Student Number:

SCHOOL OF COMPUTING AND INFORMATION SYSTEMS

COMP30023 Computer Systems

June Assessment 2018

Writing Time 2 hours.
Reading Time: 15 minutes.
Marks Available: 60 marks.
Length: This paper has 11 pages including this cover page.
Authorized Materials: None.

Instructions to Invigilators: Students will write all of their answers on this test paper. Students may not remove any part of the test paper from the examination room.

Instructions to Students: This paper counts for 60% of your final grade. All questions should be answered in the spaces provided on the test paper.

Part A 10 $\times$ 1 mark multiple choice questions

Part B 10 $\times$ 2 marks short answer questions

Part C 4 short answer questions worth a total of 15 marks

Part D 4 short answer questions worth a total of 15 marks

You may make rough notes, and prepare draft answers, on the reverse of any page, and then copy them neatly into the boxes provided. The number of ruled lines in the box under each question provides an indication as to the maximum length of the expected answer. Dot point answers are acceptable.

Calculators: Calculators are not permitted.

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Part A 10	**Part B** 20	**Part C** 15	**Part D** 15

Part A (10 marks).

Pick the most appropriate answer to each of the following questions. Please write your answer to each of the questions in the boxes below.

Question	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Answer										

1. The IP address of your machine is given as 192.168.44.38/16 what is the network address?

   (a) 192.16.0.0
   (b) 192.168.0.0
   (c) 192.168.1.1
   (d) 192.168.255.255

2. IP multicasting allows

   (a) the sharing of an IP address to provide redundancy
   (b) packets to be sent via different routes to the same destination
   (c) a one-to-many communication for sending packets
   (d) a single host to concurrently respond to different requests

3. The purpose of congestion control is

   (a) to avoid overloading the recipient
   (b) to avoid overloading the sender
   (c) to keep senders within service plan limits
   (d) to avoid overloading the network

4. What is the purpose of the Address Resolution Protocol?

   (a) to discover where an IP address is, in order to route traffic to it
   (b) to translate an IP address into a MAC address
   (c) to automatically allocate IP addresses to new hosts
   (d) to discover the cost of different routes to an IP address

5. The 802.11 WiFi standard is an example of a

   (a) acknowledged connectionless service
   (b) unacknowledged connectionless service
   (c) acknowledged connection-oriented service
   (d) unacknowledged connection-oriented service

6. A half-duplex connection permits

   (a) each party to only use half the bandwidth
   (b) communication in only one direction
   (c) only one party to communicate at a time
   (d) both parties to communicate at the same time

7. When a hub receives an ethernet frame it

   (a) reads the frame and sends it to the destination MAC address
   (b) reads the IP address and sends it to the next appropriate router
   (c) sends it only to the next hub it is connected to
   (d) sends it to all connections except the one it came in on

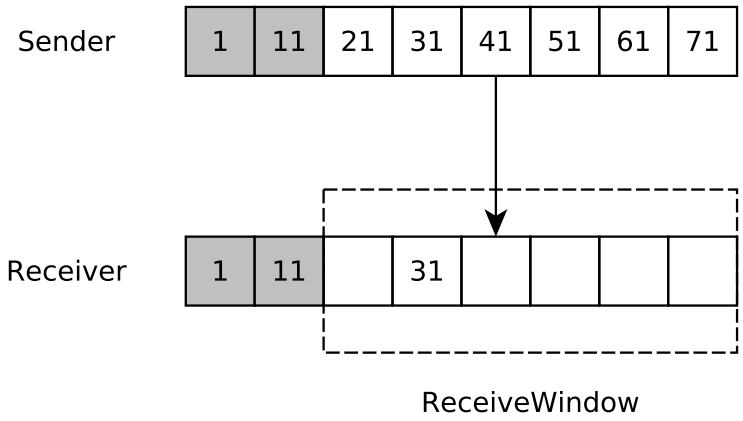
8. Which of the following statements best describes asymmetric cryptography?

   (a) it involves two keys, one for encryption, one for decryption
   (b) it involves one key, which is used for both encryption and decryption
   (c) it does not use keys, instead using cryptographic hash functions
   (d) it involves one key that is shared by two parties

9. When using the Advanced Encryption Standard (AES), why should you not use the Electronic Codebook (ECB) mode?

   (a) it uses a weak source of randomness that allows key recovery attacks
   (b) repeating patterns in the plaintext will be evident in the cipher text
   (c) it is an old standard that use key sizes that are too short
   (d) the codebook is predictable and therefore keys can be guessed

10. The following image depicts a sender and receiver using the TCP sliding window protocol. Segments are 10 bytes in size, segments with Sequence Numbers of 1 and 11 have been successfully sent, acknowledged, and read by the receiver. The segment with Sequence Number 21 has yet to arrive (you can assume it has been lost). The dashed rectangle depicts the receivers current ReceiveWindow. What ACK and WindowSize values will the receiver send on receipt of the segment with Sequence Number 41?



(a) ACK=41, WindowSize=60

(b) ACK=41, WindowSize=40

(c) ACK=31, WindowSize=50

(d) ACK=21, WindowSize=60

Part B (20 marks).

