



Bishop Challoner

Computer Science Department

A Level Computer Science Revision Pack 01 – Computer Systems

The mark scheme for each paper follows the questions

Included (in order of appearance)

2019
2018
2017

How to revise Computer Science

Practice questions from past papers are one of the best methods of revising topics from the course. This approach, accompanied by creating notes and reading the course textbook as a source for information, has proven successful for many of our previous students.

How to revise a particular topic

this is generic and by no means a one size fits all approach

1. On a single sheet of A4, write down everything you currently know about the topic. Do this prior to reading the course textbook or seeking help from previous notes.
2. Now consult course textbook for the topic and add to this sheet, anything you did not know that is necessary – once complete, highlight these points – these are the areas you need to learn.
3. Locate questions based around this topic in the past paper pack and attempt to answer them.
4. Confirm with the mark scheme as to your success in answering the question.

The end goal of this approach would be that you are comfortably able to produce a piece of A4 for each topic of the course and then apply this information to the past paper questions.

Obtaining feedback for answers

The students who succeed the best in computer science are those who seek constant feedback from teachers, not just in the scope of a lesson. Any work you produce out of lesson such as past paper question answers or programming challenges, you should want to seek feedback for. This can be achieved by:

1. Taking work to a teacher during school time.
2. Emailing a teacher your answers, questions etc.

Mr Ravenscroft – l.ravenscroft@bishopchalloner.bham.sch.uk
Mr Ebrahim – b.ebrahim@bishopchalloner.bham.sch.uk

As your teachers we want to give you feedback!

Study Skills and Support

Exam board: OCR

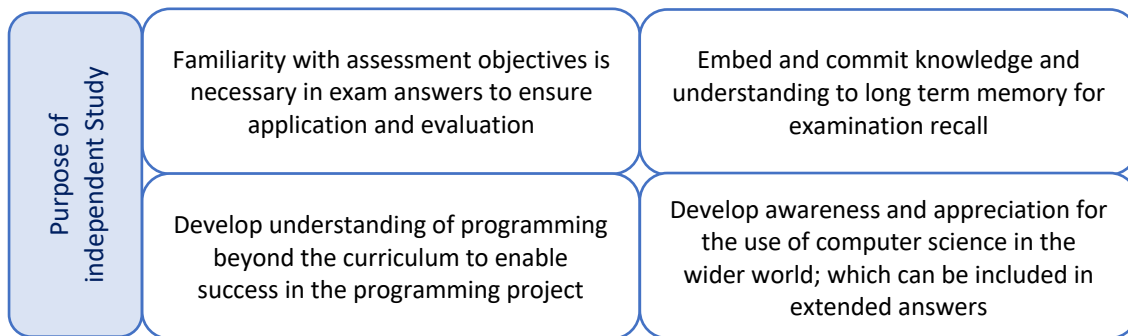
Course length: 2 years

How is it assessed? 2 written exams on 01 – Computer Systems and 02 – Algorithms and Programming (each worth 40%) and a programming project worth 20%.

Modules covered:

01 – Processors, Input – Output and Storage, Systems software, software development, compression, databases, networks, web technologies, data types, data structures, Boolean algebra, morals and ethics.

02 – Thinking abstractly; ahead; procedurally; logically; concurrently, programming techniques, computational methods, algorithms.



Resource	Link	Useful For...	Requirements
Course Textbook	N/A	Independent revision & study	Course textbook from the school library.
YouTube	YouTube	Knowledge booster, second voice	N/A
Past Paper Packs	N/A	Exam style question practice, independent study	Past paper pack from class teacher
Departmental resources	All stored within the Microsoft Teams Team for the group.	Accessing departmental materials and lessons	School email and password login.
Mr Fraser	www.mrfraser.org	Accessing resources and work sheets	mrfraser.org login account (free to create)
Craig n Dave	craigdave.org	Resources for topics – broken down by spec	Access is free for most content – school has a paid account
AQA Past Papers	Search 'AQA A Level Computer Science Past Papers' on Google.	Different phrasing of exam style questions.	N/A
Class Teachers	l.ravenscroft@bishopchalloner.bham.sch.uk b.brahim@bishopchalloner.bham.sch.uk		

