**AQA**

General Certificate of Secondary Education
June 2015

# Computer Science          4512/2

## Unit 2     Computing Fundamentals

Wednesday 3 June 2015     9.00 am to 10.30 am

**You will need no other materials**
You must **not** use a calculator.

**Time allowed**
* 1 hour 30 minutes

**Instructions**
* Use black ink or black ball-point pen.  Use pencil only for drawing.
* Answer **all** questions.
* Questions 4(b)(ii) and 8 should be answered in continuous prose.
   In these questions you will be marked on your ability to:
   * use good English
   * organise information clearly
   * use specialist vocabulary where appropriate.
* You must answer the questions in the spaces provided.  Do not write
   outside the box around each page or on blank pages.
* Do all rough work in this book.  Cross through any work you do not
   want to be marked.

**Information**
* The marks for questions are shown in brackets.
* The maximum mark for this paper is 84.
* You are reminded of the need for good English and clear presentation in
   your answers.

A

| Answer **all** questions in the spaces provided. |
|---|

**1 (a)** State the **denary** representation of the binary number 10111010.

[1 mark]

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**1 (b)** State the **hexadecimal** representation of the binary number 1110.

[1 mark]

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**1 (c)** State the **denary** representation of the hexadecimal number 4C. You **must** show your working.

[2 marks]

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**1 (d)** Place the following quantities in order of size (1 – 4, where 1 is the smallest and 4 is the largest).

| Quantity | Order (1 – 4) |
|---|---|
| 15 bits | |
| 3 nibbles | |
| 2 bytes | |
| 1 kilobyte | |

[3 marks]

**1 (e)** ASCII is a character-encoding system that uses seven bits to represent each character. Complete the table stating the binary representation of the character g.

| Character | Binary Representation |
|-----------|----------------------|
| f | 110  0110 |
| g | |

**[1 mark]**

**1 (f)** The following grid represents a bitmap image where a black pixel is represented using the bit pattern 00 and a white pixel is represented using the bit pattern 01. The binary encoding of each row is shown next to the image.

01010000

01000101

01010001

01010100

00000001

**1 (f) (i)** Which **one** of the following images has the correct encoding?

| | Image | Encoding | Tick one box |
|---|-------|----------|--------------|
| **A** | | 010100 000101 | |
| **B** | | 00010100 00000000 | |
| **C** | | 000100 010000 | |

**[1 mark]**

**Turn over ▶**

**1 (f) (ii)** State the maximum number of different colours that can be encoded when using two bits for each pixel.

**[1 mark]**

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**1 (f) (iii)** State the minimum number of bits needed to encode 32 different colours.

**[1 mark]**

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**1 (f) (iv)** State **one** factor, other than the number of bits used to represent individual colours, that can affect the quality of a bitmap image.

**[1 mark]**

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**12**

**2 (a)** Items of data can be combined together to form a data structure.

State the name of a programming language you are familiar with.

Programming language: ...............................................

Give **one** example of a data structure that can be used in that programming language.

Data structure: ...............................................

**[1 mark]**

**2 (b)** A programmer is developing a program that needs to record the names and ages of a group of students. Give **three** advantages of using a data structure to hold this information instead of using individual, separate variables for each name and age.

**[3 marks]**

Advantage 1.................................................................................................................

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Advantage 2.................................................................................................................

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Advantage 3.................................................................................................................

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**3 (a)** Define the term **algorithm**.

**[2 marks]**

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**Question 3 continues on the next page**

**Turn over ▶**

**3 (b)**   Two algorithms, **Algorithm 1** and **Algorithm 2**, are shown below.  Both algorithms have the same purpose.