1. List two of the design principles that were followed by the designers of the Internet Protocol (IP)? [2 marks]

2. What is the Time To Live (TTL) value used for in an IPv4 header, and why is it needed? [2 marks]

3. List two possible solutions to congestion control. [2 marks]

4. Network Address Translation is widely deployed, list two common criticisms of it? [2 marks]

5. In the slow-start congestion control algorithm, where the sender starts by sending one segment, what is the maximum number of unacknowledged segments that the sender can have in the network after receiving 4 ACKs. You can assume there is no packet loss. [2 marks]

```c
FILE * fp;
fp = fopen("largefile.jpg", "r");
char resp_buffer[BUFFER_SIZE];
char read_buffer[BUFFER_SIZE];

strcpy(resp_buffer, "HTTP/1.0 200 OK\r\n");
strcat(resp_buffer, "Content-Type:image/jpeg\r\n\r\n");

if (fp == NULL) {
  perror("Error opening file");
  return (-1);
}
fread(read_buffer, sizeof(read_buffer), 1, fp);

strcat(resp_buffer, read_buffer);
fclose(fp);

//write resp_buffer to client
```

6. The C source code extract above shows part of an HTTP server response function. List two errors in the code, you can assume that `BUFFER_SIZE=100000`. [2 marks]

7. How is Quality of Service (QoS) supported in the connectionless Internet Protocol (IP), and provide one argument for why it is important? [2 marks]

8. List two differences between using `fork` and `pthread_create` to achieve concurrency. [2 marks]

9. Consider a system with 32-bit logical addresses, and 24-bit physical addresses. The system uses paging to manage memory. A page frame holds 32KB (2^{15} bytes). What is the maximum number of entries in the page table (You may give you answer as a power of 2, i.e. 2^n)? [2 marks]

10. When a TCP socket is closed it enters a TIME WAIT state, briefly explain what that is and why it is important. [2 marks]

Part C (15 marks).

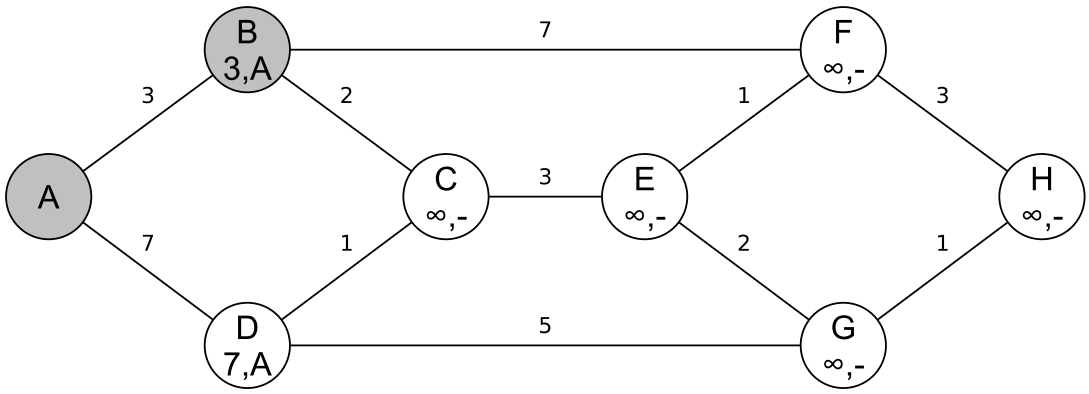
1. Traceroute provides a way of mapping the route a packet takes. State which message types of the Internet Control Message Protocol it uses, and briefly describe how it works? [4 marks]

2. Compare and contrast how IPv4 and IPv6 handle fragmentation. [4 marks]

3. A University has decided to livestream its lectures across its internal, private, campus network. You've been asked to recommend what network services and protocols they should use, and provide a brief explanation to justify your recommendations? [4 marks]

4. The University decides it also wants to offer an archive of past lectures, how would your recommendations differ from above for this additional service? [3 marks]

Part D (15 marks).



1. The above diagram depicts the network as seen by Router A. Having gathered the information, Router A has started to run Dijkstra's shortest path algorithm to find the shortest path between the routers. The shading indicates nodes that have been made permanent, and won't change. The current working node is Node B. Continuing from Node B, use the information in the diagram above to apply the shortest path algorithm and calculate the shortest path between each Router and Router A. List the values each node will end up with in the table below, the values for B and A have been completed for you: [5 marks]

A	**-**
B	3,A
C	
D	
E	
F	
G	
H	

2. What are the two forms of Network Discovery used by WiFi, and how do they differ? [2 mark]

3. With reference to WiFi Network Discovery, ARP, DNS, and HTTP, propose how an attacker could compromise a device's connection, when that device has a saved Open WiFi network in its list of connections, has WiFi on, and is set to auto-connect to saved networks. [5 marks]

4. TLS can provide secure connections over open/unsecured networks, including Open WiFI networks. Briefly explain, at a high-level, how TLS works. In doing so, provide one example of how TLS is not a perfect solution. [3 marks]