Monday 3 June 2019 – Morning

A Level Computer Science

H446/01 Computer Systems

Time allowed: 2 hours 30 minutes



You may use:

- a ruler (cm/mm)
- an HB pencil

Do not use:

- a calculator



Please write clearly in black ink. **Do not write in the barcodes.**

Centre number

--	--	--	--	--

Candidate number

--	--	--	--

First name(s)

Last name

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- 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 (*).
- This document consists of **28** pages.



1 A company releases an in-home virtual assistant called 'Bertie Butler'.

The device, when placed in a room, listens out for the phrase "Hey Bertie". When someone says that phrase it then listens to the question that follows and tries to give a relevant answer.

Bertie Butler has a number of built-in input and output devices.

(a) Name **one** input device and **one** output device that might be part of Bertie Butler. For each device give a reason for it being built into the virtual assistant.

Input Device Name:

Input Device Reason:

.....

Output Device Name:

Output Device Reason:

.....

[4]

The Bertie Butler device runs off an embedded operating system.

(b) Define the term 'embedded operating system'.

.....

.....

.....

.....

[2]

- (c) Bertie Butler’s circuitry is designed to only listen out for “Hey Bertie” under certain circumstances, which are:

The privacy button (**P**) must be off and the microphone must generate a signal (**S**) to say a sound has been heard.

- (i) Complete the truth table for whether the device is listening (**L**).

P	S	L
False	False	
False	True	
True	False	
True	True	

[2]

- (ii) Draw logic gates to represent the circuitry needed.

[3]

- (d) The Bertie Butler machine uses a multicore processor.

Define the term ‘multicore processor’.

.....

.....

.....

..... [2]

2 A survey is carried out to look at the types of vehicle that travel down a stretch of motorway.

For each vehicle that passes by, a letter is entered into the system.

For a car 'C' is entered.

For a motorbike 'M' is entered.

For a lorry 'L' is entered.

For any other vehicle 'O' is entered.

It is decided to compress the data that has been generated.

(a) State what is meant by the term 'compression'.

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

It is decided that Run Length Encoding will be used.

(b) The following sequence has been compressed using Run Length Encoding.

3C3M4C

Show the result of decompressing the sequence.

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

(c) Show the result of using Run Length Encoding to compress the sequence:

CCCCOLLCCCCMOCCCC

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

5

The survey takers want to find out the longest continuous sequence of cars in any given chunk of data. For example, in the data

CCMCCCCLLCCC

the longest sequence would be 4.

- (d) Write the function `longest` which takes in a string of characters as an argument and returns an integer representing the longest continuous sequence of Cs.

[5]

3 A program written in the Little Man Computer instruction set is given below.

```

        INP
        STA    num
loop    LDA    total
        ADD    num
        STA    total
        LDA    count
        ADD    one
        STA    count
        SUB    num
        BRZ    end
        BRA    loop
end     LDA    total
        OUT
        HLT
one     DAT    1
num     DAT    0
count   DAT    0
total   DAT    0
    
```

(a) State what the program outputs are for the following inputs.

Input	Output
1	
2	
3	

[3]

(b) State what the purpose of the program is.

.....
 [1]

(c) Explain which registers are used and their values when the line `STA count` is **executed** and the accumulator is holding the value 9. The label `count` refers to memory location 16.

.....

 [2]

Whilst the line `STA count` is being executed, the CPU receives a signal from another process, requiring its attention.

(d) State the name for the signal received by the CPU.

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

(e) The code uses direct addressing. Describe **one** other mode of addressing.

