OCR
Oxford Cambridge and RSA

A Level Computer Science

H446/01 Computer Systems

Friday 16 June 2017 – Morning

Time allowed: 2 hours 30 minutes

6826891436

Do not use:
- a calculator

H446/01

First name									
Last name									
Centre number						Candidate number				

INSTRUCTIONS
- Use black ink.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided. Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the barcodes.

INFORMATION
- The total mark for this paper is **140**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended responses will be assessed in questions marked with an asterisk (*).
- This document consists of **28** pages.

Answer **all** questions.

1 An architect firm specialises in designing skyscrapers.

(a) The firm uses high end computers with high performance CPUs, GPUs and large amounts of RAM.

(i) Give **one** use the firm might have for GPUs.

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..... **[1]**

(ii) Describe what is meant by the term 'RAM'.

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..... **[2]**

(iii) State **one** characteristic a high performance CPU might have.

..... **[1]**

(b) Each computer has a multi-tasking operating system installed.

(i) State the name of and describe **two** methods that the operating system can use to divide the contents of RAM.

Method 1

Name .....

Description .....

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Method 2

Name .....

Description .....

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[4]

(ii) Explain, giving an example, why the firm's computers use operating systems capable of multi-tasking.

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..... **[2]**

(c) The computers in the office are connected to a LAN which is connected to the Internet.

(i) The LAN is set up in a client-server network.

Give **one** advantage and **one** disadvantage to the architects' firm of a client-server set up rather than a peer to peer setup.

Advantage .....

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Disadvantage .....

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[2]

(ii) The LAN is connected to the Internet via a firewall. Describe the term 'firewall'.

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..... **[1]**

(iii) State why the architects' firm would use a firewall.

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..... **[1]**

2 A coach company offers tours of the UK.

(a) A linked list stores the names of cities on a coach tour in the order they are visited.

(i) Describe what is meant by the term 'linked list'.

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..... **[3]**

(ii) The tour is amended. The new itinerary is: London, Oxford, Manchester then York. Explain how Birmingham is removed from the linked list and how York is added. You may use the diagram below to illustrate your answer.

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..... **[4]**

The program stores records about its customers.

(b) Often an individual customer's record needs to be accessed. This is done by searching using the Customer ID. Explain why a hash table is better suited than a linked list to store the customer records, particularly as the company acquires more customers.

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..... **[4]**

3 A charitable organisation is trying to make the works of William Shakespeare available to more people.

(a) The organisation decides to make a copy of Shakespeare's entire works available as a downloadable text file from its website. It further decides to compress the file before making it available to download.

(i) State an advantage to the website's visitors of the file being compressed.

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..... **[1]**

(ii) Explain why the company should use lossless and not lossy compression.

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..... **[3]**

(b)* The organisation looks at using either run length encoding or dictionary encoding to compress the file described in **part (a)**.

Discuss the **two** compression methods and justify which you would recommend. You may refer to the extract of text below to illustrate your argument.

What's in a name? that which we call a rose
By any other name would smell as sweet;
So Romeo would, were he not Romeo call'd, **[12]**

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4 A cinema offers discounted tickets, but only under one of the following conditions:

- Customer is under 18 and has a student card.
- Customer is over 60 and has ID which proves this.

Let:

A be Customer is under 18

B be Customer has a student card

C be Customer is over 60

D be Customer has ID

Q be Discount ticket issued

(a) Complete the Boolean expression below:

$Q \equiv$ .....

[3]

(b) The cinema has a voucher which promises free popcorn when the voucher is produced whilst buying a soft drink or bottle of water.

Let:

E be Voucher is shown

F be Soft drink is bought

G be Bottle of water is bought

R be Free popcorn given.

This could be written as:

$R \equiv (E \wedge F) \vee (E \wedge G)$

(i) Complete the truth table below.

