NATIONAL UNIVERSITY OF SINGAPORE

SCHOOL OF COMPUTING
MIDTERM EXAMINATION FOR
Semester 2 AY2002/2003

CS2105 Computer Networking I

March 2006 Time Allowed 2 hours

MATRICULATION NUMBER: | | | | | | | | | |

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains TEN (10) questions and comprises NINE (9) printed pages, including this page.
2. Answer **ALL** questions.
3. Write **ALL** your answers in the box provided. Please indicate clearly (with an arrow) if you use any space outside the box for your answer.
4. This is an **OPEN BOOK** examination, but you are only allowed to bring in **one sheet of double-sided A4 size paper** with notes.
5. Write your matriculation number in the space provided above and on top-left corner of every page.

EXAMINER'S USE ONLY		
Question	Mark	Score
Q1-5	5	
Q6	2	
Q7	6	
Q8	3	
Q9	2	
Q10	3	
TOTAL	21	

Part I
Multiple Choice Questions (5 points)

For each of the question below, select the most appropriate answer and **write your answer in the answer box**. Each question is worth 1 point. If none of the answers provided is appropriate, put an `X` in the answer box. If multiple answers are equally appropriate, pick one and write the chosen answer in the answer box. Do NOT write more than one answers in the answer box.

1. Which of the following statements regarding HTTP protocol is FALSE?

   A. It is possible for a browser using HTTP 1.0 to support persistent connection using `Keep-Alive:` field in the header.

   B. Username and password entered in a browser are securely transmitted using `Authentication: Basic` field in the header.

   C. If a browser uses `If-Modified-Since:` field in the HTTP header, the Web server might not explicitly return the content of the file requested.

   D. More than one HTTP persistent connection may be used to download a web page and web objects referenced by the web page.

   E. The `Server:` field in HTTP response header is optional.

   Answer: ☐

2. Consider the following Java code fragment.

```
new Socket("www.example.com", 80)
```

   Which of the following statements about the above code fragment are FALSE?

   (i) The code causes a DNS query for domain name www.example.com to be issued.

   (ii) The code causes a SYN packet to be sent to host www.example.com.

   (iii) The code causes a HTTP request to be sent to host www.example.com.

   (iv) The code causes host www.example.com to open port 80 and listen for incoming connections.

   A. (i) and (ii) only

   B. (ii) and (iii) only

   C. (iii) and (iv) only

   D. (i),(ii) and (iv) only

   E. (i),(iii) and (iv) only

   Answer: ☐

3. Consider the sender's view of the sequence numbers in **Go-Back-N** protocol. Suppose the first sequence number in the sender's window is k, and the last sequence number in the sender's window is $k+3$. Let a packet with sequence number i be p_i. Which of the following MUST be TRUE?

   A. p_k is sent and acknowledge.
   B. p_{k+3} is not sent but is usable.
   C. If p_{k+2} is sent, then p_{k+1} must have been sent.
   D. If p_{k+2} is not sent, then p_{k+1} must not have been sent.
   E. The receiver is currently expecting p_k.

   Answer: ☐

4. Consider a sender and a receiver, communicating using **Selective-Repeat** protocol. The sender just sent a packet with sequence number 10. The window size is unknown. Which of the following CANNOT possibly be the sequence number of the next packet transmitted by the sender?

   A. 0
   B. 9
   C. 10
   D. 11
   E. 12

   Answer: ☐

5. Consider the checksum algorithm used to compute the checksum field in UDP header and TCP header. Although UDP and TCP uses 16-bits words in computing the checksum, in this question you are asked to consider 8-bits summands.

   Suppose a receiver received the following four 8-bit bytes over a communication channel that might introduce errors.

   ```
   1101 1011
   1101 0001
   1001 1011
   1011 0110
   ```

   One of the given byte is the checksum (but I am not telling you which one), and the other three bytes is the data used to compute the checksum. Which of the following MUST BE TRUE?

   A. There are no errors in the received bytes.
   B. There is a one bit error in the received bytes.
   C. There are two bits error in the received bytes.
   D. The last byte `1011 0110` must be the checksum.
   E. The first byte `1101 1011` must be the checksum.

   Answer: ☐

Part II

Short Questions (16 points)

Answer all questions in the space provided. Be succinct and write neatly.