**Note**: array indexing starts at 1.

<table>
<tr><th>Algorithm 1</th><th>Algorithm 2</th></tr>
</table>

```
a ← "diffie"
matched ← false
i ← 0
WHILE i < 5
   i ← i + 1
   IF arr[i] = a THEN
     matched ← true
   ENDIF
ENDWHILE
```

```
a ← "diffie"
matched ← false
i ← 0
WHILE i < 5 AND matched = false
   i ← i + 1
   IF arr[i] = a THEN
     matched ← true
   ENDIF
ENDWHILE
```

The completed trace tables for **Algorithm 1** and **Algorithm 2** are shown below when the array arr is ["kleene", "diffie", "naur", "karp", "hopper"].

| matched | i |
|---------|---|
| false   | 0 |
|         | 1 |
| true    | 2 |
|         | 3 |
|         | 4 |
|         | 5 |

| matched | i |
|---------|---|
| false   | 0 |
|         | 1 |
| true    | 2 |

Completed trace table for
**Algorithm 1**

Completed trace table for
**Algorithm 2**

**3 (b) (i)**   Both algorithms use a variable called i for the same purpose.  State the purpose of the variable i.

**[1 mark]**

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**3 (b) (ii)** What is the data type of the variable `matched`?

[1 mark]

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**3 (b) (iii) Algorithm 1** and **Algorithm 2** both have the same purpose.  State this purpose.

[1 mark]

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**3 (b) (iv)** Give **one** reason why **Algorithm 2** could be considered to be a better algorithm.

[1 mark]

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6

**Turn over for the next question**

**Turn over ▶**

**4 (a)** Four stages from a simplified waterfall software development life cycle model are given below.  Write the appropriate stage in the corresponding box in the diagram:

**Implementation    Testing    Design    Analysis**

Stage 1

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Stage 2

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Stage 3

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Stage 4

-------------------------------------------------

**[3 marks]**

**4 (b) (i)** State another software development life cycle model.

**[1 mark]**

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**4 (b) (ii)** Explain the advantages and/or disadvantages of using prototyping when developing solutions. In your answer you **must** also include a description of what prototyping is.

In this question you will be marked on your ability to use good English, to organise information clearly and to use specialist vocabulary where appropriate.

**[6 marks]**

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**10**

**Turn over ▶**

**5** The two tables **Airport** and **Country** form a relational database.

**Airport**

| AirportName | Code | CountryName | Terminals |
|---|---|---|---|
| Manchester | MAN | UK | 3 |
| Heathrow | LHR | UK | 5 |
| Frankfurt | FRA | Germany | 2 |
| Gatwick | LGW | UK | 2 |
| Hamburg | HAM | Germany | 2 |
| Fiumicino | FCO | Italy | 4 |

**Country**

| CountryName | Currency | TimeZone |
|---|---|---|
| Germany | Euro | 1 |
| Italy | Euro | 1 |
| UK | Pound Sterling | 0 |

**5 (a) (i)** Which **one** of the three fields in the table **Country** will be the primary key?

[1 mark]

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**5 (a) (ii)** How many records are there in the table **Airport**?

[1 mark]

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**5 (a) (iii)** Describe how a relationship has been created between the table **Airport** and the table **Country**.

[2 marks]

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**5 (b)** Place a tick next to the correct SQL command that will add Stansted airport in the UK (which has code STN and has 1 terminal) to the **Airport** table.

[1 mark]

| SQL Command | Tick one box |
|---|---|
| PUT INTO Airport VALUES ('Stansted', 'STN', 'UK', 1) | |
| UPDATE Airport SET AirportName = 'Stansted', Code = 'STN', Terminals = 1 WHERE CountryName = 'UK' | |
| INSERT INTO Airport (AirportName, Code, CountryName, Terminals) VALUES ('Stansted', 'STN', 'UK', 1) | |

**5 (c)** List the results of executing the following SQL query on this relational database.

```
SELECT Airport.Code, Airport.Terminals
FROM Airport, Country
WHERE Country.Currency = 'Euro' AND
      Country.CountryName = Airport.CountryName
ORDER BY Airport.Code ASC
```

[3 marks]

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**Turn over for the next question**

**Turn over ▶**

**6 (a)** What is a **computer system**?

[1 mark]

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**6 (b)** Memory and the processor are two essential pieces of hardware.  Explain, with reference to both memory and the processor, how a computer processes instructions.