E	F	G	(E∧F)	(E∧G)	(E∧F)∨(E∧G)
1	1	1			
1	1	0			
1	0	1			
1	0	0			
0	1	1			
0	1	0			
0	0	1			
0	0	0			

[4]

(ii) Simplify the expression

(E∧F) ∨ (E∧G)

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..... **[2]**

Most films are now distributed to cinemas digitally. A studio allows cinemas to download its latest film 5 days before the release date via a private download. It wants to ensure that no cinema shows it before the release date.

(c) Describe **one** technical measure the studio could use to ensure that films are not shown early.

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..... **[2]**

5 **(a)** Below is part of a program written using the Little Man Computer instruction set. This section of code can exit by either jumping to the code labelled `pass` or `fail` depending on what value is in the accumulator when the code is run.

```
test    SUB     ten
        BRZ     pass
        BRP     test
        BRA     fail

ten     DAT     10
```

(i) Explain what the line `ten DAT 10` does.

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..... **[3]**

(ii) Complete the table below determining whether the program branches to `pass` or `fail` given the following values in the Accumulator when it is run.

Starting value in Accumulator	`pass` or `fail`
29	
30	
31	

[3]

(b) The complete program is shown below:

```
        INP
main    STA     entry
        BRA     test
fail    LDA     entry
        ADD     one
        BRA     main

test    SUB     ten
        BRZ     pass
        BRP     test
        BRA     fail

pass    LDA     entry
        OUT
        HLT

entry   DAT
ten     DAT     10
one     DAT     1
```

(i) Give **one** instruction in the program that when executed, changes the value in the Accumulator.

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..... **[1]**

(ii) Give **one** instruction in the program that when executed, changes the value in the Program Counter.

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..... **[1]**

(iii) State the value the code outputs for the input 18.

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..... **[1]**

(iv) State the value the code outputs for the input 37.

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..... **[1]**

(v) Describe the purpose of the program.

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..... **[2]**

6 **(a)** **(i)** Convert the denary number 188 to an unsigned 8-bit binary number.

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..... **[1]**

(ii) Convert the denary number 188 to hexadecimal.

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..... **[1]**

(b) **(i)** Convert the denary number −44 to an 8-bit binary number with sign and magnitude representation.

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..... **[1]**

(ii) Convert the denary number −44 to an 8-bit binary number with two's complement representation.

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..... **[1]**

(c) Explain how, using bit shift, the unsigned binary number 00101100 can be divided by 4.

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..... **[2]**

(d) Demonstrate subtraction on the two numbers below, both stored in normalised floating point format, using 6 bits for their mantissa and 4 for their exponent. Show the result in the same format. Show your working.

010010 0100 - 010010 0010

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..... **[6]**

7 A web forum stores all its content in a database.

(a) The forum stores details of its users in the table called `Users`. An extract of `Users` is shown below.

userID	username	passwordHash	locked
1	Zeus	8dfa46a79248037752bba6166fcb34f8	1
2	Hera	74d39d60507eb55e000c6ec5c1265891	0
3	Poseidon	b015d770d0208ddcce2c2c719fe29371	0

Describe what is meant by the term 'primary key', giving an example from the table above.

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..... **[2]**

(b) The user's password is passed to a function that generates a hash and the result is stored in `passwordHash`.

(i) Describe what is meant by the term 'hash'.

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..... **[1]**

(ii) Describe **one** advantage to storing the password as a hash.

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..... **[2]**

(c) Write an SQL statement to get just the `passwordHash` and `locked` values of the user `Apollo`.

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..... **[3]**

(d) Sometimes users can have their accounts locked if they behave inappropriately. When this is the case the `locked` field is set to 1 rather than 0.

Write an SQL statement that locks the account of the user `Hades`

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..... **[3]**

(e) The function `checkAccess` takes in the password the user has entered (`givenPassword`) along with the password hash (`passwordHash`) and locked value (`locked`).

`passwordHash` and `locked` have already been extracted from the database before being passed to the function. It should return the value `true` if a user should be allowed access to a system and `false` if they aren't.