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

4 Traditionally films have been distributed on optical media such as DVDs.

(a) Giving an example other than DVDs, describe what is meant by the term 'optical media'.

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

(b) Give **one** advantage of films being distributed using optical media.

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

Adding a DVD drive to a computer would often require the installation of a piece of software called a device driver.

(c) State the purpose of a device driver.

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

It is now common for people to purchase films which, rather than having a physical copy of, they can stream or download over the internet whenever they want.

(d) Explain the advantages and disadvantages of owning films that are streamed or downloaded on demand rather than owning a physical copy.

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

Being able to stream high resolution films is only possible due to improvements in compression.

(e) Explain why compression is important for the streaming of high resolution films.

.....

.....

.....

.....

.....

.....

..... [3]

- 5 A programmer is writing software for a firewall. She is writing code so that it keeps a track of websites that users are permitted to visit. The software stores the websites' addresses along with details about who can view them and when.

The following data is also stored about each website:

- Access level needed (1-4)
- If it is available all the time (`true`) or just lunch times and out of work hours (`false`).

So a website which is available to users of access level 2 and above, all the time, would have the details `[2, true]` stored.

A website accessible to users of access level 3 and above, only outside of work hours, would have the details `[3, false]` stored.

- (a) State the name of a data structure that could be used to store a single site's details.

.....
 [1]

The address of each website, along with the relevant details, are stored in a hash table.

The hash table's hash function is carried out on the website's address (which acts as the key). The hash function works in the following way:

1. Discard the characters up to and including the first dot.
2. Discard the characters including and to the right of the remaining leftmost dot.
3. Convert the characters to uppercase.
4. Add the ASCII values of the characters together.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90

For example `www.ocr.org.uk` gets hashed in the following manner:

Step 1:

`ocr.org.uk`

Step 2:

`ocr`

Step 3:

`OCR`

Step 4:

$79+67+82 = 228$

giving a hashed value of 228.

(b) State what hashed value would be given by the website `www.foo.co.uk`

.....
 [1]

(c) Complete the function `hash` which takes in a string and returns the hashed value.

You can assume you have access to the following three functions.

- `asc()` – this takes in a character and returns its ASCII value. For example `asc("A")` returns 65.
- `locate()` – this takes in a string and character and returns the location of the first instance of the character (with the string starting at character 0). For example `locate("electricity", "c")` returns 3.
- `upper()` – this takes in a string and returns the UPPERCASE version. For example `upper("hello")` returns "HELLO".

You should also assume that all given website names use letters but no numbers or symbols.

You will be given credit for the readability of your code.

```
function hash(siteName)
```

```
endfunction
```

[5]

.....

.....

.....

.....

.....

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.....

.....

.....

.....

6 A company makes anti-virus software.

Anti-virus software is an example of a utility.

(a) Define the term 'utility'.

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

(b) State how an application differs from a utility.

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

In order to keep up to date with the latest virus threats, the company is continually updating their software.

The programmers use an Extreme Programming approach when developing the updates.

(c) Explain what is meant by Extreme Programming and why it is a suitable approach in this case.

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

(d) Explain why the programmers of anti-virus software may make use of virtual machines when developing the updates.

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

When running the anti-virus software, an operating system uses a scheduling algorithm to determine an allocation of CPU time to the anti-virus software.

(e) Explain why a First Come First Served scheduling algorithm would **not** be suitable in this situation.

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

In the late 1990s the CIH virus hit headlines because it was able to overwrite and destroy the contents of a computer's BIOS.

(f) Describe what the effect would be of a computer having its BIOS overwritten.

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

7 RestaurantReview is a website that allows users to leave reviews and ratings for different restaurants.

The website uses a database with the following structure.



The database management system ensures referential integrity is maintained.

(a) Explain what is meant by referential integrity, giving an example which refers to the database described above.

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

(b) Each review includes a score out of 5. When the score is entered on the website it is checked in the browser to ensure a number no higher than 5 has been entered. It is then checked again on the server.

