Diploma Programme
Programme du diplôme
Programa del Diploma

**Computer science
Higher level
Paper 1**

Friday 4 May 2018 (afternoon)

2 hours 10 minutes

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]**.

8 pages

International Baccalaureate
Baccalauréat International
Bachillerato Internacional

Section A

Answer **all** questions.

A new computerized system is being planned for a school library.

1. (a) Describe **one** method by which systems requirements can be obtained from the
        stakeholders.   [2]

    (b) Outline **one** reason for providing a prototype for this new system.   [2]

2. Outline the role of the memory data register in the machine execution cycle.   [2]

3. Calculate how many different colours can be represented using two hexadecimal characters. [2]

4. Explain the importance of the memory management function of an operating system.   [3]

5. Construct a logic diagram for the following Boolean expression.

    NOT A OR (A AND B)   [3]

6. Consider the following algorithm.
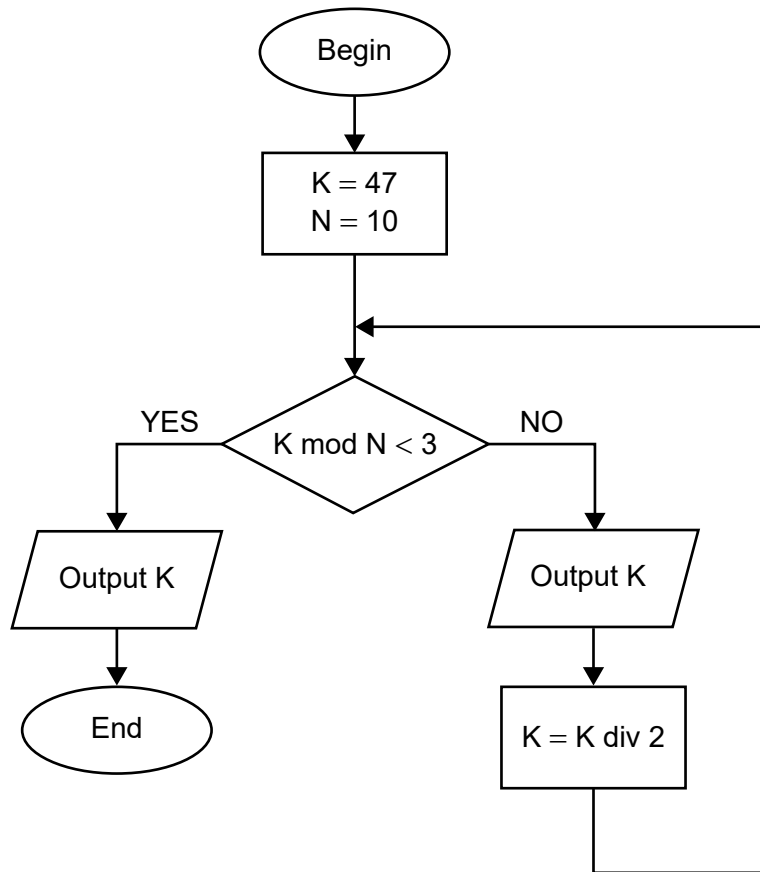
Determine the outputs that will be produced by this algorithm. [3]

7. Define the term *recursion*. [1]

8. Describe the characteristics of a queue. [2]

9. Compare the use of a linked list with an array to store and process the daily sales in a business. [3]

10. Outline the function of an interrupt. [2]

Turn over

Section B

Answer **all** questions.

11.   A medical centre uses a computer system to manage both patients' data and appointments. This system, which is used by the doctors, nurses and secretaries, has two unordered files: a patients' file and an appointments' file, both of which can only be accessed sequentially.

Every evening the following processing takes place:

- a list of appointments for the next day is printed out
- reminders are sent by SMS text messages to the patients' mobile devices.

(a)   Outline the pseudocode that the processing must follow when the system sends out the text reminders.   [5]

(b)   Describe **two** different methods that the medical centre could use that would allow data to be restored should it be lost for any reason.   [4]

The medical centre is concerned about the privacy of the data it is storing and has to make decisions concerning:

- access to the data stored on this system
- storing the data locally or through the use of a cloud service.

(c)   Discuss the issues that should be considered before making these decisions.   [6]

12. A company has expanded its office space into nearby rooms and has decided to set up a local area network (LAN) to support its operations.