[4 marks]

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**6 (c)** Give **one** reason why a CPU with two cores might perform faster than an equivalent CPU with only one core.

[1 mark]

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**6 (d)** The following are types of memory and storage (labelled A – F):

> A. Cache memory
> B. Magnetic media
> C. Non-volatile memory
> D. Optical media
> E. ROM
> F. Solid state media

For each of the descriptions in the table, write the label of the type of memory or storage it best describes.

| Description | Label (A – F) |
|---|---|
| Uses a laser to read the data | |
| Contents cannot be edited | |
| Small and very fast storage found close to the processor | |

**[3 marks]**

**6 (e)** State **one** situation when virtual memory might be needed.

**[1 mark]**

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**10**

**Turn over for the next question**

**Turn over ▶**

**7** The following function calculates the second hand price of different models of car. The parameter `condition` is an integer with a value between 1 and 4 where 1 is excellent and 4 is very bad.

```
FUNCTION CarPrice(model, condition, age)
  cost ← 0

  IF model = 'Daley' THEN
    cost ← 6000
  ELSE
    IF model = 'Minty' THEN
      cost ← 4000
    ELSE
      cost ← 2000
    ENDIF
  ENDIF

  CASE condition OF
    1: cost ← cost – 100
    2: cost ← cost – 300
    3: cost ← cost – 500
    4: cost ← cost – 1000
  ENDCASE

  cost ← cost / age

  RETURN cost
ENDFUNCTION
```

**7 (a)** `FUNCTION` and `ENDFUNCTION` are keywords in `CarPrice` that indicate it is a function. Which other keyword indicates that it is a function?

**[1 mark]**

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**7 (b)** Tick the most appropriate data type of the variable `cost`.

| Data Type | Tick one box |
|---|---|
| Boolean | |
| Character | |
| Real | |
| String | |

**[1 mark]**

**7 (c)** Complete the trace table below showing the changes in the variable `cost` when the function `CarPrice` is called with the following arguments:
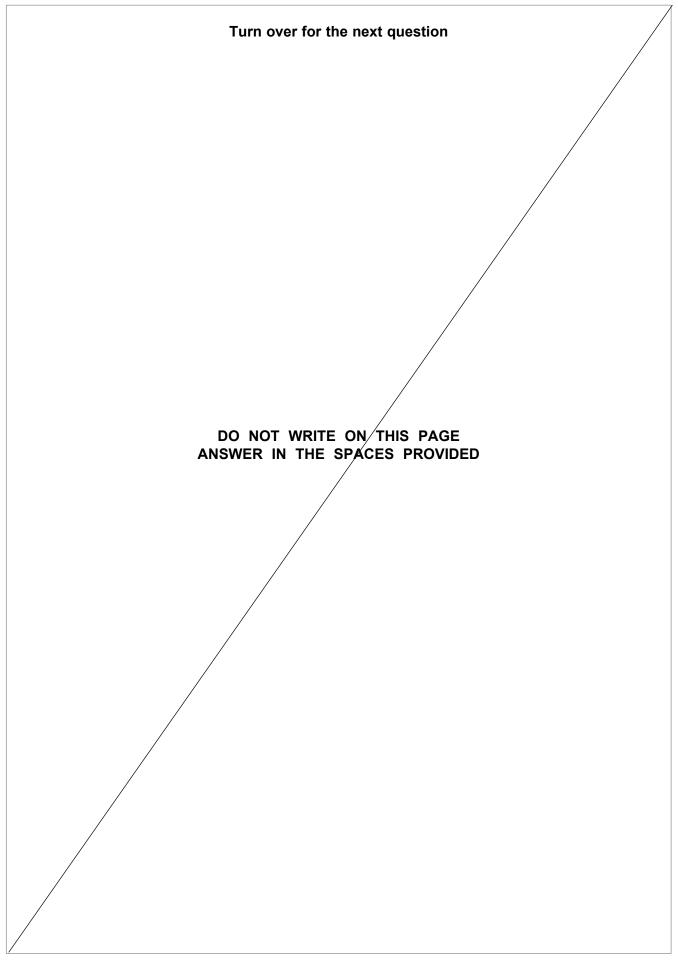
```
CarPrice('Tidy', 4, 2)
```

| cost |
|---|
| |
| |
| |
| |

**[4 marks]**

**7 (d)** State **three** advantages of using functions/procedures when developing a program.

**[3 marks]**

Advantage 1 ................................................................................................................................

