



SUBJECT: **Computing**
DATE: 11th December 2020
TIME: 9:00 a.m. to 12:05 p.m.

Directions to Candidates

Answer **ALL** questions in Section A and **ONE** question from Section B.

- Good English and orderly presentation are important.
- All answers are to be written on the booklet provided.
- The use of flowchart templates is permitted but calculators may **not** be used.

SECTION A

Answer ALL questions in this section.

1. The operating system on your laptop or mobile devices implements various features that enable it to handle your devices as well as your software needs.
 - a. Fill in with **ONE** of these terms:

schedules

interrupts

polls

An application program often requests certain services from the operating system. These are known as software _____. (Write your answer on the booklet provided.) (1)

- b. How does the technique mentioned in part (a) impact Operating System performance? (1)
- c. Describe a factor considered when allocating device priorities. (1)
- d. Reducing *latency* in *interrupt-intensive* apps is even more important on a Real Time Operating System (*RTOS*) than your laptop's operating system. Explain the terms in italics. (3)

(Total: 6 marks)

Please turn the page.

2. Networking is at the heart of the modern computing experience, connecting out systems to global information systems and our devices to each other.

a. Networks can be classified as PANs, LANs, MANs and WANs. The type of cabling used in the networks is one aspect in which they differ. Name **ONE** other aspect in which these types of network differ from each other. (1)

b. Which of the above types of network would you associate with the following situation? Briefly explain your answer. (2)

When Tom sits at his desk, the proximity of his watch automatically unlocks his laptop.

c. Which of the following are you most likely to find being used on a WAN? Briefly explain your answer.

Twisted pair

Coaxial cable

Optical Fibre

(2)

d. Explain why a mesh topology is ideal for use on a WAN. (1)

(Total: 6 marks)

3. In the Spring and Summer of 2020, the Covid-19 reality made remote working the only viable solution for many companies. However, not all companies transitioned smoothly and some companies lagged behind for one or more reasons.

a. Suggest **TWO** ways in which some companies may have been kept from switching effectively to remote working. (2)

b. During lockdown, e-commerce also shot upwards. Once more we saw certain companies rising immediately to the occasion and others lagging behind. Name and briefly describe **ONE** factor that can make a company more competitive in e-commerce. (1)

c. As education also moved online, remote learning took many forms, including online live lessons, recorded sessions etc. Suggest **ONE** way in which some schools made the transition smoother for students. (1)

d. With the sudden and unexpected shift to online working, some services that had up to then run smoothly slowed down and at times were down entirely. Suggest **ONE** possible reason for this. (1)

e. Technology also helped us keep track of the pandemic, following the situation both abroad and in our own country. Case statistics were available and updated nearly in real-time on certain websites. However, health authorities did not publish personal information about patients, including name, surname, address etc. Name the legislation that dictated this. (1)

(Total: 6 marks)

4. A gym is introducing a new online system that allows clients to manage their memberships and book sessions via the gym's website.
- The new system is being introduced by a direct changeover. Suggest **ONE** reason why the analyst proposed this type of changeover. (1)
 - Name **ONE** other changeover method and briefly outline an advantage this changeover could offer. (2)
 - Following implementation, the system was monitored for a while to ensure that the system does satisfy all documented user requirements. Name this stage in the system lifecycle. (1)
 - If a year down the line, the gym starts offering classes, the system will require maintenance to be updated accordingly. This is known as adaptive software maintenance. Name and briefly describe another type of maintenance that could be needed. (2)
- (Total: 6 marks)**
5. Read Buddy is an application designed to motivate users to read more. One feature on this app is Take Reading Challenge, a feature that asks the user to enter the number of pages he reads in 10 minutes (pages), the number of minutes he will commit to reading each week (minutes) and the number of weeks for the challenge (weeks).

The system will then output the number of pages the user will read if he commits to his challenge according to the formula:

$$\text{Pages read} = \text{pages}/10 * \text{minutes} * \text{weeks}$$

This is part of the code written to implement the above:

```
class Buddy{
    double x;
    int y, z;
    ...
    int takeReadingChallenge(double x, int y, int z){
        int pages = x/10 * y * z;
        return pages;
    }
    void takeChallenge(){
        ...
        System.out.println("You will read:" +
            takeReadingChallenge(x,y,z) + "pages");
        ...
    }
    ...
}
```

This question continues on next page.

a. Explain why this line will give an error:

```
int pages = x/10*y*z; (1)
```

b. The application needs to output pages read as a whole rather than a fractional number. Explain why typecasting can solve the above issue. (1)

c. Implement typecasting to solve the issue identified in part (a). (2)

d. Explain which of the following changes to this line:

```
int takeReadingChallenge(double x, int y, int z){
```

(if any) would result in an error and briefly explain your answer.

i. `int takeReadingChallenge(double pages, int minutes, int weeks){`

ii. `int takeReadingChallenge(int x, int y, int z){`

(2)

(Total: 6 marks)

6. a. What are the roles of DML and DDL in a Database Management System? (2)

b. Give **ONE** advantage and **ONE** disadvantage of the Relational Database model when compared to a Flat Database. (2)

c. Briefly describe the importance of Normalisation in Relational Databases. (2)

(Total: 6 marks)

7. a. What is modulation? Why is modulation important in the world of communication? (2)

b. Mention **ONE** modulation technique. (1)

c. Mention **ONE** popular device that part of its role is to perform modulation. (1)

d. To which aspect of communication is bandwidth associated with? (1)

e. What are the units used to measure bandwidth? (1)

(Total: 6 marks)

8. a. Draw the Karnaugh Map for this truth table and derive the minimised boolean expression. (2)

