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SUBJECT: **Computing**  
DATE: 5<sup>th</sup> September 2019  
TIME: 4:00 p.m. to 7:05 p.m.

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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. Simplify the following Boolean expression. (3)

$$B = \overline{\overline{X+Y} + \overline{Y.X} + X+Y}$$

- b. Draw the logic circuit that corresponds to the answer to part (a). (2)
- c. Identify **ALL** ordered pairs (X,Y) that make the circuit output true. (1)

**(Total: 6 marks)**

2. A company sells handmade cards online. It is currently planning to introduce a database management system (DBMS) to be used together with the online shop.

- a. Identify **TWO** capabilities that must be supported by the DBMS tools. (2)
- b. One feature of DBMS is security. For the scenario above, discuss **TWO** security features required for this DBMS. (2)
- c. Explain the importance of data modelling in the design of the database. (2)

**(Total: 6 marks)**

3. a. Describe the improvements in performance of a personal computer by:
- i. increasing the size of RAM; (1)
  - ii. increasing the size of cache memory. (1)
- b. Is cache memory an SRAM or a DRAM kind of RAM? Explain. (2)
- c. Is main memory an SRAM or a DRAM kind of RAM? Explain. (2)

**(Total: 6 marks)**

4. a. Explain the relationship between assembly language instructions and machine code instructions. (1)
- b. Trace the assembly language program by making use of a trace table. The values of register AX and memory addresses 507-510 should be recorded in the trace table. (3)

500	MOV AX, [507], Copy contents of memory location addresses by contents of register 507 to register AX
501	INC AX, Increment AX
502	MOV 509, AX, Copy contents of register AX to register 509
503	MOV AX, [508], Copy contents of memory location addresses by contents of register 508 to register AX
504	INC AX, Increment AX
505	MOV 510, AX, Copy contents of register AX to register 510
506	HLT
507	22
508	76
509	0
510	0

- c. Consider the assembly language instruction, MOV AX, [507]. During the fetch - decode - execute cycle; after the instruction is decoded, the address bus has to be reused before the execution of the instruction can be completed. Explain why? (2)

**(Total: 6 marks)**

5. A company sells a number of items over the phone. Operators take the orders using a computer as a terminal attached to a LAN. Each customer has a credit limit. Credit limits can only be changed by a manager. The system checks that there is enough stock when an order is taken.
- a. Describe the importance of maintaining integrity of customer data. (2)
- b. State and describe a suitable LAN topology for the system. (2)
- c. What happens if there is a cable failure in the topology mentioned in part b? (2)

**(Total: 6 marks)**

6. A football simulator game is to include a class called Player and another called Team. The developers are considering introducing a subclass of Player called GoalKeeper.

a. Fill in the blanks with three of the following terms (Write the answers on the booklet provided.) (3)

**Methods, objects, variables, array, instance**

For efficient coding, class Team can be an (1)\_\_\_\_\_ of Player objects. Each of these objects would have instance (2) \_\_\_\_\_ and (3) \_\_\_\_\_ of class Player.

b. How would you declare class GoalKeeper that extends Player? (1)

c. Briefly describe the advantage of implementing inheritance in Java applications. (1)

d. Name **ONE** other feature of Object Oriented Programming (not mentioned above) that improves code efficiency. (1)

**(Total: 6 marks)**

7. Among many others, the instruction set of the IBM System/360 series implemented Binary Coded Decimal.

a. What is a machine's instruction set? (1)

b. Suggest **ONE** reason implementing Binary Coded Decimal (BCD) may be seen preferable. (1)

c. Express  $246_{10}$  in BCD. (2)

d. Express the fixed-point binary number  $1001.101_2$  in decimal, clearly showing your working. (2)

**(Total: 6 marks)**

***Please turn the page.***

8. The FLAGS register is the status register in Intel x86 microprocessors that contains the current state of the processor.
- a. Explain the role of the:
    - i. zero flag; (1)
    - ii. carry flag. (1)
  - b. Answer **True** or **False**, if False write the correct statement: (3)
    - i. The memory address of the instruction to be executed next is obtained from the Program Counter.
    - ii. The Memory Buffer Register holds the memory address from which data is currently being read or written.
    - iii. The instruction currently being decoded or executed is found in the Current Instruction Register.
  - c. Explain what happens during the decode stage of the fetch-decode-execute cycle. (1)

**(Total: 6 marks)**

9. Online banking systems often require a system of identification for system login called multifactor user-identification which uses more than one element e.g. a password and a number generated by a separate device.
- a. Why is user identification important in this context of banking systems? (1)
  - b. Why is the use of two different elements as in multifactor user-identification important in the above context? (1)
  - c. Name **TWO** ways of user identification you expect to find on a modern smartphone. (2)
  - d. Briefly explain why it is useful to allow different types of access in a multi-user access system. (1)
  - e. Name **TWO** different types of file access rights a user can be granted. (1)

**(Total: 6 marks)**

10. A gaming library keeps track of the games it has available via a database. This database includes a number of tables which include the table Games.

