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**COMPUTER SCIENCE
HIGHER LEVEL
PAPER 1**

Thursday 17 November 2011 (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. (a) State **one** advantage and **one** disadvantage of communication by *electronic mail* rather than by telephone. [2 marks]
- (b) Outline **two** possible measures that prevent computers from being affected by *viruses*, when using electronic mail. [2 marks]

- 2. (a) State **one** application that uses *robots*. [1 mark]
- (b) Outline **two** advantages of using robots rather than manual-based systems. [2 marks]

- 3. A code for representing colours is used, where each colour is stored using 8 bits.
 - (a) State the number of different colours that can be represented. [1 mark]
 - (b) The *binary* representation of a particular colour is shown below.

0	0	0	1	1	1	0	0
---	---	---	---	---	---	---	---

- (i) State the *decimal* representation of this colour. Show all of your working. [2 marks]
 - (ii) State the *hexadecimal* representation of this colour. [1 mark]
- 4. (a) Define the term *syntax*. [1 mark]
 - (b) Define the term *semantics*. [1 mark]
 - (c) Describe, using examples from the code below, how each of the following types of error could occur: *syntax error*, *logical error* and *run-time error*.

$$a = b / c + d \quad \text{[3 marks]}$$

- 5. Systems analysis, software design and program construction are all stages of the *software life cycle*.
Outline **two** other stages in the software life cycle. [4 marks]

- 6. (a) Using computer memory as an example, outline the meaning of the term *volatile*. [2 marks]
- (b) Outline the reasons for having both *primary memory* and *secondary memory*. [2 marks]
- (c) Explain why a hard disk might need to be defragmented. [3 marks]

- 7. (a) Define the term *operand*. [1 mark]
- (b) Define the term *operator*. [1 mark]
- (c) Convert the following *infix* expression into a *prefix* expression.

$$a * (b + c * d) \quad [1 \text{ mark}]$$

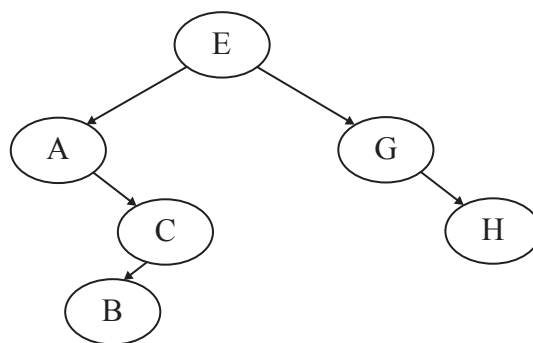
- (d) Calculate the value of the following *postfix* expression. [1 mark]
- $$5 \ 3 \ 7 \ + \ * \ 4 \ -$$

8. Define *direct memory access* (DMA). [1 mark]

9. Describe the function of the following processor components.

- (a) *accumulator* [2 marks]
- (b) *program counter* [2 marks]

10. Consider the following binary search tree.



Draw the resulting binary search tree after

- (a) deleting H from the initial tree; [1 mark]
- (b) deleting C from the initial tree; [1 mark]
- (c) deleting E from the initial tree. [2 marks]

SECTION B

Answer *all* the questions.

11. Consider the array and algorithm shown below.

	[0]	[1]	[2]	[3]	[4]
A	1.5	7.2	3.6	5.3	0.1

```

for (int index = 4; index > 0; index = index - 1)
{
    int j = index;
    for (int i = index - 1; i >= 0; i = i - 1)
    {
        if (A[i] < A[j])
        { j = i; }
    }
    if (j != index)
    {
        double w = A[j];
        A[j] = A[index];
        A[index] = w;
    }
}
    
```

- (a) Outline the operation of the outer `for` loop.

[2 marks]
- (b) Analyse the efficiency of the algorithm in terms of *BigO notation*.

[3 marks]
- (c) Identify, by tracing the algorithm or otherwise, the contents of the array `A` after each execution of the outer loop.

[4 marks]
- (d) State the purpose of the algorithm.

[1 mark]

12. A program accesses a text file on disk. To edit the text the user of the program enters data using a keyboard. The program then amends the text which was read from the file, writes the updated file back to disk and produces a printed report of all amendments made to the text file.

- (a) Construct a *systems flowchart* representing this process.

[4 marks]

The data on disk can be lost due to various errors.

- (b) (i) State **two** examples of how data can be lost due to human error.

[2 marks]
- (ii) State **two** examples of how data can be lost other than by human error.

[2 marks]
- (iii) Describe how data lost from disk could be recovered.

[2 marks]

13. (a) State **two** problems associated with the use of images, that have large file sizes, in computer systems. [2 marks]
- (b) One photograph is estimated to occupy 2000 KB. Outline the steps needed to calculate the number of gigabytes (GB) required for 50 000 photographs. [2 marks]
- (c) Outline **one** advantage of using *data compression* software on stored images. [2 marks]
- (d) Discuss the ethical considerations linked to the misuse of image processing software. [4 marks]

14. A garage uses a computer system to test whether the amount of exhaust fumes emitted by a car is at an acceptable level.

A *sensor*, used to measure exhaust fumes, is placed in the exhaust pipe.

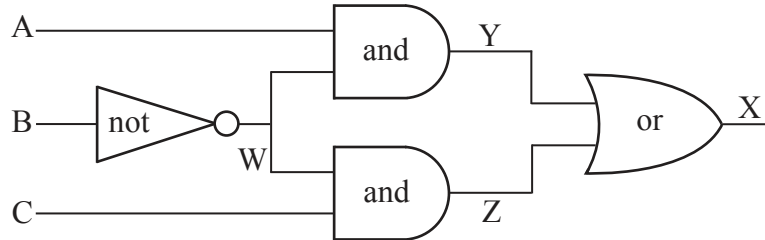
- (a) Outline the processing taking place in this computer system. [4 marks]
- (b) Explain why the sensor data needs to be converted before being processed. [2 marks]
- (c) Outline **three** errors that can occur in this system. [3 marks]
- (d) Identify **one** appropriate output device for this system. [1 mark]

15. (a) Determine the value of the following expression, where A = true and B = false . Show each step of your working.

$$\overline{A + B} + B \cdot A$$

[2 marks]

- (b) Consider the following logic circuit.



State the Boolean expression in terms of inputs A, B and C for output

- (i) W; [1 mark]
- (ii) Y; [1 mark]
- (iii) Z; [1 mark]
- (iv) X. [1 mark]

- (c) Consider the following truth table.

A	B	C	E
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

- (i) Express the Boolean expression for output E from the above truth table. [2 marks]
- (ii) Simplify the expression. [2 marks]

16. Consider the following Java class.

```
public class Point
{
    // point in the Cartesian plane
    private double x, y;

    public Point(double x, double y)
    {
        this.x = x;
        this.y = y;
    }

    public double getX() { return this.x; }
    public double getY() { return this.y; }

    public boolean isEqualTo(Point P)
    {
        return (this.x == P.getX() && this.y == P.getY());
    }

    public void showPoint()
    {
        output("(" + this.x + ", " + this.y + ")");
    }
}
```

- (a) Outline **two** features of *classes*. [2 marks]
- (b) Outline the relationship between a *class* and an *object*. [2 marks]
- (c) Consider the following code.

```
Point A = new Point(5, 7);
Point B = new Point(3, 0);

A.showPoint();
B.showPoint();

if (A.isEqualTo(B))
{
    output("are the same points");
}
else
{
    output("are different points");
}
```

Explain line by line, how the output below is produced.

(5, 7)
(3, 0)
are different points

[6 marks]