
International Baccalaureate®
Baccalauréat International
Bachillerato Internacional

**COMPUTER SCIENCE**
**HIGHER LEVEL**
**PAPER 1**

Monday 17 November 2014 (afternoon)

2 hours 10 minutes

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INSTRUCTIONS TO CANDIDATES

- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer all questions.
- The maximum mark for this examination paper is *[100 marks]*.

## SECTION A

*Answer **all** questions.*

**1.** (a) Outline **two** characteristics of spreadsheets. *[2]*

(b) Define the term *operating system*. *[1]*

**2.** Outline the function of the ALU. *[1]*

**3.** Outline the relationship between binary and hexadecimal. *[2]*

**4.** (a) Describe the characteristics of a stack. *[2]*

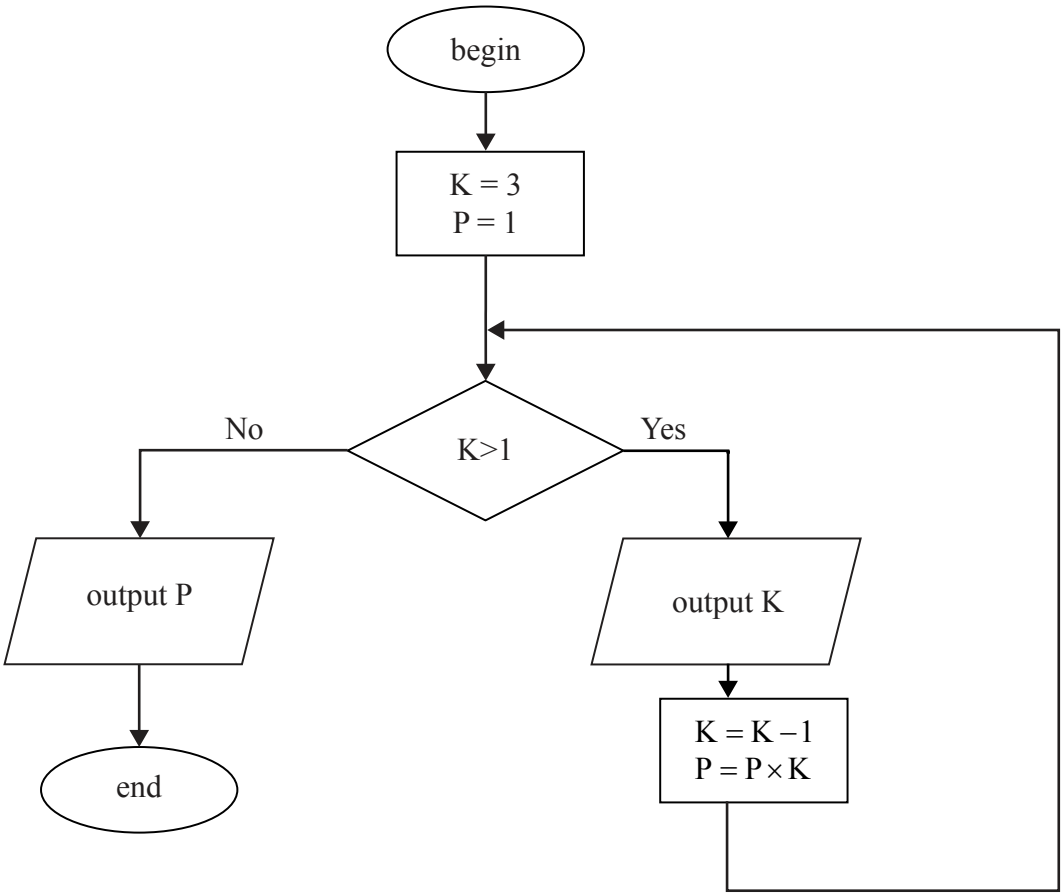
(b) Identify **two** applications of a stack in computing. *[2]*

**5.** Construct the truth table for the following Boolean expression.

X = NOT A AND B OR A AND NOT B *[4]*

**6.** State **three** advantages of using sub-programs in solving programming problems. *[3]*

**7.** Consider the following algorithm.




Trace the algorithm and show the outputs that will be produced. *[3]*

**8.** Define *polling*. *[2]*

**9.** (a) Define the term *protocol*. *[1]*

(b) Outline why protocols are necessary. *[2]*

## SECTION B

*Answer **all** questions.*

**10.** A customer buys an item in a small local shop and pays with a credit card. The sales transaction data is input to a computer at the point of sale. Prices are downloaded every morning from a central computer at the company headquarters. The credit card is verified with the card authorization centre and then the receipt is printed.

(a) Draw and label a system flow chart to represent this process in the shop. *[5]*

At the end of the day the sales transaction data is sent to the central computer at the company headquarters.

(b) Describe the processing that should be carried out at the company headquarters. *[2]*

All programs and data should be protected from theft, destruction, manipulation and alteration in this process.

(c) Identify **three** causes of data loss. *[3]*

(d) Describe why data loss is a more serious problem than the loss of software or hardware for a sales company. *[3]*

(e) Identify **two** methods of preventing data loss. *[2]*

**11.** A *magic square* is a two-dimensional array with $n$ rows and $n$ columns in which each of the integers 1, 2, 3, …, $n^2$ appears exactly once **and** all column sums, row sums and diagonal sums are equal.

The array A is a $7 \times 7$ magic square in which all rows, columns and the two main diagonals add up to 175.

