22077011

COMPUTER SCIENCE
HIGHER LEVEL
PAPER 1

Tuesday 8 May 2007 (afternoon)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Section A: answer all the questions.
- Section B: answer all the questions.

SECTION A

*Answer **all** the questions.*

1. An organization is considering using a direct changeover method to implement a new computer system.

    (a) State **one** advantage of using the direct changeover method.   *[1 mark]*

    (b) State **one** disadvantage of using the direct changeover method.   *[1 mark]*

2. State the efficiency of the following *sorting algorithms*:

    (a) *Bubble sort*   *[1 mark]*

    (b) *Quick sort*   *[1 mark]*

3. In relation to a database define the role of the *key field* (sometimes called *primary key*).   *[1 mark]*

4. Outline a reason for the use of *external sorting methods*.   *[1 mark]*

5. Outline the steps in the *fetch* and *execution cycle*.   *[4 marks]*

6. Outline an example of a situation in which each of the following computer processing methods might be used.

    (a) *Batch*   *[1 mark]*

    (b) *Real-Time*   *[1 mark]*

    (c) *Online*   *[1 mark]*

7. Explain **one** advantage of a *star network topology* over a *bus network topology*.   *[2 marks]*

8. State if the following data stream has been received correctly, assume the *most significant bit (MSB)* is an *even parity bit*.   *[1 mark]*

                            1000 0101 1101 1101

9.   Applying 7 bit *two's complement* representation:

(a)   Calculate and then state the binary notation for -15_{10}.   *[2 marks]*

(b)   Explain why an *overflow* error goes undetected after the following calculation is
performed: $0111111_2 + 0000001_2$.   *[2 marks]*

10.   With respect to entering and storing temperature data in a computer system:

(a)   Define the term *analog data*.   *[1 mark]*

(b)   Describe the process of entering temperature data into a computer.   *[2 marks]*

11.   Outline **one** key task a *packet switched network protocol* must be able to achieve.   *[2 marks]*

12.   Describe the factors that contribute to the time taken to transfer data from a hard disk.   *[3 marks]*

13.   In relation to the *array data structure* `name []` shown below:

```
String name [] = {"Smith","Ng","Wong","Brown"};
```

(a)   Describe the role of an index to access elements of the array.   *[2 marks]*

(b)   State the data value represented by `name[2]`.   *[1 mark]*

(c)   Explain the function of the word String in the declaration.   *[2 marks]*

14.   (a)   Outline how a *run-time error* could occur in a computer program.   *[2 marks]*

(b)   Suggest a way to prevent this run-time error occurring.   *[2 marks]*

15.   Discuss the need for *defragmentation* utility software.   *[3 marks]*

SECTION B

*Answer **all** the questions.*

16. The following characters 'c', 'a', 'c', 'b' and 'c' are stored in an array called `d[]` as shown below.

note: the ascii code for 'a' is 97, 'b' is 98 and 'c' is 99.

```
public class Hlp1
{
    public static void main (String args[])
    {
    new Hlp1();
    }
    Hlp1()
    {
        int max = 4;
        char d [] = {'c', 'a', 'c', 'b', 'c' };
        int c [] = {0,0,0};
        char p;
        int m;
        for (int i=0; i< d.length; i++)
        {
            p = d[i];
            m = p-97;
            c[m] = c[m]+1;
        }
        for (int i=0; i<c.length; i++)
        {
            Output((char)(i+97)+".."+c[i]); //(char) casts an int to a char
        }
    }
}
```

(a) Copy and complete the following trace table for the first loop. *[5 marks]*

i	p	m	c[m]
0	c	99-97 is 2	

(b) List the contents of the array `c[]` after the first loop has been completed. *[1 mark]*

(c) List the output from the second `for` loop. *[2 marks]*

(d) Describe the purpose of the program. *[2 marks]*

17. A car's safety alarm sounds when the door (D) is open and the key (K) is in the ignition, or the seat belt (S) is not buckled and the key is in the ignition.

(a) Draw a *truth table* for this logic system. *[3 marks]*

(b) Construct the full Boolean expression from the *truth table*. *[3 marks]*

(c) Calculate and state the *minimized Boolean* expression and fully show the method used. *[2 marks]*

(d) Derive the *minimized Boolean circuit*. *[2 marks]*

18. Mark sense cards are to be used to record students' answers to a multiple choice exam. They also write their names on the card using a pen.
The computer mark sense processing system will be able to access the central student database using the student ID.
The answer data needs to be checked for reading and errors reported so that these can be fixed and the card run through again.
The ID on each card is to be matched with the main student file. Mismatches found are printed as an error report.
The exam is to be marked by the computer.
The results are to be stored in a separate disk file.
A printout of each student's results is made.
A summary of the overall results is to be printed that also shows the average mark.

