

**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 Client/Server paradigm is TRUE?
  - A. Client must always be alive.
  - B. Server offers service while client requests for service from server.
  - C. Only server can transmit data to client.
  - D. Only client can transmit data to server.
  - E. Server must run either DNS or HTTP protocol.
2. A UDP server needs only one socket to communicate with  $n$  different clients simultaneously. How many sockets would a TCP server have ever created for the same situation?
  - A. 1
  - B.  $n$
  - C.  $n+1$
  - D.  $2n$
  - E. None of the above

3. Which of the following is the most appropriate description of the service provided by UDP?
  - A. Process-to-process communication
  - B. Host-to-host communication
  - C. End-to-end reliable data delivery
  - D. Guarantee on minimal throughput and timing
  - E. Connection-oriented multiplexing and de-multiplexing
  
4. Which of the following is a correct description of `nslookup`?
  - A. It is used to check network connectivity to destination host.
  - B. It is used to trace the network path between source and destination hosts.
  - C. It is used to show network configuration of a host.
  - D. It is used to find the DNS mapping between hostname and IP address.
  - E. None of the above
  
5. Which of the following statement is TRUE when a packet containing application message is passed from router *A* to router *B* in the Internet?
  - A. Upon arrival, the packet may be discarded by *B* if *B*'s buffer is full.
  - B. *A* and *B* must establish a TCP connection before the packet is transmitted.
  - C. *A* may pass the packet to *B* through a UDP connection.
  - D. Circuits must be reserved before *A* can pass the packet to *B*.
  - E. None of the above
  
6. Consider sending a sequence of packets from a host in NUS to another host in NTU. Packets may be of different length but all go through the same route to the destination. Which of the following end-to-end delay component is a constant (i.e. doesn't vary from packet to packet)?
  - A. Queueing delay
  - B. Transmission delay
  - C. Propagation delay
  - D. Processing delay
  - E. None of the above
  
7. Which of the following is a VALID subnet mask?
  - A. 255.254.255.0
  - B. 255.255.208.0
  - C. 255.240.0.0
  - D. 255.232.0.0
  - E. 127.0.0.0

8. In a client/server connection using HTTP over TCP, if multiple objects are sent over the same TCP connection, then this connection is classified as \_\_\_\_\_.
- A. stateless
  - B. stateful
  - C. conditional
  - D. persistent
  - E. non-persistent
9. Which of the following statement about TCP initial sequence number (ISN) is TRUE?
- A. ISN is increased by 1 after sending every TCP segment.
  - B. In bi-directional communication, both directions of communication must choose different ISNs.
  - C. ISN determines the amount of data that can be transmitted over TCP.
  - D. ISN is randomly chosen between  $[0, 2^{32}-1]$ , both inclusive.
  - E. None of the above
10. **Telnet** protocol allows a user to establish a TCP connection to a remote server. Consider the following command.

```
telnet www.nus.edu.sg 80
```

Which of the following statement is TRUE?

- i. The command causes a DNS lookup for the IP address of **www.nus.edu.sg**.
  - ii. The command causes a SYN packet to be sent to **www.nus.edu.sg**.
  - iii. The command causes a HTTP request to be sent to **www.nus.edu.sg**.
  - iv. The command causes host **www.nus.edu.sg** to open port 80 and listen for incoming connections.
- A. (i) only
  - B. (i) and (ii) only
  - C. (i), (ii) and (iii) only
  - D. (ii), (iii) and (iv) only
  - E. (i), (ii) and (iv) only

11. Consider a sender and a receiver communicating using **Selective Repeat** protocol. After transmitting for a while, the first and the last sequence numbers in the sender's window are  $k$  and  $k+3$  respectively. Let a packet with sequence number  $i$  be  $p_i$ . Which of the following statement MUST be TRUE?
- A.  $p_k$  is sent and acknowledged.
  - B. If  $p_{k+2}$  is not sent,  $p_{k+1}$  is also not sent.
  - C. Receiver is currently expecting  $p_k$ .
  - D. If  $p_{k+3}$  is sent, it is still unacknowledged.
  - E. None of the above
12. A **Go-Back-N** sender just receives an ACK packet with sequence number 14. This ACK number falls within sender's window. Sender's window size is 6. Every packet embeds a  $k$ -bit sequence number field ( $k$  is an unknown constant). Which of the following definitely CANNOT be the sequence number of the next packet transmitted by the sender?
- A. 9
  - B. 4
  - C. 15
  - D. 19
  - E. 20
13. Consider sending a packet over a path from node 0, through nodes 1, 2, ..., till node  $K+1$ . The links, from node  $i$  to node  $i+1$ , for  $i = 0, 1, \dots, K$  each has the same link transmission rate  $C$  (in bits/s) and propagation delay  $p$  (in seconds). The packet has  $h$  header bits and  $L$  data bits.
- The delay  $D$  of a packet from node 0 to node  $K+1$  is defined to be the duration from when the last bit of the packet leaves node 0 to when the last bit of the packet arrives at node  $K+1$ . Suppose the delay also includes a processing time of  $q$  seconds in each of the nodes 1, 2, ...,  $K$ . The processing time includes the waiting time in the queue.
- Which of the following formula correctly gives the delay  $D$  of a packet travelled from node 0 to node  $K+1$ ?
- A.  $D = p + K[(L + h)/C + p + q]$
  - B.  $D = (K + 1)[(L + h)/C + p + q]$
  - C.  $D = p + K[(L + h)/C] + (K + 1)q$
  - D.  $D = (K + 1)p + K[(L + h)/C] + q$
  - 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. A file of size 9990 bytes is transferred over a TCP connection. The connection is still open after file transmission. MSS is 1000 bytes and TCP sends as much data as possible in a segment. TCP also adds 20 bytes header to each segment.

What is the size of the last TCP segment?

15. What is the checksum (1's complement of the sum) of the following 3 bytes?

11110100

10010101

11011101

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### Suggested answers

1. B

2. C

3. A

4. D

5. A

6. C

7. C

8. D

9. D

10. B

11. E

12. A

13. A

14. 1010

15. 10010111