Games:

Field name	Description
Game ID	Unique identification number
Game Name	Official game name
Developer	Company developing the game
Release Year	Year the game was released
Genre	Game type
Consoles	Consoles the game is available on
Computer	Computer OSes the game is available on
Mobile	Mobile OSes the game is available on
Age Restriction	Age restriction for the game
Game Engine	Game engine the game is built on

a. Which of the above fields would you create as drop-down fields? (1)

Another table in this database is Developers. This table includes details of games developers and is linked to the Games Table.

Field Name	Description
Developer ID	Unique developer identification number
Developer Name	Name of the production company
Year Founded	Year the company was founded
Employees	Number of employees employed by this company.
Headquarters	Location of headquarters

b. What is the function of the foreign key in relational databases? (1)

c. Which is the foreign key in the Games table and how is this linked to the Developer table? (1)

d. Explain **TWO** advantages of relational databases over a flat database. (2)

e. Suggest **ONE** query one may wish to make on this data. (1)

**(Total: 6 marks)**

**SECTION B**

**Answer ONE question from this section.**

1. a. An international train station uses an object-oriented program to keep track of arrivals and departures of trains. Some of the objects in this system are listed below:

Train	Each Train has many attributes including a unique ID code
Arrival	In addition to a variable of the type Train, each Arrival object has a Scheduled Time of Arrival in 24 hour format, a railway number, the remaining time in minutes, an indicator whether the train has arrived.
TrainManagement	The main class that manages the arrival and departure of trains.

The code below outlines the Train class used in this program.

```
public class Train {
    private String id;

    public String getID() {
        return this.id;
    }
    // more variables, accessor and mutator methods
}
```

- i. Outline the general nature of an object. (1)
- ii. Describe **TWO** disadvantages of using OOP. (2)
- iii. State the relationship of the Train object and the Arrival object. (1)
- iv. Construct the Arrival object including only the constructor. (5)

One of the methods in the Arrival object is the compareWith.

```
public int compareWith (String TrainID) {
    if (myTrain.getID().equals(TrainID)) {
        return 0;
    }
    else {
        return 1;
    }
}
```

The code below outlines part of the TrainManagement class.

```
public class TrainManagement {
    private Arrival[] inbound; //array of train arrivals

    public TrainManagement() {
        inbound = new Arrival [200];
    }

    public int search (String trainID) {
        //missing code that searches the array inbound
        //and returns the index of the Arrival object with TrainID
    }

    // more methods
}
```

- v. Construct the method search() in the TrainManagement class which searches in the array inbound and returns the index of the Arrival object with the given trainID. A linear search should be implemented. Make use of the compareTo method and assume that the trainID exists in the array inbound. (4)
- vi. If in the Arrival object, there is another compareTo method:

```
public int compareTo(Arrival anotherArrival),
```

explain why there will **not** be a conflict in this case. (2)

- b. Each component in the train station was tested before it was open to the public. A variety of testing methods were used.
- i. Define the term parallel running. (1)
  - ii. Outline **ONE** reason for choosing a parallel form of changeover as opposed to any other. (2)
  - iii. Identify **TWO** factors that should be considered when selecting a testing method. (2)

**(Total: 20 marks)**

***Please turn the page.***

2. The Operating System is at the heart of a computer system. Many personal computers these days run Microsoft's Windows 10.
- a. Suggest a use for each of the following types of Operating Systems:
    - i. Batch Processing OS; (1)
    - ii. Online Operating System; (1)
    - iii. Networked Operating System. (1)
  
  - b. The choice of operating system depends on the type of application software to be used. Briefly explain whether in your opinion Windows 10 is a batch operating system and give reasons for your answer. (2)
  
  - c. One of the roles of an OS is Memory Management.
    - i. What is memory management? (1)
    - ii. Distinguish between logical and physical address. (1)
    - iii. In a 32-bit system, the address space is  $2^{32}$ . Does this refer to the logical or the physical address space? Explain. (2)
    - iv. What is memory mapping? (2)
  
  - d. One of the problems when using computer systems is memory fragmentation.
    - i. Briefly explain what is memory fragmentation. (2)
    - ii. What is the effect on the functioning of the computer if memory fragmentation is **not** kept under control? (1)
    - iii. Briefly explain how an operating system may help recover from this problem or help keep it under control. (2)
  
  - e. Name and briefly explain **TWO** other roles of an Operating System besides Memory Management. (4)

**(Total: 20 marks)**