A partial system flowchart is given below:
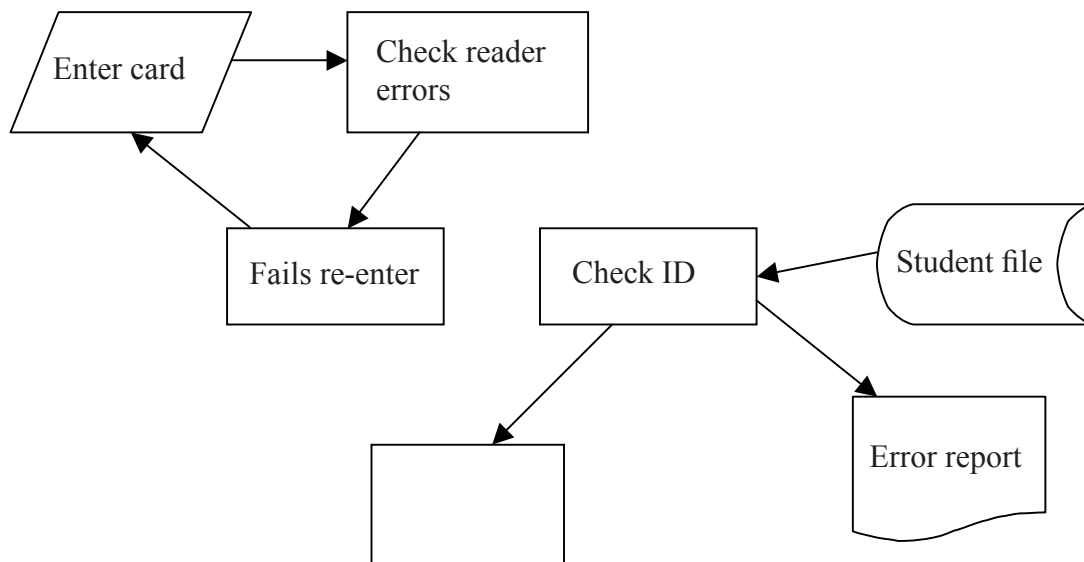
(a) Copy the above *systems flow chart* and complete it. *[5 marks]*

(b) (i) Identify a file access method that could be used to check the student's ID on the card against the central student file. *[1 mark]*

 (ii) Outline how this method would operate. *[2 marks]*

(c) Suggest a suitable *file organization* method for the results file. *[2 marks]*

19. An organization uses software to calculate the cost of the area they are required to carpet.
The basic cost is calculated by (area * cost per square metre).
Areas are calculated by the formula (area = length * breadth) or if the room is circular by the formula (area = 3.12*radius*radius).
A simple class is provided below to allow the cost to be calculated for rectangular and circular rooms.

```java
public class CalcCost
{
    private double cost;
    public CalcCost(double costIn)
    {
        cost = costIn;
    }
    public double getCost()
    {
        return cost;
    }
    public double carpetCost(double length, double width)
    {
        return length * width * getCost( );
    }
    public double carpetCost(double radius)
    {
        return 3.12*radius*radius*getCost( );
    }
}
```

(a) Outline in general terms how the class `CalcCost` can be used to calculate the cost of carpeting a rectangular room. *[2 marks]*

(b) Write the **two** Java/programming statements required to output the cost of carpeting a room that measures 10m by 20m, with carpet that costs $20 per sq metre. *[2 marks]*

(c) Outline an advantage of making the variable *cost* private. *[2 marks]*

(d) Outline how *Polymorphism* allows classes to have multiple methods of the same name. *[2 marks]*

(e) Write the **two** Java/programming statements required to output the cost of carpeting a room that has a radius of 20m, with carpet that costs $32 per square metre. *[2 marks]*

20. The following questions relate to the internal structure of a Central Processing Unit (CPU) and how it interacts with external requests or devices.

(a) Construct a detailed diagram of a CPU to show the following logically grouped components: *Program Counter* (PC), *Instruction Register* (IR), *Accumulator*, relevant *Buses* and connections to *Cache* and *RAM*. *[4 marks]*

(b) Outline the role of the *PC*. *[2 marks]*

(c) Explain how *hardware interrupts* are used in relation to the operation of the *CPU*. *[2 marks]*

(d) Explain an advantage of using *polling* instead of *interrupts*. *[2 marks]*

21. An organization is considering promoting its services on the World Wide Web (WWW) and using email to communicate with customers. Prospective customers will be required to complete a registration process and provide personal data *e.g.* name, email address, home address, age, sex, date of birth and up to three favourite hobbies or activities they enjoy.

(a)   Outline **one** threat to security of the organization's data, other than viruses, that may arise from this use of the WWW.   *[2 marks]*

(b)   Suggest a way to protect against the threat identified in (a).   *[2 marks]*

(c)   Suggest one procedure that the organization should seek to implement to protect itself *over time* from the threat of viruses.   *[2 marks]*

(d)   Explain why many customers are able to access the central computer at the same time.   *[2 marks]*

(e)   Explain why each customer's data is secure when different customers access the system at the same time.   *[2 marks]*