Your function should make use of the pre-written function `hash()` which takes in a string and returns the hash of that string.

e.g.

`hash("Hello")` returns `f7ff9e8b7bb2e09b70935a5d785e0cc5d9d0abf0`

Complete the function `checkAccess`.

```
function checkAccess(givenPassword, passwordHash, locked)
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endfunction
```

[4]

8* *"Developments in Artificial Intelligence mean that in twenty years time most people will be unemployed."*

Discuss whether or not you agree with this statement.

[9]

9 A website contains the following HTML:

```
<html>
<head>
   <title>Boris' Cake Shop</title>
   <link rel="stylesheet" type="text/css" href="style.css">
</head>
<body>
   <h1>Boris' Cake Shop</h1>
   <p id="intro">
      Welcome to Boris' cake shop.
      <script>
         var hour = new Date().getHours();//gets the hour value of the
current time
         if(hour>9 && hour<17)
         {
            document.write("We are currently open.");
         }
         else
         {
            document.write("We are closed, come visit us when we are
open (09:00 - 17:00).");
         }
      </script>
   </p>
   <div class="customerQuote">
      Boris makes the best cupcakes I have ever tasted.
   </div>
</body>
</html>
```

(a) Explain the difference between a HTML id attribute and a HTML class attribute.

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..... **[2]**

(b) The html file is linked to the CSS file `style.css`

Text between `h1` tags should be in the font Arial.

The customer quote should be on a background with the colour E8C3E1.

The introduction text should be dark red (using the named colour darkRed).

Write the code that should go in `style.css` to give this formatting.

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..... **[6]**

(c) The code between the `script` tags is supposed to display a different message during the shop's opening hours of 09:00 and 17:00.

(i) State the name of the language used between the `script` tags.

..... **[1]**

Some users have reported that there is a bug and the site says the shop is closed when they log on between 9 and 10 in the morning.

(ii) Explain how this bug can be fixed.

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..... **[1]**

(iii) Give **one** disadvantage of this code being run client side rather than server side.

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..... **[1]**

10 A software development team is writing a word game.

The team is using Rapid Application Development.

(a) Describe the Rapid Application Development process.

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..... **[4]**

Players are given 10 random letters and asked to find the largest word they can make from those letters. Each letter can only be used once. The length of the word determines the number of points awarded. e.g. a word with 6 letters would mean 6 points are awarded.

The function `validateAnswer` takes in the `randomLetters` as an array of letters and the player's `answer` as a string. It then checks if the word the player has entered only contains letters from the 10 random letters with each letter being used only once. (At this stage the program doesn't check if the answer provided is an actual word.) It then returns a score, out of 10, for a valid word or 0 for an invalid word.

Example

If the random letters are

`OPXCMURETN`

The word `COMPUTER` returns 8

Whereas

The word `POST` returns 0 (there is no S in the random letters).

And

The word `RETURN` returns 0 (there is only one R in the random letters).

(b) Complete the function `validateAnswer`

```
function validateAnswer(answer, randomLetters[])
```

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```
endFunction
```

[6]

(c) Code is to be added to check if the word is an actual English word. All English words are stored in a binary search tree.

Give **one** advantage of storing the words in a binary search tree over an array.

..... **[1]**

(d) The software team use a prebuilt library to create the Graphical User Interface.

(i) Give **two** advantages to the software team of using a library.

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[2]

(ii)* The program is compiled. Explain the process of compilation including how code from the library becomes part of the finished program, justifying why each stage is necessary.

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.... **[9]**

11 A half adder has the truth table shown below:

A	B	Sum	Carry
1	1	0	1
1	0	1	0
0	1	1	0
0	0	0	0

(a) Draw a half adder using logic gates.

[3]

(b) Draw the logic gates represented by the Karnaugh Map below. Show your working.

CD \ AB	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	0	0	1	1
10	0	0	1	1

[4]

END OF QUESTION PAPER

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