(i) State what is meant by the term 'server'.
.....
..... [1]

(ii) Explain why it is important that the review score that the user entered is also checked server-side.

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

Whenever a review is added to the system, the restaurant's average rating is updated. This transaction is ACID.

The A in ACID refers to Atomic.

- (c) Describe what is meant by the term 'Atomic' in the context of ACID transactions. You should refer to the example of a review being added.

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

- (d) State what the letters CID refer to in ACID.

C

I

D

[3]

The database previously stored reviews using the ASCII character set. ASCII uses 1 byte per character. It is decided to switch to the Unicode UTF-32 character set which uses 4 bytes per character.

- (e) Give an advantage and disadvantage of changing character sets from ASCII to Unicode UTF-32.

Advantage

.....

Disadvantage.....

.....

[2]

8 A simple program is shown below.

```
//Program to calculate number of times
//a number goes into 100
count = 0
num = int(input("Enter a number"))
while (count*num)<=100
    count=count+1
endwhile
count=count-1 //Take one off as gone over
print(str(num) + " goes into 100 " + str(count) + " times.")
```

Fig. 8.1

(a) State the output of the program when the number 30 is entered.

.....
 [1]

(b) State the most suitable data type of the variable `count`

.....
 [1]

(c) State the data type of the result of the expression `(count*num)<=100`

.....
 [1]

(d) State the data type of the result of the expression

`str(num) + " goes into 100 " + str(count) + " times."`

.....
 [1]

(e) Write extra code so the program also displays the remainder.

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

The program is compiled. The first stage is Lexical Analysis.

(f) Referring to examples in the code in Fig. 8.1, explain what happens in Lexical Analysis.

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

(g) State the name of the stage of compilation that directly follows Lexical Analysis.

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

10 (a) Show how the binary number 01011110 is represented in hexadecimal.

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

(b) Show how the hexadecimal number 9B is represented in denary.

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

(c) Show how the denary number -87 is represented in sign and magnitude binary.

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

(d) Complete the following binary subtraction. Show your working.

$$\begin{array}{r} 01001001- \\ \underline{00101111} \end{array}$$

[2]

- (e) The floating point binary number 010011 011 consists of a 6-bit mantissa and 3-bit exponent, both represented in two's complement. Convert the number to denary, showing your working.

.....

.....

.....

.....

.....

.....

.....

..... [3]

- (f) Show the denary number -5.25 in floating point binary form representing the mantissa and exponent in two's complement, using as few bits as possible. Show your working.

.....

.....

.....

.....

.....

.....

.....

.....

..... [4]

(b) Part of a website's code is shown below.

```
<head>  
  <title>Orville's Oranges</title>  
  <link rel="stylesheet" type="text/css" href="mainStyle.css">  
</head>
```

Explain the meaning of the code.

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

(c) The site also contains the following code.

```
<div class="offer">All oranges 50% off.</div>
```

Complete the CSS code that would make any div elements of the class `offer` have an orange border.

```
..... {  
    border-style: solid;  
    .....  
}
```

[2]

26
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OCR

Oxford Cambridge and RSA

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GCE

Computer Science

H446/01: Computer systems

Advanced GCE

Mark Scheme for June 2019

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This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

Annotation	Meaning
	Omission mark
	Benefit of the doubt
	Subordinate clause / consequential error
	Incorrect point
	Expansion of a point
	Follow through
	Not answered question
	No benefit of doubt given
	Point being made
	Repeat
	Correct point
	Too vague

0	Zero (big)
BP	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
L1	Level 1
L2	Level 2
L3	Level 3

Subject-specific Marking Instructions

INTRODUCTION

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper and its rubrics
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

USING THE MARK SCHEME

Please study this Mark Scheme carefully. The Mark Scheme is an integral part of the process that begins with the setting of the question paper and ends with the awarding of grades. Question papers and Mark Schemes are developed in association with each other so that issues of differentiation and positive achievement can be addressed from the very start.