The LAN will connect the room where the server is installed to new computers in the additional office space. The network engineer produced the following Gantt chart for this task.

TASK NAME	1	2	3	4	5	6	7	8	9	10
Lay ducts for new cables	▓	▓								
Lay cables inside the ducts			▓	▓	▓					
Install connectors on wall of server room						▓	▓			
Install connectors on wall of new office space						▓	▓			
Test the cabling								▓	▓	
Connect the new computers with the cabling									▓	▓

(a) Define the term *concurrent processing*.   [1]

(b) Identify **two** tasks that will be carried out concurrently.   [1]

(c) Identify **two** tasks that will be carried out sequentially.   [1]

After 5 years the company decided to replace the LAN with a wireless local area network (WLAN).

(d) Outline **two** advantages, to this company, of installing a WLAN.   [4]

A WLAN will introduce additional security issues for the company.

(e) Discuss any **two** of these issues and the ways in which the company might resolve them.   [4]

The company is considering expanding their network to allow employees to connect from anywhere in the world. The expanded network would need to provide security and allow the employees full functionality of the internal network.

(f) Explain how setting up a virtual private network (VPN) would provide a suitable solution.   [4]

Turn over

13. The names of students attending a science fair were recorded in a stack data structure as each one arrived.

…
Troy
Mia
Jane
Rick
Ryan
Abed
Zara
Sophie

The first item stored in the stack was "Sophie".

Note that "Troy" is currently in position 0 in the stack.

(a) Construct the pseudocode that will search the stack for a specific name, and output its position in the stack. You may assume that all names in the stack are unique. [5]

(b) Explain the benefits of using a binary search tree, compared to a stack, when searching for a specific item. [3]

If the tree is populated with the data from the stack, the first item popped off will become the root. For each subsequent item popped from the stack, a recursive procedure is followed until the item is correctly placed in the tree.

(c) Without writing code, describe this recursive procedure. [4]

(d) By considering only the data visible in the stack shown above, sketch the binary search tree that has been created from the items removed from the stack. [3]

14.   A number of devices in and around the home can be operated by control systems.

A home owner wishes to install automatic lights to illuminate a water fountain in her garden. These lights will automatically turn on at sunset and turn off at sunrise.

(a)   Describe **two** hardware components that would be an essential part of this
        control system.   [4]

(b)   Explain the concept of feedback, with respect to computer control systems in general.   [3]

The home owner has also installed a control system that waters the flowerbeds in the garden. This system aims to maintain the water content of the flowerbeds between a minimum and a maximum value. However, the system is only activated when the light intensity is below a certain level.

(c)   Outline the algorithm involved in controlling the watering system described above.   [5]

Turn over

15. A transport authority is investigating how many people use a certain direct train route.

At the end of each day, the total number of passengers who travelled on this route is stored in a collection, PASSENGERS.

The first item was written to the collection on Monday 1st May 2017.

(212)

The next items, collected on Tuesday and Wednesday, were added like this:

(212) ◄——— (454) ◄——— (342) ◄———
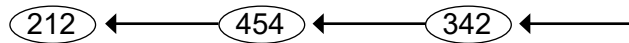
Data for 30 complete weeks was added to the collection.

(a) Construct pseudocode that will read PASSENGERS into the two-dimensional array, 2D_ARRAY.   [4]

2D_ARRAY		**Monday**	**Tuesday**	**Wednesday**	…
		[0]	[1]	[2]	…
Week 1	[0]				
Week 2	[1]				
Week 3	[2]				
…	…				

(b) Construct the pseudocode for the procedure total, that takes as input a column number of this two-dimensional array and returns the sum of the elements in that column.   [4]

The transport authority wish to know how many passengers, on average, travel on each day of the week.

(c) Using the procedure total construct the pseudocode to output the day of the week with the highest average number of passengers, and the value of this average.

You should make use of the sub procedure convert() which converts the numbers 0 to 6 into days of the week, for example convert(1) will return "Tuesday".   [3]

The transport authority stores details about the ticket prices in a one-dimensional array, FEES, where FEES[0] contains the price of a ticket for Monday to Friday, while FEES[1] contains the price of a ticket for Saturday and Sunday.

The procedure salesCalculate() takes as input the column and row indices that define two specific days during the 30 weeks, and outputs the total amount of money generated from ticket sales between those two days (inclusive).

(d) Construct, in pseudocode, the procedure salesCalculate().   [7]