**A**

| | [0] | [1] | [2] | [3] | [4] | [5] | [6] |
|---|---|---|---|---|---|---|---|
| [0] | 30 | 39 | 48 | 1 | 10 | 19 | 28 |
| [1] | 38 | 47 | 7 | 9 | 18 | 27 | 29 |
| [2] | 46 | 6 | 8 | 17 | 26 | 35 | 37 |
| [3] | 5 | 14 | 16 | 25 | 34 | 36 | 45 |
| [4] | 13 | 15 | 24 | 33 | 42 | 44 | 4 |
| [5] | 21 | 23 | 32 | 41 | 43 | 3 | 12 |
| [6] | 22 | 31 | 40 | 49 | 2 | 11 | 20 |

(a) Construct an algorithm to calculate the sum of all elements on the main diagonal, from A[0, 0] to A[6, 6]. *[2]*

(b) An array with $n$ rows and $n$ columns holds every number from 1 to $n^2$. Construct an algorithm that checks whether the $n \times n$ array is a magic square. *[8]*

The following is the algorithm for constructing a magic square with $n$ rows and $n$ columns for any odd integer $n$.

- Z = 1
- Place Z in the middle of top row
- Loop until all integers 1, 2, 3, …, $n^2$ are placed in the array
  - Z = Z + 1
  - Move one row up and one column to the right to place the integer Z, unless one of the following occurs
    - If a move takes you above the top row in the $j^{th}$ column, move to the bottom of the $j^{th}$ column and place the integer Z there
    - If a move takes you outside to the right of the square in the $i^{th}$ row, place the integer Z in the $i^{th}$ row at the left side
    - If a move takes you to an already filled square or if you move out of the square at the upper-right corner, place Z immediately below Z – 1.

(c) By applying this algorithm, **copy** and complete the $5 \times 5$ magic square, which has been started below. Do **not** write solutions on this page. *[5]*

| | | | | |
|---|---|---|---|---|
| | | 1 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

**12.** Three IB students are working on a programming project. They have 10 days to complete the work. To plan the project activities and timeline they produce the following Gantt chart.

| **Project activity** | **Timeline in days** | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Define the problem | | | | | | | | | | |
| Design algorithms | | | | | | | | | | |
| Code the program | | | | | | | | | | |
| Design test data | | | | | | | | | | |
| Test and correct modules | | | | | | | | | | |
| Overall program test | | | | | | | | | | |
| Produce documentation | | | | | | | | | | |

(a) State **two** tasks students should perform to define a problem. *[2]*

(b) Identify **two** tools or techniques that students could use to represent algorithms. *[1]*

(c) Discuss whether beta testing would be appropriate in this scenario. *[3]*

(d) Outline **three** criteria that could be used when deciding which programming language is to be used for coding. *[3]*

(e) From the Gantt chart above

(i) identify **two** tasks that could be done concurrently; *[1]*

(ii) identify **two** tasks that should be done sequentially. *[1]*

(f) Explain why a Gantt chart may not be suitable for planning a large business project. *[4]*

**13.** An automated security system monitors a prison.

(a) Suggest the sensors that could be used to detect any person crossing the perimeter. *[2]*

A team of security guards patrols the perimeter of the prison at night. The guards each carry a device incorporating a GPS that links to the prison's security system.

(b) Outline a suitable output that would notify a guard that a prisoner has escaped. *[2]*

The guards' GPS devices transmit information to the security system.

(c) Suggest the most suitable method for the transmission

(i) between the perimeter's sensors and the security system; *[1]*

(ii) between the security system and the guards' devices. *[1]*

(d) State **one** method of network security that could be used when transmitting the GPS information. *[1]*

(e) Outline how this GPS information may be used once transmitted to the security system. *[2]*

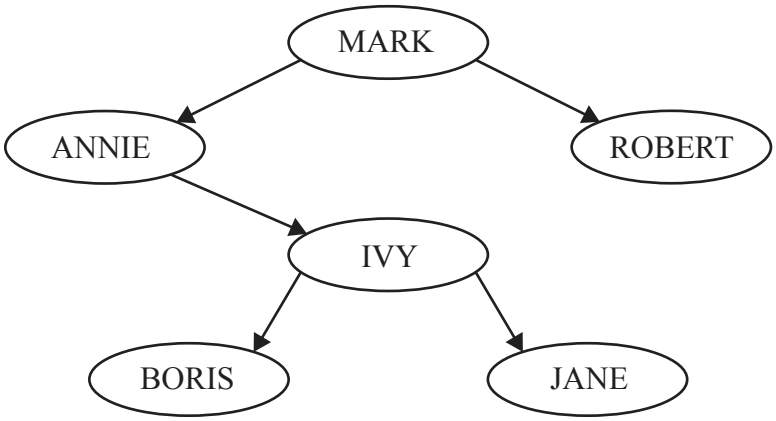
There are other situations where people may be required to carry GPS devices.

(f) Discuss the ethical implications of insisting people carry GPS devices. *[6]*

**14.** (a) (i) Describe, with the aid of a suitable diagram, a dynamic singly linked list. *[3]*

(ii) Explain how an item could be found in this list. *[3]*

(b) Consider the following binary tree.




(i) State the order in which data will be listed using postorder tree traversal. *[1]*

(ii) Identify the traversal which will return a list of names sorted in alphabetical order. *[1]*

(c) Describe how a name which is stored in **a node with two children** could be deleted from the binary tree without changing the order of the remaining names. *[4]*

(d) Compare the efficiency of finding a name in the binary tree with finding the same name in a linked list. *[3]*