This Mark Scheme is a working document; it is not exhaustive; it does not provide 'correct' answers. The Mark Scheme can only provide 'best guesses' about how the question will work out, and it is subject to revision after we have looked at a wide range of scripts.

The Examiners' Standardisation Meeting will ensure that the Mark Scheme covers the range of candidates' responses to the questions, and that all Examiners understand and apply the Mark Scheme in the same way. The Mark Scheme will be discussed and amended at the meeting, and administrative procedures will be confirmed. Co-ordination scripts will be issued at the meeting to exemplify aspects of candidates' responses and achievements; the co-ordination scripts then become part of this Mark Scheme.

Before the Standardisation Meeting, you should read and mark in pencil a number of scripts, in order to gain an impression of the range of responses and achievement that may be expected.

In your marking, you will encounter valid responses which are not covered by the Mark Scheme: these responses must be credited. You will encounter answers which fall outside the 'target range' of Bands for the paper which you are marking. Please mark these answers according to the marking criteria.

Please read carefully all the scripts in your allocation and make every effort to look positively for achievement throughout the ability range. Always be prepared to use the full range of marks.

LEVELS OF RESPONSE QUESTIONS:

The indicative content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.

Using 'best-fit', decide first which set of **BAND DESCRIPTORS** best describes the overall quality of the answer. Once the band is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.

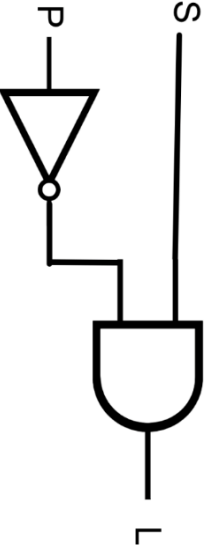
- **Highest mark:** If clear evidence of all the qualities in the band descriptors is shown, the **HIGHEST** Mark should be awarded.
- **Lowest mark:** If the answer shows the candidate to be borderline (i.e. they have achieved all the qualities of the bands below and show limited evidence of meeting the criteria of the band in question) the **LOWEST** mark should be awarded.
- **Middle mark:** This mark should be used for candidates who are secure in the band. They are not 'borderline' but they have only achieved some of the qualities in the band descriptors.

Be prepared to use the full range of marks. Do not reserve (e.g.) high Band 3 marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the band descriptors, reward appropriately.

	AO1	AO2	AO3
High (thorough)	Precision in the use of question terminology. Knowledge shown is consistent and well-developed. Clear appreciation of the question from a range of different perspectives making extensive use of acquired knowledge and understanding.	Knowledge and understanding shown is consistently applied to context enabling a logical and sustained argument to develop. Examples used enhance rather than detract from response.	Concerted effort is made to consider all aspects of a system / problem or weigh up both sides to an argument before forming an overall conclusion. Judgements made are based on appropriate and concise arguments that have been developed in response resulting in them being both supported and realistic.
Middle (reasonable)	Awareness of the meaning of the terms in the question. Knowledge is sound and effectively demonstrated. Demands of question understood although at times opportunities to make use of acquired knowledge and understanding not always taken.	Knowledge and understanding applied to context. Whilst clear evidence that an argument builds and develops through response there are times when opportunities are missed to use an example or relate an aspect of knowledge or understanding to the context provided.	There is a reasonable attempt to reach a conclusion considering aspects of a system / problem or weighing up both sides of an argument. However the impact of the conclusion is often lessened by a lack of supported judgements which accompany it. This inability to build on and develop lines of argument as developed in the response can detract from the overall quality of the response.
Low (basic)	Confusion and inability to deconstruct terminology as used in the question. Knowledge partial and superficial. Focus on question narrow and often one-dimensional.	Inability to apply knowledge and understanding in any sustained way to context resulting in tenuous and unsupported statements being made. Examples if used are for the most part irrelevant and unsubstantiated.	Little or no attempt to prioritise or weigh up factors during course of answer. Conclusion is often dislocated from response and any judgements lack substance due in part to the basic level of argument that has been demonstrated throughout response.

