



SUBJECT: **Computing**
DATE: 14th May 2019
TIME: 4:00 p.m. to 7:05 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.

- A hospital is currently in the process of changing its current system.
 - One method of collecting data during the analysis stage is interviewing users. Outline **TWO** other suitable methods. (2)
 - Outline **TWO** tasks, other than collecting data, that the system analyst may have carried out whilst investigating the original system. (2)
 - Identify **TWO** security measures that are required to protect data records from physical hazards and unauthorised access. (2)

(Total: 6 marks)

- Use the truth table below to construct a Boolean expression for output Y in terms of O, P and Q.

O	P	Q	Y
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

(2)

- Simplify the expression and state the laws used. (3)
- Draw the simplified logic circuit corresponding to part (b). (1)

(Total: 6 marks)

Please turn the page.

3. The design department of a manufacturing company consists of six designers. The designers have access to previous designs and to an expert system of real world objects. They are to modify the previous design by changing some parameters and re-use some real world objects. The final design will be sent to the manufacturing department in another building. A number of control machines will be used to manufacture the final product.
- Recommend and describe a suitable network topology to be used by the design department. How will it be used in the scenario mentioned above? (2)
 - Recommend and describe a suitable network topology to be used by the manufacturing department. (2)
 - With reference to data integrity, identify a suitable way to link the two departments. Explain why it is suitable. (2)

(Total: 6 marks)

4. Consider the following Java method:

```
double myList (double a, int[] y) {
    double o;
    y[0] = 15;
    //more code
}
```

- Define the term local variable and identify the local variable in the method myList(). (2)
- State the data type of the value that should be returned by the method above. (1)
- An integer array z is initialised in the main method.

The values of array z are {19, 15, 34, 12}.

The following call is made in the main method.

```
x = myList (15.21, z);
```

Explain why the assignment `y[0] = 15` in the body of the method changes `z[0]` in the calling part of the program. (3)

(Total: 6 marks)

5. a. Give **TWO** reasons why assembly language is rarely used nowadays for writing programs. (2)
- b. The diagram below shows a program loaded in memory starting at location 100. Locations 200 onwards contain data which is used by the program.

100	MOV CX, 4; Set CX = 4 in decimal
101	MOV AX, [150]; Copy contents of memory location addresses by contents of register 150 to register AX
102	MOV AX, [150]; Copy contents of memory location 150 into register AX
103	INC AX; Increment AX
104	MOV [150], AX; Copy contents of register AX to memory location 150
104	SUB CX, 1; Subtract CX by 1
105	CMP CX, 0; Compare CX to 0
106	JG 101
107	HLT
...	...
150	200
...	...
200	65
201	76
202	65
203	77
204	32
205	32

Trace the first **FOUR** iterations of the given program using a trace table like the one below. (4)

AX	CX	Memory Location 150

(Total: 6 marks)

Please turn the page.

6. A school system tracking staff and student attendance is being implemented in Java which is an object-oriented language. Object-oriented programming is characterised by encapsulation, inheritance and polymorphism.
- Briefly describe how inheritance can be implemented in this school system, clearly specifying how one (or more) class can inherit another. (2)
 - Encapsulation impacts the way the programmer can inspect or manipulate fields.
 - Explain the above statement. (1)
 - Hence, why is encapsulation desirable? (1)
 - Object-orientation is one of many programming paradigms. Name and briefly describe **ONE** other programming paradigm. (2)

(Total: 6 marks)

7. Two's complement representation allows addition and subtraction to be performed with the same CPU circuitry. Therefore, it is simpler and more economical to design processors this way.
- What is the largest positive decimal number that can be stored in an 8-bit two's complement register? (1)
 - Show how the operation 67-35 is carried out using two's complement. (2)
 - Which CPU register temporarily stores the result of the answer to part (b)? (1)
 - Computers store all data in binary. Hence character encoding standards allow the representation of letters, numbers and other characters. Explain how the global use of Internet has made Unicode 16-bit coding system better suited than a 7-bit coding system like ASCII. (2)

(Total: 6 marks)

8. a. Special internal registers inside the CPU help it carry out its functions. Which of the following is a reasonable size for a register on a modern CPU? (1)
- 64 bits, 64 bytes, 64 kilobytes
- b. Complete the fetch cycle: Fill in the blanks with the name of appropriate registers. *The first one has been done as an example.* (2)
- The CPU sends the contents of the Program Counter to the _____ and sends a read command on the address bus.
 - In response to the read command, the memory returns the data stored at the memory location indicated on the data bus.
 - The CPU copies the data from the data bus into its _____.
 - A fraction of a second later, the CPU copies this data to the _____ for instruction decoding.
 - The _____ is incremented so that it points to the next instruction. This step prepares the CPU for the next cycle.
- c. Briefly describe the role of the accumulator. (1)
- d. At which stage of the Fetch-Execute cycle may the accumulator be used? (1)
- e. Name and describe **ONE** factor that affects CPU performance. (1)