A	B	C	OUT
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	0

- b. Use **ONE** Boolean algebra law to further minimise the expression obtained in part (a) and name the law used. (2)
- c. Draw the logic circuit for the expression obtained in part (b). (2)

(Total: 6 marks)

9. For this question consider the following class, which implements a method that sorts an array of integer numbers passed as a parameter:

```
public class SortUtils {
    public static void sort (int a[]) {
        int t;
        for (int j=1; j < a.length; j++) {
            for (int i=0; i < a.length-1; i++) {
                if(a[i] > a[i+1]) {
                    t = a[i];
                    a[i] = a[i+1];
                    a[i+1] = t;
                }
            }
        }
    }
}
```

- a. Given the array {12, 7, 2, 15, 6, 0, 1}, dry run the above code and write down the contents of the array after performing 3 iterations of the outer loop (the one controlled by counter j), showing the contents of array a at each iteration. (3)
- b. Which sorting algorithm is being used here? (1)
- c. You might have noticed while dry running the code that this algorithm requires a small change to make it a more efficient implementation of the sorting algorithm you mentioned in part (b).
- Why is the code **not** so efficient? (1)
 - What change should be done to the code to make it more efficient? (1)

(Total: 6 marks)

10. a. The OSI model uses a number of layers to describe how data travels over a network. For each of the following features, write down the layer in the OSI model to which they belong:
- IP Addressing; (1)
 - Cabling and Network Topologies; (1)
 - HTML and FTP. (1)
- b. Name another popular network model other than the OSI model. (1)
- c. A communication system uses even parity. Data is sent as 8-bit data words using 7 bits for the character and 1 bit for parity. Write down the contents of the parity bit for the following binary patterns:
- 1000110; (1)
 0110011. (1)

(Total: 6 marks)***Please turn the page.***

Section B

1. The following is a simple Assembly Language program

```

MOV R1, 99      Set the value in R1 to 99
MOV AX, R1     Set the value in the Accumulator to the value in R1
MOV R2, AX     Set the value in R2 with the current value in the Accumulator
DEC AX        Reduce value in accumulator by 1
repeat: MOV R1, AX Set the value in R1 to the current value in the Accumulator
ADD AX, R2    Add the value in R2 to the value in the Accumulator
MOV R2, AX   Set the value in R2 to the current value in the Accumulator
MOV AX, R1   Set the value in the Accumulator to the value in R1
DEC AX      Decrement the value in the Accumulator
JNZ repeat  Jump to repeat if the value in the Accumulator is not zero

```

- a. Identify **ONE** label in the above code. (1)
- b. Explain the function of the above code, clearly noting the role of R1 and R2. (2)
- c. Why are Assembly programs faster to execute than higher level languages? (1)
- d. The speed with which programs are executed does not only depend on the programming language being used but also on the hardware itself. Name **TWO** CPU characteristics that can impact speed and briefly describe how they impact performance. (4)
- e. Other elements of a computer system contribute to the performance of our system. One of these elements is RAM. Name **TWO** features common to **all** types of RAM. (2)
- f. Mention **TWO** differences between SRAM and DRAM. (1)
- g. Suggest, with a reason, **ONE** use for each of SRAM and DRAM. (2)
- h. Registers are very fast computer memory which are used to execute programs and operations efficiently. Briefly explain the role of the MAR and MDR in the fetch-execute cycle. (2)
- i. Distinguish between special-purpose and general-purpose register. Give an example of each from the above code. (3)
- j. Identify the role of AX in **ONE** of the instructions in the above assembly code. (Clearly indicate the instruction you are describing.) (1)
- k. Answer **True** or **False** for each of the following statements. (1)
 - i. The Current Instruction Register holds the address of the next instruction.
 - ii. The Carry Flag contains the carry of 0 or 1 from a high-order bit after an arithmetic operation.

(Total: 20 marks)

2. Consider the following Java Class that contains one method:

```
public class BinaryUtils {
    public static int [] toNegative (int bin []) {
        int st = 7;
        int res [] = new int [8];

        // section 1
        while (st > 0 && bin[st] == 0) {
            res [st] = bin[st];
            st--;
        }
        res[st] = bin[st];
        st--;

        // section 2
        while (st >= 0) {
            res[st] = 1 - bin[st];
            st--;
        }

        // return the converted binary number
        // as an array of type int
        return res;
    }
}
```

The purpose of this method is to convert a given binary number to negative representation.

a. A programmer using this method includes the following code in his main program:

```
int num [] = {0,0,0,1,1,0,0,0};
int bin [] = BinaryUtils.toNegative(num);
```

Which decimal number is stored in array num? (1)

b. Dry run the method `toNegative()` and write down the contents of the array `res` after:

i. Section 1; (2)

ii. Section 2. (2)

c. Referring to the code in part (a) what result is returned in array `x` by the `toNegative()` method if the following call is made after the second statement:

```
int x [] = BinaryUtils.toNegative(bin); (1)
```

d. Which method of representing negative numbers is this algorithm using? (1)

e. What is the maximum number of bits that can be processed by the method `toNegative()`? (1)

f. What is the range of decimal numbers that can be represented using the number of bits in part (d) and the method of storing negative numbers in part (c)? (2)

This question continues on next page.

- g. Mention **ONE** other method of storing negative numbers, and using the binary number stored in array num, show how this method would turn the number to negative. (3)
- h. Write Java code to display the result returned in the array bin after calling the `toNegative()` method. (4)
- i. What is UNICODE? Why is it important? (2)
- j. Besides numeric quantities, mention **ONE** other type of data that can be stored using unsigned binary numbers. (1)

(Total: 20 marks)