

SUBJECT: **Computing**  
 DATE: 15<sup>th</sup> May 2018  
 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. A logic circuit has three inputs X, Y and Z and one output W. When a signal at X is 1, the output at W is the same as input Y while when a signal at X is 0, the output at W is the same as input Z.
  - a. Construct the truth table for this circuit. (2)
  - b. Construct a simplified Boolean expression for the output at W. (3)
  - c. Draw the logic circuit that corresponds to the expression in part (b). (1)

**(Total: 6 marks)**

2. A clothing brand would like to open an online store. It sets up a Wide Area Network (WAN) so that customers can place orders directly with the company's computer.
  - a. State **ONE** advantage to the company and **ONE** advantage to the customer of such a system. (2)
  - b. The communication uses a packet switching system. Explain how this works. (2)
  - c. Outline how packet switching:
    - (i) helps to provide better security for the data being sent; (1)
    - (ii) is less likely to be affected by network failure. (1)

**(Total: 6 marks)**

3. An organisation is considering using social networks to promote its services on the World Wide Web (WWW) and using the email to communicate with its customers. Any interested people have to complete an online form with personal data so that any updates are sent via email.
  - a. Outline **TWO** threats to security of the organisation's data other than viruses that may arise when using social networks. (2)
  - b. Suggest a way to protect against each of the threats identified in part (a). (2)
  - c. Suggest **TWO** procedures that the organisation should seek to implement to protect itself over time from the threat of viruses. (2)

**(Total: 6 marks)**

4. A hotel has a department which lets patrons in the hotel hire a bicycle. The data about the bicycles and the hirers is stored in a database file. The table below illustrates the data for one day.

HirerID	HName	HPhone	TimeOut	TimeIn	BicycleID	BMake	BModel
PS102	Peter Smith	96521296	08:00	13:00	DU12	BMS_11	A
LJ501	Lisa Jones						
AW167	Alfred Williams						
FT345	Fred Taylor						
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- Identify **TWO** functions of a DBMS in an application such as hiring bikes. (2)
- Suggest a suitable data type for each field. (2)
- There are several aspects of the table that are unsatisfactory and it is decided to normalize the database. Outline the purpose of normalisation in relation to this database file. (2)

**(Total: 6 marks)**

5. a. Consider the bit pattern below:

0 1 0 1 0 1 1 0

- What is the hexadecimal equivalent of the bit pattern above? (1)
  - What is the decimal equivalent of the bit pattern above if it represents an unsigned fixed-point binary value with four bits before the binary point and four bits after the binary point. (2)
- Represent the decimal value  $-67_{10}$  as an 8-bit two's complement binary integer. (1)
  - The ASCII binary code for character a is 1100001. Show how the word 'be' would be encoded in the binary form of ASCII. (2)

**(Total: 6 marks)**

6. The architecture of the microprocessor and the way data is stored are closely interconnected to its operations.

- Convert 3AD5 and B36C to binary and hence find their logical AND. Express your answer in hexadecimal. (2)
- How many fetch operations will a 64-bit CPU need to load the value in part (a) above from RAM? (1)
- Briefly explain the importance of 64-bit computing over 32-bit computing when considering the efficiency of a fetch-execute cycle. (1)
- A stack is a LIFO (last in first out) data structure accessed with the help of a stack pointer. Explain the role of the stack pointer. (2)

**(Total: 6 marks)**

7. High Level Language (HLL) programs need to be translated into machine code that a CPU can execute.
- Briefly explain why a CPU cannot directly execute a HLL program. (1)
  - Compilers are one type of High Level Language translators. Compilers produce object code. How is object code different from the source code? (1)
  - Explain why object code is platform-dependent. (1)
  - Name **ONE** other translator that translates HLL to machine code and clearly outline how this translator differs from a compiler. (2)
  - Which of these above-mentioned translators are you most likely to find in software debugging tools? (1)

**(Total: 6 marks)**

8. A company is developing a multiplayer quiz that is to be played online between groups of maximum 20 players at a time.
- Declare an array to store the user's scores. The array is to be called 'scoreboard'. (1)

At the end of each quiz the scores are sorted in ascending order to produce the leaderboard.

- Modify the code such that the array contents are sorted in ascending order using the Bubble Sort algorithm. (2)

```
public void makeLeaderboard(){
    for(int i = 1; i<20; i++){
        int temp = 0;
        if(scoreboard[i-1]>scoreboard[i]){
            temp = scoreboard[i-1];
            scoreboard[i-1] = scoreboard[i];
            scoreboard[i] = temp;
        }
    }
}
```

- Name the above sorting algorithm. (1)
- Name another sorting algorithm and briefly explain its logic. (2)
- Currently the leaderboard is capable of sorting the scores in ascending order. Name **ONE** edit that would make the leaderboard more meaningful to users. (1)

**(Total: 6 marks)**

9. In multithreading Operating Systems, thread or process scheduling is pivotal to system performance.
- Briefly explain Round Robin scheduling. (1)
  - Suggest **ONE** shortcoming of Round Robin scheduling. (1)
  - Explain how a multithreading OS can be caught in a deadlock. (1)
  - Operating systems are also responsible for memory management. Explain the role an Operating System plays in memory store protection. (1)
  - Name **ONE** facility an Operating System can have to make it easier for the user to limit unauthorised access to files. (1)
  - How is an Operating System's interrupt handling relevant to user experience? (1)

