



22127011



International Baccalaureate®
Baccalauréat International
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**COMPUTER SCIENCE
HIGHER LEVEL
PAPER 1**

Friday 18 May 2012 (afternoon)

2 hours 15 minutes

INSTRUCTIONS TO CANDIDATES

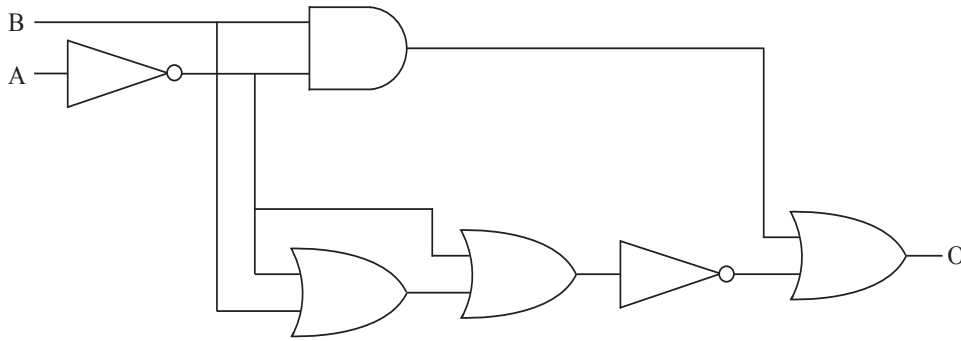
- Do not open this examination paper until instructed to do so.
- Section A: answer all the questions.
- Section B: answer all the questions.
- The maximum mark for this examination paper is *[100 marks]*.

SECTION A

Answer **all** the questions.

1. State **two** ways in which a *compiler* will help in the development of a program. [2 marks]
2. State **two** differences between the CPU in a desktop computer and the microprocessor in a washing machine. [2 marks]
3. Explain why both *validation* and *verification* are important when processing data. [4 marks]
4. Outline the *resource monitoring* function of an operating system. [2 marks]
5. (a) Determine the representation of the decimal number 12.25, in *fixed-point*, using 8 bits, where 3 bits are used for the fractional part. [2 marks]
(b) Determine the representation of –12.25, in *fixed-point*, using 3 bits for the fractional part, in *two's complement*. [1 mark]
6. Outline the function of *formatting* a disk for its first use by an operating system. [2 marks]
7. Explain the difference in the effect of a *logic error* and a *syntax error* in the development of a program. [4 marks]
8. A picture measures 70 by 100 pixels and is stored as a graphic file. The colour representation uses 5 bits for red, 5 bits for green and 5 bits for blue.
 - (a) Calculate how many different colours can be represented. [1 mark]
 - (b) Each pixel is stored in two bytes. Calculate the size of the graphic file. [1 mark]
 - (c) State **two** ways of storing the file in 12 kB RAM. [2 marks]
9. State **two** features of modern computers that can contribute to our environment's protection. [2 marks]

10. Consider the following circuit.



- (a) State, without simplifying, the Boolean expression in O that corresponds to the circuit. [2 marks]
 - (b) Simplify the Boolean expression in O from part (a) to minimize the number of gates in the corresponding circuit. [2 marks]
 - (c) Suggest a way to prove that the given circuit is equivalent to A **xor** B. [2 marks]
11. Identify **two** advantages of serial transmission over parallel transmission. [2 marks]
12. Explain **two** disadvantages of using *interviews* as a technique for data collection. [4 marks]
13. Identify **three** pieces of information that a *data packet* must contain. [3 marks]

SECTION B

Answer *all* the questions.

14. In a self-service fuel station, each pump has a touchscreen display equipped with a credit card reader and a printer for receipts. All these peripherals are connected to a common computer that can communicate with the various credit card companies. The pumps are set to deliver up to a maximum of 70 EUR of fuel.

The customer inserts the payment card, enters the PIN and chooses the type of fuel. The card is returned after validation and authorization from the credit card company, and only if these operations were successful can the fuel be dispensed. Finally, the customer can choose to have a printed receipt with the actual expenditure.

- (a) Describe the process that takes place at the station's computer after the card's PIN is entered through the touchscreen. *[2 marks]*
- (b) Identify **one** piece of information that the computer at the fuel station needs to communicate to the credit card company if the authorization was successful. *[1 mark]*
- (c) Construct the system flowchart for the scenario described above. *[4 marks]*

At night, the self-service fuel station may not be a particularly safe place.

