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SUBJECT: **Computing**  
DATE: 21<sup>st</sup> May 2024  
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. Imagine you are tasked with designing a system for an online bookstore that allows users to search for books, add them to their cart and proceed to checkout. The process involves the users logging in to the bookstore website where they have the option to search for a book. If the book is not found, a "not found" message is displayed, and the user is given the opportunity to search again. If the book is found, they are asked if they wish to add it to the cart. If yes, the book is added to the cart, if not, they are redirected to the search option. The users are then asked if they wish to proceed to checkout. If the answer is yes, the process includes asking the users for payment information. If the payment is valid, then a "thank you" message is displayed. If not, the user is asked to enter payment information again. If the users opt not to proceed to check out, they are redirected to the search option.
  - a. Draw a flowchart detailing the steps involved in the above process. (5)
  - b. Flowcharts are one way of representing algorithms. Name **ONE** other way of how an algorithm can be represented. (1)

**(Total: 6 marks)**

2. a. Design a logic circuit diagram based on the following Boolean expression.

$$F = \bar{X} + XY + Y\bar{Z} \quad (3)$$

- b. Given that inputs A and B are defined by the Boolean expressions:

$$A = P(Q + R)$$

$$B = P + \bar{Q}R$$

Through the use of Boolean Algebra, evaluate and simplify the following expression.

$$C = A + B \quad (3)$$

**(Total: 6 marks)**

***Please turn the page.***

3. a. Consider an unsigned fixed-point representation with 6 bits, where 3 bits are allocated to the integer part and 3 bits to the fractional part.  
Given the fixed-point number 110.101, convert to its decimal equivalent. (2)
- b. Represent -3 in an 8-bit two's complement system. (2)
- c. i. Convert  $402_{10}$  into Binary Coded Decimal (BCD) format. (1)  
ii. How many bytes are required to store the number in part (i)(c)? (1)

**(Total: 6 marks)**

4. a. i. With the aid of a clearly labelled diagram, describe how a previously empty stack would hold the following names arriving in the given sequence:  
Jack, Lee, George, Graham (1)  
ii. Show what the stack would contain if two names were popped from it and one other name (Louis) was pushed. (2)
- b. Name **ONE** sorting algorithm of your choice. (1)
- c. Show how the list [2,8,1,3,7] would be sorted in ascending order using the algorithm named in part (b). (2)

**(Total: 6 marks)**

5. The World Wide Web is an example of a client-server system. It consists of web servers and web clients (browsers).
- a. What roles do a web server and a web client play in the process of viewing a website? (2)
- b. A Uniform Resource Locator (URL) is composed of several components, each serving a specific purpose on the web. Using a URL example of your choice, identify **THREE** main components that make up a URL. (4)

**(Total: 6 marks)**

6. A multinational corporation has offices located in different countries around the world. Each office has its own LAN while a WAN is established to connect these geographically dispersed locations.
- a. Suggest **ONE** example of how WAN connectivity can be used in this context. (1)
- b. Suggest a reason why LANs are often implemented using copper wires. (1)
- c. Suggest a context where it may be necessary for a LAN to make use of optic fibre. (1)
- d. Analogue and digital signals play a crucial role in networking.  
i. Differentiate between analogue and digital signals. (2)  
ii. Suggest why this difference often leads digital signals to be the preferred option. (1)

**(Total: 6 marks)**

7. System performance is highly dependent on CPU and RAM.
- a. Name the bus used to identify the memory location being read or written to. (1)
- b. Briefly explain how the size of this bus may limit the amount of usable RAM. (1)
- c. Explain how the word length can impact the efficiency of data transfer between CPU and RAM. (1)
- d. Name **ONE** other factor, besides word length, that impacts a computer's performance and briefly explain your answer. (2)
- e. Briefly explain why SRAM is much faster than DRAM. (1)

**(Total: 6 marks)**

8. Process scheduling is very important to the performance of multi-tasking operating systems.
- Outline how a multi-tasking operating system can be caught in a deadlock. (1)
  - Suggest **ONE** shortcoming of Round Robin scheduling. (1)
  - How is an operating system's interrupt handling relevant to user experience? (1)
  - Operating systems are also responsible for memory management. Explain the role an operating system plays in memory store protection. (1)
  - Part of the role of the operating system is to provide an interface between the user and the hardware. Explain a feature you expect to be included with an operating system interface on a wearable device. (2)

**(Total: 6 marks)**

9. The database of a wellness centre includes a table of Clients and a table of Services they are registered for. The following are the structures for both tables:

<b>Clients Table</b>
Client_id
Name
Surname
Email
Registration_date
Service_Level

<b>Services Table</b>
Service_Level_id
Service_Level_Name
Service_Description
Cost

- Every client must opt for only one Service Level upon registration.
  - Explain how a relationship can be established between the above two tables. (2)
  - What type of relationship exists between these two tables? Explain. (2)
- State **TWO** advantages that a database system provides over a flat file system. (2)

**(Total: 6 marks)**

10. An online retail business is in the process of developing a new system that has the potential to better cater to its users' ever-evolving requirements.