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Advantage 2 ................................................................................................................................

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Advantage 3 ................................................................................................................................

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**9**

**Turn over ▶**

**8** Discuss the advantages **and** disadvantages of connecting a computer to a network.

In this question you will be marked on your ability to use good English, to organise information clearly and to use specialist vocabulary where appropriate.

**[6 marks]**

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**6**

**Turn over for the next question**

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**Turn over ▶**

**9**  An English teacher wants to estimate how long it should take his students to read a book.  You have been asked to develop an algorithm to calculate this estimate.  The algorithm must do the following:

- ask the teacher how many pages the book has and store this in an appropriately named variable

- for every page in the book the algorithm should:

    ○ ask the teacher if the page looks 'easy' or 'difficult'

    ○ if a page is 'difficult' then the total number of seconds should increase by 100

    ○ if a page is 'easy' then the total number of seconds should increase by 40

- after the teacher has entered the difficulty level for all the pages, the algorithm should output the estimated number of seconds that it should take to read the book.

Write pseudocode or draw a flowchart that represents this algorithm.

**[9 marks]**

**Turn over ▶**

**10** A built-in function commonly found in programming languages is one that finds the character in a string at a specific position. In some programming languages this function is called `CharAt`.

`CharAt(str, i)` returns the character found at position `i` of the string `str`. For example,

`CharAt("abc", 1) returns 'a'`
`CharAt("abc", 3) returns 'c'`

**10 (a) (i)** What value will be returned by the function call `CharAt("hello", 5)`?

**[1 mark]**

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**10 (a) (ii)** What value will be returned by the function call `CharAt("goodbye", (1+3))`?

**[1 mark]**

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**10 (b)** A palindrome is a string that is the same read forwards or backwards. For example, "abba" and "abcba" are both palindromes but "abcbb" is not.

The following algorithm uses the function CharAt to check if a string is a palindrome. This algorithm also uses the LEN function. LEN returns the length of a string, for example LEN("cpu") returns 3.

**Note:** line numbers have been shown but are not part of the algorithm.

```
1    strIn ← USERINPUT
2    isPalindrome ← true
3    iUp ← 1
4    iDown ← LEN(strIn)
5    WHILE iUp < iDown
6      IF CharAt(strIn, iUp) ≠ CharAt(strIn, iDown) THEN
7        isPalindrome ← false
8      ENDIF
9      iUp ← iUp + 1
10     iDown ← iDown - 1
11   ENDWHILE
```

Complete the trace table for this algorithm when the user input is "abcaba".

| strIn | isPalindrome | iUp | iDown |
|-------|--------------|-----|-------|
| abcaba | | | |
| | | | |
| | | | |
| | | | |
| | | | |

**[6 marks]**

**Question 10 continues on the next page**

**Turn over ▶**

**10 (c) (i)** A programmer develops a program from this algorithm but mistakenly types `WHIKE` instead of `WHILE` when implementing **line 5**. Tick the type of error that has been made.

| Type of error | Tick one box |
|---|---|
| Logical | |
| Run-time | |
| Syntax | |

**[1 mark]**

**10 (c) (ii)** The programmer makes another mistake and types a > symbol instead of a < symbol when implementing **line 5**. Tick the type of error that will occur when the program is run.

| Type of error | Tick one box |
|---|---|
| Logical | |
| Run-time | |
| Syntax | |

**[1 mark]**

10

**END OF QUESTIONS**

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