- (d) Explain why the owner of the fuel station has decided to set a limit of 70 EUR. *[3 marks]*

15. Consider the following recursive method.

```
public int foo(int n)
{
    if (n <= 0) return -1;
    else
    {
        if (n == 1) return 1;
        else
        {
            int y = n % 2;
            if (y == 0) return foo(n / 2);
            else return foo(3 * n + 1);
        }
    }
}
```

(a) Identify the following in the code:

(i) a formal parameter; *[1 mark]*

(ii) a local variable. *[1 mark]*

(b) By copying and completing the following table, trace the algorithm for the call `foo(3)`. *[2 marks]*

n	y	return
3		

(c) Suggest a way to modify the method above in order to optimize the tests on `n`. *[2 marks]*

(d) Suggest how the method `bfoo`, that returns Boolean values, can be obtained as a modification of the method `foo`. *[2 marks]*

(e) State **one** advantage and **one** disadvantage of recursion versus iteration. *[2 marks]*

16. A farm grows fruit in several greenhouses. There is a network of sensors that contain microprocessors, which periodically measure the temperature and humidity in the greenhouses. When a sensor detects a value outside of the acceptable range, it sends a message that causes an *interrupt* in the main server.

- (a) Explain why *polling* would not be appropriate in this situation. [2 marks]
- (b) Outline how a CPU handles an interrupt. [3 marks]
- (c) Identify **one** process that takes place in the sensors' microprocessors. [1 mark]

The server performs various tasks, including the regulation of temperature and humidity in each greenhouse.

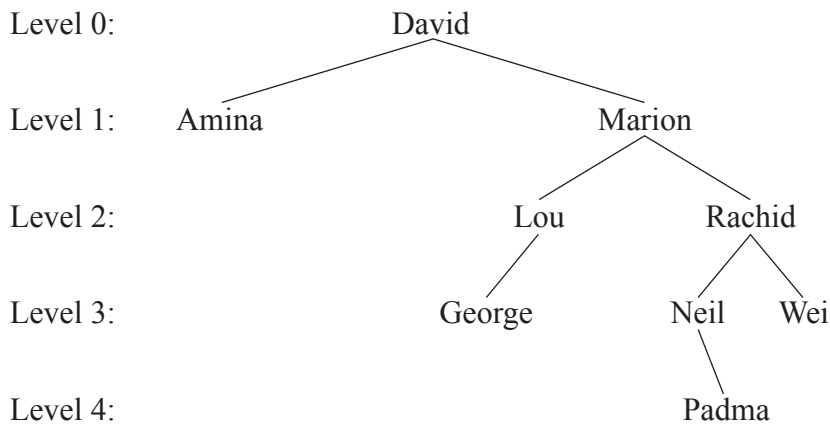
- (d) Suggest the steps the server would now take to restore conditions to within the acceptable range. [4 marks]

17. A social club stores on a disk file records containing some data of its members. The records do not need to be frequently accessed. The record structure is shown below.

Data type	Field name	Example data
int	memberNr	1000
String	name	Smith
String	address	Hollyoak Farm

- (a) Define the term *fixed-length record*. [1 mark]
- (b) Explain how the length of each record can be fixed considering the data types above. [3 marks]
- (c) Explain why *direct access* is an appropriate system for accessing data in this situation. [3 marks]
- (d) Describe how a record can be accessed quickly if the file does not consist of fixed-length records. [3 marks]

18. The tree shown below is *unbalanced*, i.e. there are at least two leaves in the tree that are located at levels whose difference is more than one. For example, the levels' difference for the leaves labelled Padma and Amina is three.



(a) State the mode of *traversal* on the tree above that would allow a list of names to be obtained in alphabetical order. [1 mark]

Successive operations of insertion and deletion of nodes must preserve the possibility of producing a list of names in alphabetical order through the mode of traversal identified in part (a).

(b) The node Silvia is added to the tree. Identify its position in the tree. [1 mark]

(c) Discuss how the order in which the names are inserted in the tree can affect the BigO efficiency of searching. [4 marks]

(d) Describe the steps, without writing any code, necessary to delete the node Marion from the given tree. [4 marks]

19. A company has set up a nationwide telephone call centre for enquiries. Depending on the phone number of the caller, a mainframe (central server) redirects incoming calls to one of the four servers, each of them located at a regional centre. The calls will then be directed to the operators in the regional call centre, working with their computers. The network developed is hybrid.

(a) Construct a labelled diagram showing a suitable hybrid network made up of two basic topologies. [5 marks]

(b) Suggest a physical transmission medium for communication:

(i) between the mainframe and the four servers at regional centres; [1 mark]

(ii) between the server and the operators' computers. [1 mark]

(c) Explain why switches would be used, rather than hubs, in this hybrid network. [3 marks]