Assessment Objective	
AO1	Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation.
AO1.1	Demonstrate knowledge of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO1.2	Demonstrate understanding of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO2	Apply knowledge and understanding of the principles and concepts of computer science including to analyse problems in computational terms.
AO2.1	Apply knowledge and understanding of the principles and concepts of computer science.
AO2.2	Analyse problems in computational terms.
AO3	Design, program and evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.
AO3.1	Design computer systems that solve problems.
AO3.2	Program computer systems that solve problems.
AO3.3	Evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.

Question	Answer	Marks	Comments
1	<p>Input Device</p> <p>Microphone...</p> <p>... To allow the device to hear spoken requests.</p> <p>Buttons...</p> <p>... To turn the device off or on / To mute device/ to put device in privacy mode</p> <p>(max 1 device name, max 1 reason)</p> <p>Output Device</p> <p>Speaker...</p> <p>... To play the device's responses</p> <p>LEDs...</p> <p>... To indicate the device is on/listening</p> <p>Screen...</p> <p>... To show visual information</p> <p>(max 1 device name, max 1 reason)</p>	<p>4</p> <p>AO1.2 (2)</p> <p>AO2.1 (2)</p>	<p>Do not award "...listen out for the phrase "Hey Bertie""</p> <p>Award any appropriate input/output device</p>
b	<ul style="list-style-type: none"> - System software/software used to manage the device - Which is built into the device itself - Stored in the device's ROM/cannot be changed - Specific to the hardware/purpose <p>(1 mark per -, max 2)</p>	<p>2</p> <p>AO1.1</p>	

c	i	<table border="1" data-bbox="1118 331 1382 909"> <tr> <td>P</td> <td>S</td> <td>L</td> </tr> <tr> <td>False</td> <td>False</td> <td>False</td> </tr> <tr> <td>False</td> <td>True</td> <td>True</td> </tr> <tr> <td>True</td> <td>False</td> <td>False</td> </tr> <tr> <td>True</td> <td>True</td> <td>False</td> </tr> </table> <p>1 Mark for first 2 rows, 1 Mark for second 2 rows.</p>	P	S	L	False	False	False	False	True	True	True	False	False	True	True	False	2	AO1.2	Accept any sensible representation of True or False
P	S	L																		
False	False	False																		
False	True	True																		
True	False	False																		
True	True	False																		
	ii	<p>-P going into NOT Gate -S going into AND gate... -...NOT P going into AND gate, L coming out of it and no additional gates or connections. (1 per -, max 3)</p>	3	AO3.1																
	d	<ul style="list-style-type: none"> - more than one processing unit in a (single) processor - ...which can independently process instructions at the same time. 	2	AO1.1																
2	a	(The process of) making a file smaller/take up less storage	1	AO1.1																
	b	Full answer CCCMMMMCCCC	2	AO1.2																
		<ul style="list-style-type: none"> - CCC - ... followed by MMMCCCC <p>(1 per -, max 2)</p>																		

