

**OXFORD CAMBRIDGE AND RSA EXAMINATIONS
A LEVEL**

H446/01

COMPUTER SCIENCE

Computer Systems

FRIDAY 16 JUNE 2017:

Morning

**TIME ALLOWED: 2 hours 30 minutes
plus your additional time allowance**

MODIFIED ENLARGED 24pt

First name		Last name	
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Centre number						Candidate number				
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DO NOT USE:

A calculator

READ INSTRUCTIONS OVERLEAF



INSTRUCTIONS

Use black ink.

Complete the boxes on the first page 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).

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 (*).

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.

_____ **[1]**

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

_____ **[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 _____

Method 2

Name _____

Description _____

_____ [4]

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

_____ [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 _____

Disadvantage _____

[2]

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

[1]

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

[1]

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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’.

- (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.



[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.

[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.

[1]

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

[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. [12]

**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,**

[illegible]

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: [3]

Q \equiv _____

(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:

$$\mathbf{R \equiv (E \wedge F) \vee (E \wedge G)}$$

(i) Complete the truth table below. [4]

E	F	G	$(E \wedge F)$	$(E \wedge G)$	$(E \wedge F) \vee (E \wedge G)$
1	1	1			
1	1	0			
1	0	1			
1	0	0			
0	1	1			
0	1	0			
0	0	1			
0	0	0			

(ii) Simplify the expression

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

[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.

[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.

[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. [3]

Starting value in Accumulator	pass or fail
29	
30	
31	

(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.

[1]

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

[1]

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

[1]

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

[1]

(v) Describe the purpose of the program.

[2]

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

[1]

- (ii) Convert the denary number 188 to hexadecimal.**

[1]

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

[1]

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

[1]

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

[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

[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 opposite.

Describe what is meant by the term ‘primary key’, giving an example from the table opposite.

[2]

userID	username	passwordHash	locked
1	Zeus	8dfa46a792480377 52bba6166fcb34f8	1
2	Hera	74d39d60507eb55e 000c6ec5c1265891	0
3	Poseidon	b015d770d0208ddc ce2c2c719fe29371	0

(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'.

[1]

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

[2]

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

[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

[3]

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- (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  
f7ff9e8b7bb2e09b70935a5d785e  
0cc5d9d0abf0
```

Complete the function `checkAccess` below. [4]

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

endfunction

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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]

[illegible]

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.

[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.

[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.

[1]

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

[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.

[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 [ ] ) [6]
```

endFunction

- (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.**

1 _____

2 _____

[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. [9]**

[illegible]

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 below. [3]

(b) Draw the logic gates represented by the Karnaugh Map below. Show your working. [4]

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

END OF QUESTION PAPER

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