6. (2 points) Consider the following abbreviated output from the command

```
dig a3.nstld.com +trace
```

issued from within NUS.

```
; <<>> DiG 9.2.2 <<>> a3.nstld.com +trace
;; global options:  printcmd
.                       162410  IN      NS      M.ROOT-SERVERS.NET.
.                       162410  IN      NS      A.ROOT-SERVERS.NET.
.                       162410  IN      NS      B.ROOT-SERVERS.NET.
.                       162410  IN      NS      C.ROOT-SERVERS.NET.
;; Received 436 bytes from 137.132.90.2#53(137.132.90.2) in 27 ms

com.                    172800  IN      NS      C.GTLD-SERVERS.NET.
com.                    172800  IN      NS      D.GTLD-SERVERS.NET.
com.                    172800  IN      NS      E.GTLD-SERVERS.NET.
com.                    172800  IN      NS      F.GTLD-SERVERS.NET.
;; Received 490 bytes from 202.12.27.33#53(M.ROOT-SERVERS.NET) in 296 ms

a3.nstld.com.           172800  IN      A       192.5.6.32
nstld.com.              172800  IN      NS      a2.nstld.com.
nstld.com.              172800  IN      NS      c2.nstld.com.
nstld.com.              172800  IN      NS      d2.nstld.com.
;; Received 277 bytes from 192.26.92.30#53(C.GTLD-SERVERS.NET) in 246 ms
```

Give the IP address of

(a) a root DNS server

(b) a top-level domain DNS server

(c) local DNS server

(d) host a3.nstld.com

7. (6 points) Suppose we want to design a stop-and-wait, reliable protocol for communication between a sender S and a receiver R, over a channel with the following characteristics.

   - Packets can be lost from S to R.
   - The channel from R to S is reliable.
   - Neither channel will corrupt a packet (it a packet is received, it must be correct)
   - Neither channel will reorder packets.
   - The maximum RTT between S and R is known and is guaranteed to be D.

   (a) (4 points) For each of the following techniques you learnt in class for building reliable protocol, comment on whether or not, it is needed in the design of the protocol. Justify your answer.

   Acknowledgement

   Negative Acknowledgement

   Timeout

   Sequence Number

(b) (2 points) Using *only* the necessary techniques above, design a stop-and-wait protocol for reliable communication between S and R through the channel with the specified characteristics. Show your design by drawing the FSM for the sender side and receiver side of the protocol. You can use either the C-like notation in the textbook or the pseudocode notation shown in lecture to describe the events and actions in your FSM.

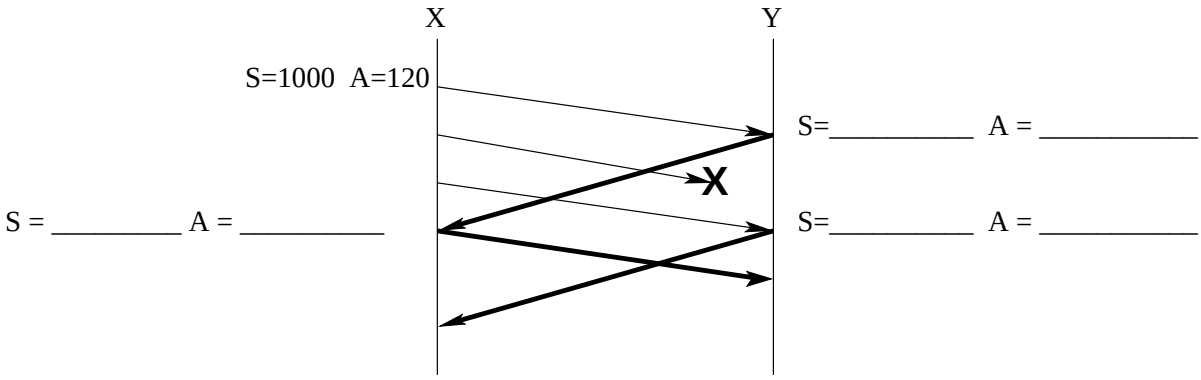
Note that for full credit, your protocol should not only be correct, but should also be as simple as possible.

FSM for Sender:

FSM for Receiver:

8. (3 points) The following figure shows two hosts X and Y communicating over a channel using TCP. X and Y are sending data to each other (recall that TCP supports duplex communications). Each segments contain 100 bytes of data. None of the segments shown in the figure are retransmitted packets, and the second segment send by X is lost.

   The sequence numbers (S) and acknowledgement numbers (A) for some segments (indicated by thicker line) are missing. Complete the figure below by filling in the missing sequence numbers and acknowledgement numbers.



9. (2 points) Two hosts A and B are connected by a link with bandwidth-delay product of P bits and transmission rate of R bps. A sends a packet of size L bits to B.

   (a) Let T be the time between the first bit of the packet leaving A and the last bit of the packet arriving at B. Express T in terms of P, R and L.

   Answer:

   (b) Suppose A and B are using alternating-bit protocol. Assuming no packets are lost, express the link utilization in terms of P, R, and L.

   Answer:

10. (3 points) Two hosts A and B are connected directly through a channel with a propagation delay of 100ms. A is sending a file to B using TCP. The file fits into eight segments, each of size MSS.

    Suppose that:

    - No segments are lost.
    - A starts with a congestion window of 1 MSS.
    - B always has a receiver window of 10 MSS.
    - A has a slow start threshold of 8 MSS.
    - The processing delay, queueing delay and transmission delay of the channel are negligible.

    Ignoring the connection setup time, how long does it take for all eight segments to be *received* at B? Explain your answer.

    Answer:

END OF PAPER