c	<p>4C1O3L5C1M1O5C</p> <ul style="list-style-type: none"> - 4C1O - Followed by 3L5C - Followed by 1M1O5C 	3	<p>Accept answer without 1s</p>								
d	<ul style="list-style-type: none"> - Correct function name and parameter AND the function returns a value. - Use of a loop to correctly iterate through the sequence - Adds one to a running total when a C is encountered - -when character changes from a C if running total is > maximum, overwrites maximum... - ...correctly reset running total <p>1 mark per -, max 5</p>	5	<p>E.g. function longest(sequence) currentRun = 0 biggestRun = 0 for i = 0 To sequence.length - 1 if sequence.substring(i, i + 1) == "C" then currentRun = currentRun + 1 else if currentRun > biggestRun then biggestRun = currentRun end if currentRun = 0 endif next i return biggestRun endfunction</p>								
3	<table border="1" data-bbox="533 309 671 568"> <thead> <tr> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> </tr> <tr> <td>2</td> <td>4</td> </tr> <tr> <td>3</td> <td>9</td> </tr> </tbody> </table> <p>1 per row, max 3</p>	Input	Output	1	1	2	4	3	9	3	
Input	Output										
1	1										
2	4										
3	9										
b	<p>Squares a number / multiplies a number by itself</p>	1									
c	<ul style="list-style-type: none"> - The value <u>16</u> is copied to the MAR - The contents of the of the ACC (i.e. 9) are copied to the MDR - The value <u>9</u> is copied to location <u>16/count</u> <p>1 per -, max 2</p>	2	<p>AO3.3</p> <p>AO2.2</p>								

d	Interrupt	1 AO1.1	cao
e	<ul style="list-style-type: none"> - Immediate addressing... - ... operand is the value to be used. - Indirect Addressing... - ...operand is the memory location holding a value representing the memory location to be used. - Indexed Addressing... - ...Operand is added to contents of Index Register to get memory location of value needed. <p>(1 mark for naming addressing mode, 1 mark for correct description)</p>	2 AO1.1	
4	a	2 AO1.1	Accept legacy media such as laserdisc and videodisc. Do not accept DVD variants (DVD-R, DVD-RW etc)
	b	1 AO1.1	
c	A program that enables communication between an <u>operating system</u> and a (hardware) device.	1 AO1.1	

d	<p>Advantages</p> <ul style="list-style-type: none">- Can access film (and indeed entire library) from anywhere with an internet connection- No physical storage needed- No risk of films being stolen/damaged/lost- Optical/disk player hardware not required to play film <p>Disadvantage</p> <ul style="list-style-type: none">- Reliant on having an (fast enough) internet connection.- Need enough storage for download- Reliant on servers of the company providing the connection.- People like having a physical copy- If the company providing the stream goes out of business, copy is lost. <p>(1 per -, max 4. If only advantages or disadvantages, max 3)</p>	4 AO1.2	
---	--	------------	--

	e	<ul style="list-style-type: none"> - High resolution videos take up large amounts of memory/RAM - Due to the large number of pixels that need to be represented - When streaming, the data being sent is time sensitive/ sufficient data (i.e. the next chunk of video) needs to be received and processed within a given amount of time - Otherwise there will be pauses/buffering. - Compression reduces the amount of data that needs to be sent/bandwidth needed - Compression reduces the cost/data usage for those with download limits <p>(1 per -, max 3)</p>	3 AO2.2	
5	a	tuple / record / list	1 AO2.1	Don't accept array
	b	228	1 AO2.1	cao

