INSTRUCTIONS

1. This is an **OPEN BOOK** assessment.

2. Calculators are allowed, but not laptops or other electronic devices.

3. Answer all the **MCQ questions** by shading the letter corresponding to the most appropriate answer on the OCR form provided. Shade and write down your student number on the **OCR form** as well. You must use a 2B pencil to shade on the OCR form, or the grading machine might not be able to register your shading.

4. Answer all the **short questions** on this question paper, within the space provided in each question.

5. Submit both OCR form and this question paper at the end of the assessment.

Please DO NOT upload questions and answers onto the Internet.

Part I. Multiple Choice Questions (MCQs)

1. Which of the following statement about HTTP is FALSE?

   A. HTTP typically runs on top of TCP.
   B. HTTP is an application layer protocol.
   C. In HTTP/1.0, the server will usually close the connection after every request.
   D. In HTTP/1.1, the default connection type is persistent.
   E. HTTP is only used to download HTML data from a Web server.

2. UDP uses _____ to dispatch incoming packets to different processes in the same host.

   A. multiplexing
   B. de-multiplexing
   C. congestion control
   D. flow control
   E. IP address

3. Which of the following statement about DNS is FALSE?

   A. DNS provides hostname to IP address mapping.
   B. A hostname may be mapped to multiple IP addresses.
   C. All DNS queries must go to the root servers.
   D. DNS servers typically listen to UDP port 53.
   E. Failure to contact DNS servers can cause disruption in access to Internet services.

4. A port number in TCP is _____ bytes long.

   A. 1
   B. 2
   C. 4
   D. 16
   E. 32

5. In a _____ network, data is first divided into manageable chunks before being sent.

   A. connection-oriented
   B. connection-less
   C. circuit-switching
   D. packet-switching
   E. telephone

6. The _____ layer of the Internet protocol stack is responsible for delivering data from sending process to receiving process.

   A. application
   B. transport
   C. network
   D. link
   E. physical

7. In HTTP, a response status code of 404 tells you

   A. Web server is unavailable
   B. Web server is currently busy
   C. your browser needs to be updated to the latest version
   D. the requested Web object is not found
   E. your HTTP request is malformed

8. It's said that a TCP Client/Server connection formation is "asymmetric" because a TCP server must exist before a TCP client can communicate with it. What can be said about UDP-based connection formation?

   A. A UDP client may send data to a non-existing UDP server without noticing that server is offline.

   B. A UDP server must exist before a client can send data to it. Otherwise client will encounter an exception.

   C. A UDP client and server must exchange control information before the client can send data to the server.

   D. Two UDP clients on one host cannot communicate with the same UDP server at the same time.

   **E.** None of the above

9. Consider the following Java code snippet.

```
Socket socket = new ServerSocket(2105).accept();
```

   What port number is `socket` bound to when above statement finish execution?

   A. It depends on the client's port that's making the connection.

   B. TCP port 2105

   C. Cannot say; it's operation system dependent and is usually a randomly chosen port.

   D. UDP port 2105

   E. None of the above

10. A huge file is transferred over an existing TCP connection (i.e., 3-way handshake is already done). The connection is still open after transmission. The first and last TCP segments have the sequence numbers 12,345 and 2,105 respectively. MSS is 1,024 bytes and TCP sends as much data as possible in a segment.

    How many TCP segments are used to transfer the file, assuming the communication channel is perfectly reliable?

    A. 10

    B. 4,194,294

    C. 4,194,303

    D. 33,554,360

    E. 8,388,599

11. The following diagram 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 bi-directional communications). Each segment contains 100 bytes of data. None of the segments shown in the figure are retransmitted packets, nor are they corrupted. However, the second segment send by **Y** is lost.
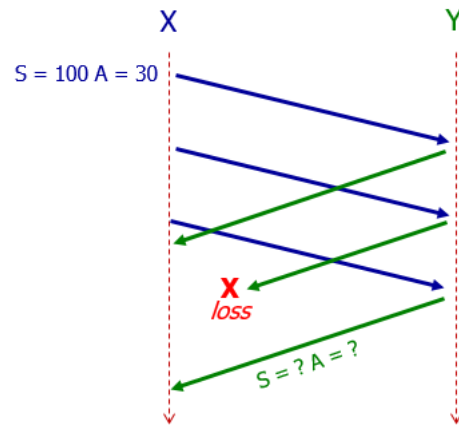
What is the sequence number (S) and acknowledgement number (A) in the last segment send by Y?

A. S = 300, A = 130

B. S = 130, A = 300

C. S = 400, A = 230

D. S = 230, A = 400

E. S = 230, A = 300

12. Consider a sender and a receiver communicating using Selective Repeat protocol. Every packet embeds a 3-bit sequence number field. Sender just sends a packet with sequence number 6. Sender's window size is 3.

Which of the following CANNOT possibly be the sequence number of the next packet transmitted by sender?

A. 0
B. 2
C. 4
D. 5
E. 6

13. A sender and a receiver communicate over an unreliable channel of the following characteristics: **packets may be lost or delayed for arbitrarily long time but won't be corrupted or reordered**.

    We would like to design a stop-and-wait, NAK-free protocol called rdt 4.0 to ensure reliable transmission. In rdt 4.0, sender keeps a timer for a sent but unacknowledged packet. When timer expires, sender deems the packet is lost and will retransmit it.

    You are to design other features of rdt 4.0 to make it a reliable protocol for the given scenario. The features you design must not conflict with the features/specifications given above.

    Which of the following statement about your rdt 4.0 is TRUE?

    A. Receiver may receive duplicate packets. However, receiver should simply ignore duplicate packets and do not send ACKs.

    B. Receiver must maintain a timer for the ACK sent. If no packet arrives before timer expires, receiver should retransmit the ACK.

    C. Sender must resend data packet if a duplicate ACK is received.

    D. Sender won't receive duplicate ACKs at all.

    E. None of the above

Part II. Short Questions

Write your answer in the box provided in each question. There is no need to show your working.

14. Suppose two hosts are connected by a direct link of 1 Mbps. A stop-and-wait protocol is used to transfer 10 packets from the sending host to the receiving host. Each packet is 1000 bytes long. RTT is 24 milliseconds. No packet is lost or corrupted during transmission and ACK packets are of negligible size.

    What is the throughput of the transmission (**in Mbps**)?

15. Two hosts **A** and **B** are connected by a router **R** as shown in the following diagram.

```
        link 1                link 2
┌───┐             ╭───╮             ┌───┐
│ A │─────────────│ R │─────────────│ B │
└───┘             ╰───╯             └───┘
```
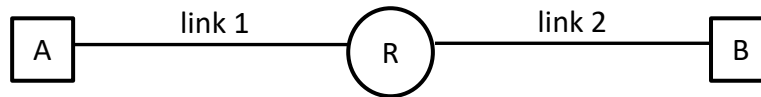
For link 1, link transmission rate is 1 Kbps and propagation delay is 100 milliseconds. For link 2, link transmission rate is 250 bps and propagation delay is 150 milliseconds. Suppose Host **A** sends 2000 packets to Host **B** continuously and each packet is 500 bits long. Host **A** starts sending the 1st packet at time $t = 0$.

When (**in seconds**) will Host **B** receive the kth packet ($1 \le k \le 2000$)?

Please DO NOT upload questions and answers onto the Internet.

Suggested answers

1. E	6. B	11. D
2. B	7. D	12. B
3. C	8. A	13. E
4. B	9. B	14. 0.25
5. D	10. E	15. 0.75 + 2k