IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

COMPUTER SCIENCE
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PAPER 1

Wednesday 15 November 2006 (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. Suggest **two** ways in which the introduction of a microprocessor into the design of a car could improve its safety features.   *[2 marks]*

2. Banks make extensive use of computer systems in the running of their operations. Identify a situation in which banks would make use of each of the following types of processing.

    (a) real-time   *[1 mark]*

    (b) batch   *[1 mark]*

    (c) interactive   *[1 mark]*

3. Explain the features of *cache memory.*   *[3 marks]*

4. Explain the purpose of *optical character recognition software.*   *[3 marks]*

5. (a) Outline what is meant by *user interface.*   *[2 marks]*

    (b) Outline the problem computers have in understanding speech.   *[3 marks]*

6. Identify **two** possible reasons for the need for the *maintenance stage* of the software cycle.   *[2 marks]*

7. An 8-bit register is used to represent integers in two's complement.

    For example:

0	0	1	0	1	1	1	0

    is the representation of 46_{10}.

    (a) Determine the binary representation and calculate the decimal value of

        (i)   the largest number that can be stored.   *[2 marks]*
        (ii) the smallest (most negative) number that can be stored.   *[2 marks]*

    (b) Calculate $7F_{16} + 1B_{16}$ and identify the error that occurs when the result is stored in the 8-bit register.   *[3 marks]*

8. (a) Outline the structure of a binary tree which is used to store search keys. *[2 marks]*

(b) Outline **three** cases to be considered when a node is to be deleted from such a tree. *[3 marks]*

9. State the efficiency of each loop in the following algorithm and hence determine the *BigO* efficiency of the algorithm. *[4 marks]*

```
int s=0, i=1, j=1, k=1, n=100;
 while (i<=n)
    {
       while (j<=n)
          {
             while (k<=n)
                {
                    s=s+1;
                    k=k+1;
                }
             j=j+1;
          }
       i=i+1;
    }
```

10. (a) Identify **two** security measures that would be used in a Local Area Network (LAN). *[2 marks]*

(b) Identify **one** additional security measure needed if the LAN is connected to a Wide Area Network. *[1 marks]*

11. Explain how the use of check sums could ensure that data integrity is maintained during the transmission of text. *[3 marks]*

SECTION B

*Answer **all** the questions.*

12. A small electronic firm employs staff who are on 24 hour call. Once a job has been completed the technician has to fill in a job sheet which includes information on the duration of the job and all expenses. The sheets are eventually returned to the office and stored on a transaction file held on disk. The file is then validated, an error report produced (which gives details of invalid transactions) and all valid transactions are copied to a tape.

    (a) Construct a system flowchart to illustrate the process of collecting and validating transactions. *[5 marks]*

    The system analyst has been asked to submit proposals for updating the computer system.

    (b) Outline the role of system analyst in developing the computer system. *[3 marks]*

    (c) Identify **one** strength and **one** weakness of interviewing as a technique for determining user requirements. *[2 marks]*

13. (a)   Define *recursion*.   *[2 marks]*

(b)   Consider the following program

```
public class TestMystery
{
    public static void main(String [] args)
    {
     int a=1;
      for (int k=1; k<=3; k++)
        { a=a+1;
          mystery(a);
        }
    }
    public static void mystery (int a)
    { if (a>1)
            mystery (a-1);
        System.out.println(a);
    }
}
```

(i)   By tracing the program show the output that will be produced.   *[5 marks]*

(ii)   Define the term local variable.   *[2 marks]*

(iii) State the names of all variables local to main().   *[1 mark]*

14. (a) Determine, by drawing an appropriate *truth table*, whether the following expressions are equivalent or not.

> **not**(A **and** B **and** C)
> **not** A **or not** B **or not** C   *[4 marks]*

(b) Construct a *logic circuit* corresponding to the following expression

> A **or** B **and** C   *[2 marks]*

(c) Simplify the following Boolean expression

> A **or** B **and** (**not** A **or** B) **or** A **and** (A **or** B)   *[4 marks]*

15. The processing unit of a computer contains an 8 bit data bus, a control bus and an 8 bit address bus. It also contains a number of registers including a program counter and an instruction register.

(a) Explain the functions of a bus. *[3 marks]*

(b) Outline the steps in the fetch-execute cycle and describe the function of the program counter in the cycle. *[5 marks]*

(c) State the number of bits contained in each memory location and the maximum number of memory locations available. *[2 marks]*

16. The following question refers to a Stack class with an object `theStack`, that defines

`int items[]` – indexed from 0;

`int top` – the index (subscript) of the last item put on the stack.

`int maxsize` – the maximum number of elements in the array.

Stack class methods are: `push(int anItem), pop(), isEmpty()` and `isFull()`.

(a)   Outline the purpose of

      (i)   `push()`   *[2 marks]*

      (ii)   `pop()`   *[2 marks]*

(b)   Identify the value of variable `top` when

      (i)   `theStack` is empty.   *[1 mark]*

      (ii)   `theStack` is full.   *[1 mark]*

(c)   One of the uses of stacks in computing is evaluation of arithmetic expressions.

      (i)   Convert the expression (5+6)/(4*3+9) to postfix notation.   *[2 marks]*

      (ii)   Evaluate the prefix notation expression * +2 4 – 6 8.   *[2 marks]*

17. A software application is used to monitor important environmental data. The application uses this data to create many graphics files which are then sent over a network.

    (a)   (i)   Define *file*.   *[2 marks]*

           (ii)   Outline **two** functions of the *file manager*.   *[2 marks]*

           (iii) Identify **one** common format of graphics files.   *[1 mark]*

           (iv) Explain the benefit of *data compression* in this software application.   *[2 marks]*

    (b)   A file used to store data about the air pollution which is measured every day of the year is partially indexed.
Compare *fully indexed* and *partially indexed* file organization.   *[3 marks]*