server application executes a close


    e. The client receives a FIN segment


2. A client C and a server S establish a connection. The initial sequence number is 2000 from C to S and 9500 from S to C. Show the Sequence Number and Acknowledgment Number in each segment sent below, and ignore congestion control and flow control.
    a. C sends SYN segment C1


    b. S sends SYN segment S1, including ACK of segment C1


    c. C sends three 1000-data-byte segments C2 through C4, including ACK of segment S1


    d. S sends 0-data-byte segment S2, including ACK of segment C2


    e. S sends a 1000-data-byte segment S3, including ACK of segment C3



**TCP III (12)**

1. A TCP connection has RTT = 80ms, and MDEV = 60ms.
    a. What is RTO at this point?


    b. If the next segment's acknowledgment comes back 180ms after the segment is sent, what will the new values of RTT, MDEV, and RTO be?

c. If the next segment after this times out (ACK not received), what will RTO be after this occurs?

2. A TCP sender has values cwnd=10 and ssthresh=12 (all values expressed in segments).
   a. What will the new value of cwnd and ssthresh be if the retransmission timer goes off?

   b. Ignore the answer to the previous question (i.e., start from cwnd=10, ssthresh=12). What will be the value of cwnd and ssthresh after 3 duplicate acknowledgments, followed by 1 new acknowledgment, have been received?

**TCP_IV** (10)

1. Window size
   a. For a path with round-trip delay of .3 seconds and a receiver maximum bandwidth of 4 million bytes/second, what is the optimum window size for the receiver?

   b. What values should the receiver put in the Window Size field and the Window Scale option to advertise this window size?

2. The initial sequence number for a connection is 0. The receiver has received bytes 0-1999, 3000-3999, and 5000-8999.
   a. What is acknowledged by the receiver at this point if SACK (selective acknowledgments) is used?

   b. Why is SACK better than normal acknowledgments for this case? [one sentence answer]

*** end of exam ***