(Total: 6 marks)

9. A health care providing company has multiple offices in different towns. Many doctors work for the company, and each doctor takes care of multiple patients. Each patient can be assigned to one or more doctors.
- a. Suggest a record structure for the doctor's table. Clearly identify the primary key. (2)
 - b. What type of relationship exists between doctors and patients? (1)
 - c. Identify the difference between a primary key and a foreign key. (2)
 - d. From the above situation identify a foreign key you would expect to find in the Patient file. (1)

(Total: 6 marks)

10. Android and iOS are two major types of mobile operating systems mainly used on smartphones and tablets.
- a. Explain why it is **not** practical for these operating systems to operate in batch mode. (1)
 - b. Name and briefly describe **TWO** types of user-interfacing modern users have come to expect of a mobile OS. (2)
 - c. Name **TWO** features (other than those related to interfacing) modern users expect of a modern mobile operating system and briefly explain their utility. (2)
 - d. Name **ONE** access control security feature commonly used in modern mobile devices. (1)

(Total: 6 marks)

Please turn the page.

SECTION B

Answer ONE question from this section.

1. The Operating System is responsible for memory management.
 - a. Name and describe **TWO** other roles of the Operating System. (2)
 - b. Addresses uniquely identify a location in the memory. Distinguish between logical and physical addresses. (2)
 - c. Explain how memory fragmentation can occur. (2)
 - d. Why is memory fragmentation undesirable? (2)
 - e. Explain why memory store protection is far simpler on a single user, single-tasking system than in a multiprogramming system. (2)
 - f. Complete with True or False. (2)

i.	Round robin scheduling algorithm assigns time slices to each process in equal portions and in circular order.	
ii.	Round-robin scheduling is non-pre-emptive.	
iii.	In round-robin scheduling, context switching may result in high overheads.	
iv.	Round robin handles all processes without priority.	

During program execution, *threads* are scheduled to run based on their *scheduling priority*. The system treats all threads with the same priority as equal.

- g. Explain the terms in italics:
 - i. threads; (1)
 - ii. scheduling priority. (1)
- h. A process can be in a number of states, including run, wait and suspend. Briefly describe these states. (3)

Windows XP and later versions of Microsoft Windows support deadlock detection that helps detect and report potential deadlock.

- i. What is deadlock? (1)
- j. Explain the difference between polling and interrupt-handling. (2)

(Total: 20 marks)

2. a. A chemical factory produces three dangerous gases X, Y and Z. These gases have to be continuously monitored to ensure that they remain under a specific level. If the limit is exceeded, the corresponding inputs X, Y and Z are set to logical true.
 - Z is always dangerous if it exceeds its limit.
 - X and Y neutralise one another so they are only dangerous if one or the other, but not both, exceed the limit.
 - A warning signal O is given if either X or Z are dangerous.
 - A danger alarm P is sounded if X and Z are both dangerous or if Y and Z are both dangerous.

- i. Represent the inputs X, Y and Z and the corresponding outputs O and P in a truth table. (4)
 - ii. Using Karnaugh maps, obtain a simplified logic expression for output O. (2)
 - iii. Using Karnaugh maps or otherwise, obtain a simplified logic expression for output P. (2)
 - iv. Construct a logic circuit for warning signal O and alarm P from the inputs X, Y and Z. (2)
- b. A program has been written in Java to produce a national survey about different towns in a city.

For each town, the following data is stored:

- Name
- Area
- Population

The following class Town has been developed:

```
class Town
{
    public String name;
    public double area;
    public int population;

    public Town (String n, double a, int p)
    {
        name = n;
        area = a;
        population = p;
    }
    // other methods
}
```

- i. Why is it important that the constructor is set to public? (1)
- ii. A `Town` object can be created as shown below
`Town t = new Town ("Alton", 212.9, 17816);`
 Explain what happens when the line above is executed. (2)
- iii. Describe an efficient way of creating 100 objects of class `Town`. The objects need to be adequately stored for further processing. (1)
- iv. Construct the method that returns the name of the town with the highest population. (4)
- v. Give an overview of the bubble sort algorithm if the 100 `Town` objects had to be sorted in ascending order of population. (2)

(Total: 20 marks)