N11/5/COMSC/HP1/ENG/TZ0/XX

International Baccalaureate®
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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
```

[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)
```
[1 mark]

(d) Calculate the value of the following *postfix* expression.

```
5 3 7 + * 4 -
```
[1 mark]

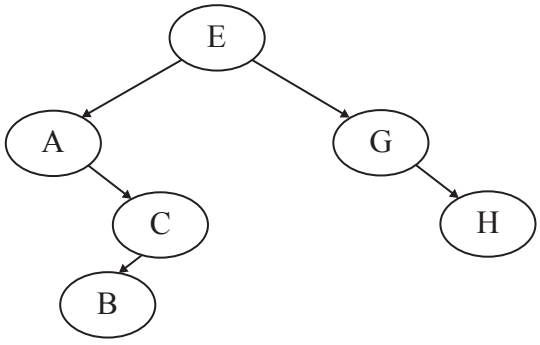
8. Define *direct memory access* (DMA). *[1 mark]*

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]*

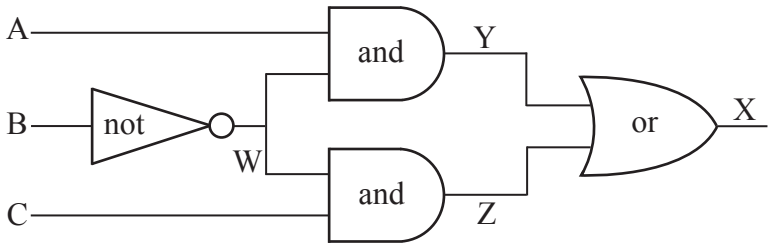
(c) Outline **three** errors that can occur in this system. *[3 marks]*

(d) Identify **one** appropriate output device for this system. *[1 mark]*

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

$$\overline{A + B} + B \bullet A$$ *[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]