**(Total: 6 marks)**

10. The following is part of an Assembly Language program.

MOV AX,BX	Set the accumulator equal to the value in BX
CMP AX,CX	compare the value in the accumulator with that in register CX
JG Done	jump to Done if value in accumulator is greater than that in CX
JE Done	jump to Done if value in accumulator is equal to that in CX
MOV DX, AX	set register DX equal to the value in the accumulator
MOV AX, CX	set the accumulator equal to that in Register CX
MOV BX, AX	set the value in Register BX equal to that in the accumulator
MOV AX,DX	set accumulator equal to the value in register DX
MOV CX, AX	set register CX equal to the value in the accumulator

Done:

- If the initial value of BX is 3 and that of CX is 6, what will be the values of AX, BX, CX and DX after this code is executed? (1)
- Hence what is the function of the above code? (1)
- Implement the above code in Java. (2)
- Name **ONE** mnemonic in the above code. (1)
- In the instruction CMP AX, CX, identify an opcode and an operand. (1)

**(Total: 6 marks)**

## SECTION B

Answer **ONE** question from this section.

- A taxi firm decides to computerise its system in a city to operate more efficiently.
  - Outline the benefits of **TWO** methods of data collection that will help them to clearly define the problem. (4)
  - State **TWO** advantages of a modular design for the new software. (2)
  - Outline an example of the documentation that would be presented to:
    - the taxi firm; (1)
    - and another type of documentation that would be presented to the design team. (1)

The taxi firm has 15 different location stands in the city. Each taxi has an onboard GPS device which provides the present location as two coordinates: longitude and latitude. Using this information, the system has to be capable of calculating the distance to the given destination. Java is being used to develop the application.

An object of class type Location defines the coordinates of a location.

```
public class Location
{
    double longitude;
    double latitude;
    //constructor
}
```

- d. Construct another constructor method that takes two double arguments to initialise the longitude and the latitude coordinates of a new Location object. (3)

The distance between location A and location B within the city is approximated by:

$$\sqrt{((latitude_A - latitude_B)^2 + (longitude_A - longitude_B)^2)}$$

- e. Construct the `distance(LocationA, LocationB)` method that returns the distance between the two locations. The `sqrt()` method should be used to calculate the square root. (3)
- f. A method, `closest(Location[] allStands, LocationB)` was constructed to search through the array `AllStands` and return the index of the point closest to location B. The distance method in part (e) was used.

```
int closest(Location[] AllStands, Location B)
{
    int closestID = 0;
    double leastDistance = distance(AllStands[0], B);
    for (i = 1; i < AllStands.length; i = i + 1)
    {
        if (distance(AllStands[i], B) > leastDistance)
        {
            leastDistance = distance( AllStands[i], B);
            closestID = i;
        }
    }
    return closestID;
}
```

- (i) Explain the need for two parameters `AllStands` and `B` for the above method. (1)
- (ii) What is the type of each parameter used in the above method and explain why this is so? (2)
- (iii) The code for the method contains a serious logical error. Indicate where it is and how it should be corrected. (1)
- (iv) What would be the output if it is left uncorrected? (1)
- (v) How is the above method able to compare the distance of a given point with a set of points irrespective of how many points there are? (1)

**(Total: 20 marks)**

***Please turn the page.***

2. An application is being created using Java to convert decimal numbers to binary. Below is Converter, one of the classes in this application.

Look carefully at the given Java code to answer the questions below.

```
import java.util.Scanner;

class Converter{

    int decNumber;

    Scanner input = new Scanner(System.in);

    public void enterDecNumber(){
        System.out.println ("Enter decimal
number");
        this.decNumber = input.nextInt();
    }

    public void convertToBinary(){
        int binNumber=0;
        int[]r = new int[8];
        int i = 0;

        for(int c = 0; c<8; c++){
            r[c] = 0;
        }

        do{
            r[i] = this.decNumber%2;
            this.decNumber =
(int)this.decNumber/2;
            i++;
        }while(this.decNumber!=0);

        for (int x = 7; x>-1; x--){
            System.out.print(r[x]);
        }

    }

}
```

- a. Name an array used in this code and describe its type and dimension. (1)  
b. Briefly explain the function of this section of the code: (2)

```
do{
    r[i] = this.decNumber%2;
    this.decNumber = (int)this.decNumber/2;
    i++;
}while(this.decNumber!=0);
```

- c. What would be the effect of initialising the variable i to 1? (1)  
d. Is this application capable of converting fractional decimal numbers to binary? Quote the code which justifies your answer. (2)  
e. Name:  
(i) a post-determined loop used in this class; (1)  
(ii) a third type of Java loop not found in this class. (1)

- f. Imagine the user enters a value of 45 for decNumber.  
(i) What will be the output? (1)  
(ii) Hence does the code give the desired result? Show working to support your answer? (2)
- g. What is the largest number this code can convert to binary? (1)
- h. How would you edit the above code so that it can handle numbers up to 65536 (16-bit numbers)? (1)
- i. Suggest **TWO** changes that need to be made to the code such that it converts decimal numbers to hexadecimal. (2)
- j. Why should variables be declared locally rather than at global level when possible? (1)
- k. What is the scope of variable c in the method convertToBinary()? (1)

l. Below is another class in the same application, called ConverterApp.

```
class ConverterApp{  
  
    public static void main(String args[]){  
        Converter decToBin = new  
        Converter();  
    }  
}
```

Briefly explain the role of the following line in this method: (2)

```
    Converter decToBin = new Converter();
```

- m. Write the Java code to call the method enterDecNumber() and convertToBinary() for the object declared in part (l) above. (1)

**(Total: 20 marks)**