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International Baccalaureate®
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COMPUTER SCIENCE
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PAPER 1

Thursday 6 May 2010 (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. State **two** items that would be included in a *requirements specification* in addition to inputs and outputs. *[2 marks]*

2. (a) Calculate $\mathrm{DE} + 3\mathrm{C}$, giving your answer in hexadecimal. *[2 marks]*

(b) State the answer to part (a) in binary. *[1 mark]*

(c) State the error that would occur when this result is stored in an 8 bit register. *[1 mark]*

3. Outline the function of the *arithmetic and logic unit* (ALU) in the *central processing unit* (CPU). *[2 marks]*

4. Compare *magnetic tape* with *flash memory* as media for backing up data. *[4 marks]*

5. Describe the difference between *private class members* and *public class members*. *[2 marks]*

6. (a) Outline **one** use of a *macro* within an application. *[2 marks]*

(b) State **two** advantages of using the macro from part (a). *[2 marks]*

7. Describe how a *check sum* could ensure data integrity in the transmission of data. *[3 marks]*

8. Outline **one** advantage of creating a prototype during the design stage of software development. *[2 marks]*

9. (a) State **two** examples of the use of an *interrupt*. *[2 marks]*

(b) Outline how the operating system processes an interrupt. *[2 marks]*

10. Describe the use of *key words* by Internet search engines. *[3 marks]*

11. (a) (i) Outline the characteristics of *serial transmission*. *[2 marks]*

(ii) State **one** suitable example of its use. *[1 mark]*

(b) (i) Outline the characteristics of *parallel transmission*. *[2 marks]*

(ii) State **one** suitable example of its use. *[1 mark]*

12. (a) Define the term *virtual memory*. *[2 marks]*

(b) Outline the use of virtual memory in the running of a program. *[2 marks]*

SECTION B

*Answer **all** the questions.*

13. Software is used to design a road bridge. The software allows the user to simulate small changes to the thickness of the materials used to build the bridge.

(a) Describe the data type needed to represent the thickness of the materials. *[2 marks]*

An important factor in bridge safety is the amount of traffic that uses the bridge.

(b) Outline **one** method for collecting data on the amount of traffic that would be using the bridge. *[2 marks]*

(c) Suggest how the results of this data collection would be used to influence the design of the bridge. *[4 marks]*

(d) Outline **one** advantage of using a computer and appropriate software to design the bridge. *[2 marks]*

14. An insurance company has over 50 000 customers, whose details are stored in records within a database. Two of the fields in the customer record are `customer name` and `customer ID`. The records are held in order of `customer ID`.

(a) Identify the search method used to access the record of a customer when the name is known and state the BigO efficiency of this search. *[2 marks]*

(b) Identify the search method that should be used to access the record of a customer when the `customer ID` is known and state the BigO efficiency of this search. *[2 marks]*

Another field in the customer record is `date payment due`. At the end of each month, the database is searched to find all customers whose payment is due.

(c) Identify the type of processing used in this search. *[1 mark]*

The company implements a completely new computer system with a better designed database. This is implemented overnight.

(d) Discuss the advantages and disadvantages of using a direct changeover method. *[5 marks]*

15. A washing machine which has several different programs can be set to start working at a specified time. The time to start and the required program are input by a user. The washing machine is controlled by a microprocessor.

(a) Identify **two** items that would need to be held in read-only memory (ROM). *[2 marks]*

(b) Identify **two** items that would need to be held in random access memory (RAM). *[2 marks]*

The microprocessor controls water input (W), heating (H) and rotation (R). The following table shows the state of these controls for whether or not the washing machine is operating (M).

W	H	R	M
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	0
1	1	1	1

(c) Use the truth table to state the logical conditions that define when the washing machine is operating **and** simplify the expression as far as possible. *[3 marks]*

(d) Construct the logical circuit from the simplified expression you obtained in part (c). *[3 marks]*

16. Study the recursive method below.

```
public int question(int n, int b)
{
  if (n / 10 > 0)
  {
    int y = (n % 10) * b;
    return (y + question(n / 10, b * 2));
  }
  else
    return (n % 10) * b;
}
```

(a) Identify the terminating condition. *[1 mark]*

(b) By showing the result of each recursive call, determine the output of this method when `n = 1011` and `b = 1`. *[5 marks]*

(c) Explain **one** advantage and **one** disadvantage of solving this kind of problem recursively rather than using an iterative method. *[4 marks]*

17. An online dictionary translates between English and German. When a user knows the German word they can find the English word and when a user knows the English word they can find the German word.

A sample of the word pairs that are stored is as follows:

GERMAN	ENGLISH
Fisch	Fish
Spinat	Spinach
Ei	Egg
Lamm	Lamb
Karotte	Carrot

Assume that these five pairs are input in the order shown.

(a) Construct the binary tree which stores the above list of pairs in alphabetical order by German word, showing the information which would need to be held at each leaf of the tree. *[4 marks]*

This data could also be represented as a single linked list in alphabetical order by German word.

(b) (i) Explain **one** advantage of using a binary tree. *[2 marks]*

(ii) Explain **one** advantage of using a single linked list. *[2 marks]*

(c) Suggest how this single linked list could be modified to allow translation from English to German as well as from German to English. *[2 marks]*

18. A website allows members to place orders for products. A person may become a member by completing an online form with their details, including payment method, email address and password. To order from the site a member must enter a username and a password.

(a) Outline the use of *verification* and *validation* in the completion of the membership form. *[2 marks]*

(b) Outline the way in which encryption should be used in this system. *[3 marks]*

(c) Explain the role of protocols when a member accesses the site. *[2 marks]*

Two members are logged onto the site at the same time and both want to buy the same product but there is only one left.

Some products are in limited supply and cannot be replaced.

(d) Outline a way in which the web server could be updated on the number of products in stock. *[1 mark]*

(e) Suggest how the web server would avoid the situation of two people buying the last item at the same time. *[2 marks]*