- At which step of the system lifecycle would you expect the following to be done?
  - A study is compiled to outline the scope and objectives of the proposed system. (1)
  - Define the architecture, components, modules and data of the system; and how they are expected to interact together to solve the problem at hand. (1)
  - The system is coded, and the relevant documentation is produced. (1)
- What considerations might lead the developers to opt for either of these changeover approaches?
  - Direct Changeover; (1)
  - Phased Changeover; (1)
  - Parallel run. (1)

**(Total: 6 marks)**

***Please turn the page.***

**SECTION B****Answer ONE question in this section.**

1. a. X represents a three-bit unsigned integer. The output Z needs to be set as:

Z = 0 if the value of X is 3 or 7.

Z = 1 for all other values.

- i. Draw the truth table for Z. (3)  
 ii. Using Karnaugh maps, find the simplified Boolean expression for Z. (3)

- b. Implement the following function F using NOR gates **ONLY**:

$$F = (A + C)(\bar{B} + C) \quad (3)$$

- c. Databases are an important tool in modern application development.

- i. Explain the concept of a data dictionary and name **TWO** items that are usually stored within it; (2)  
 ii. Name **ONE** programming language used to interface with a relational database; (1)  
 iii. Give **TWO** uses of the programming language mentioned in part c (ii). (2)

- d. Write Java statements to perform the following tasks:

- i. Declare an integer variable named `count` and initialise it with the value of 10; (1)  
 ii. Declare an array of integers named `numbers` with the values 2,4,6,8,10; (1)  
 iii. Create an instance `b` of an object class `Box`; (1)  
 iv. Call method `displayBox()` from the above object class `Box`; (1)  
 v. Create a method `myMethod()`, with integer parameters `x` and `y`, which will return the subtraction of `y` from `x`. (2)

**(Total: 20 marks)**

2. a. Program source code needs to be translated to executable code for a processor to run it. Explain why this translation is necessary. (1)

- b. Select the **THREE** correct statements from the following:

Statement 1: A compiler first translates all lines to produce object code.

Statement 2: When using an interpreter, no object code is created.

Statement 3: Interpreters are used to translate low-level languages.

Statement 4: A compiler will translate a loop every time it is executed.

Statement 5: An interpreter translates one line at a time and then executes it before moving on to translate the next line.

Statement 6: An assembler can be used to translate Java. (3)

- c. Give **TWO** differences between low-level languages and high-level languages. (2)

- d. Java is an Object-Oriented Programming (OOP) Language. OOP promotes the concept of modularity and reusability through the use of classes, inheritance and polymorphism. Explain how inheritance can increase coding productivity. (1)

- e. A dental clinic application is designed to keep track of patient records. This application offers the option 'Find Patient'. This option implements a linear search to go through records looking for a particular patient's ID number and then display their details.
- i. Distinguish between classes and objects in the context of the above-described scenario. (1)
  - ii. Produce the pseudocode for a linear search that returns the index of the desired element in the array. (4)
  - iii. When creating the Patient class, a programmer defined all its properties (name, date of birth, etc) as static. Explain what this means and whether or not you think it is a good idea in this case. (2)
- f. Consider the following class structure:
- The base class `Patient` contains common attributes and methods relevant to all patients.
  - Derived classes `RegularPatient` and `EmergencyPatient` have additional attributes and methods specific to them.
  - In the base class, a method called `displayInfo()` prints patient information.
  - Each derived class can provide its own implementation of this method to display relevant details.
- i. List at least **THREE** attributes you'd expect to find in class `Patient`. (1)
  - ii. Explain how overloading can be utilised to increase code reusability, flexibility, and easier maintenance. (2)
- g. A programmer needs to shield variables from direct external access. Explain how this can be done, being sure to mention the object-oriented characteristic that is utilised in this case. (2)
- h. Differentiate between an instance method different and a static method (1)

**(Total: 20 marks)**