c		<ul style="list-style-type: none"> - Removes/ignores characters up to and including first dot - Removes/ignores characters including and after second dot - Converts characters in variable to uppercase - Totals the ASCII values of the relevant characters. <p>Up to 1 mark for ...</p> <ul style="list-style-type: none"> - Sensible variable names. - Sensible indentation - Useful comments. <p><i>NB Don't penalise twice. If candidate hasn't removed/discarded the right characters they may lose mark points 1 and/or 2. They can still access mark points 3 and 4</i></p> <p>(1 per -, max 5)</p>	5 AO3.2	<pre>function hash(siteName) //remove up to and including first dot. firstDot=locate(siteName, ".") siteName=siteName.substring(firstDot+1,siteName.length-firstDot -1) //remove second dot and after secondDot=locate(siteName, ".") siteName=siteName.substring(0,secondDot) siteName=upper(siteName) value=0 for i=0 to siteName.length-1 value=value+asc(siteName.substring(i, 1)) next i return value endfunction</pre>
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<p>d</p>	<ul style="list-style-type: none"> - rnd.com would cause a collision with ocr.org.uk/would has to the same position as ocr.org.uk (228) - Linear probing could be used - Move through the structure one space at a time - ...to find the next free space/229 - Chaining could be used - Each location points (to the start of) a <u>linked list</u>. - The new item is added to the end of the linked list/free. - points to an overflow area - The new item is stored with the other values in the same area <p>Accept a separate or annotated diagram showing a method on given example (1 per -, max 4)</p>	<p>4 AO1.2</p>	<p>Example diagrams</p> <p>Chaining</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>227</td><td></td></tr> <tr><td>228</td><td></td></tr> <tr><td>229</td><td></td></tr> <tr><td>230</td><td>www.ppf.nz : [2, false]</td></tr> <tr><td>231</td><td></td></tr> <tr><td>232</td><td>www.ntf.biz : [4, true]</td></tr> <tr><td>234</td><td></td></tr> <tr><td>235</td><td></td></tr> </table> <p>Linear Probing</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>227</td><td></td></tr> <tr><td>228</td><td>www.ocr.org.uk : [1, true]</td></tr> <tr><td>229</td><td>www.rnd.com : [2, true]</td></tr> <tr><td>230</td><td>www.ppf.nz : [2, false]</td></tr> <tr><td>231</td><td></td></tr> <tr><td>232</td><td>www.ntf.biz : [4, true]</td></tr> <tr><td>234</td><td></td></tr> <tr><td>235</td><td></td></tr> </table> <p>228 is full, next free space, 229</p>	227		228		229		230	www.ppf.nz : [2, false]	231		232	www.ntf.biz : [4, true]	234		235		227		228	www.ocr.org.uk : [1, true]	229	www.rnd.com : [2, true]	230	www.ppf.nz : [2, false]	231		232	www.ntf.biz : [4, true]	234		235	
227																																			
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232	www.ntf.biz : [4, true]																																		
234																																			
235																																			

e	<p>Mark Band 3–High Level (9-12 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of storing and retrieving data from hash tables and linked lists. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate is able to weigh up both sides of the argument which results in a supported and realistic judgment as to which data structure is suitable.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (5-8 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding of storing and retrieving data from hash tables or linked lists; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate makes a reasonable attempt to come to a conclusion showing some recognition of influencing factors that would</p>	<p>12</p> <p>AO1.1 (2)</p> <p>AO1.2 (2)</p> <p>AO2.1 (3)</p> <p>AO3.3 (5)</p>	<p>Searching of a Linked list involves starting at the first node and following the pointers until either the desired value is found, or the end of the list is reached, meaning the item isn't in the list.</p> <p>The bigger the linked list grows, the longer it takes to search.</p> <p>If a linked list doubles in size it will, on average, take twice as long to search.</p> <p>A list of size n takes on average $n/2$ checks.</p> <p>In Big O this is $O(n)$, or linear complexity.</p> <p>Searching of a hash table requires the key to be hashed and the correct location accessed.</p> <p>The time this takes is largely dependent on the time to create the hash.</p> <p>If we ignore collisions, the time to find an item will stay the same regardless of the size of the white list.</p> <p>In other words it has $O(1)$ or constant complexity.</p> <p>Unfortunately as the white list grows collisions become more likely.</p> <p>Linear probing and chaining means that once a location has been found the time taken grows linearly with the number of collisions that have occurred for that location,</p> <p>Nonetheless this is still going to perform significantly better than a linked list.</p> <p>If items are added to the end of the linked list then if the location of the last node is stored, that location can be ready made to point at the new item.</p> <p>The time to add items is constant.</p> <p>If they are added in some sort of order then the time to add items grows linearly due to the time spent searching for the right position. (Storing in order has the advantage that it is if an item isn't in the list this can be deduced once its location is passed, rather than waiting until the end.)</p> <p>Adding items to a hash table involves hashing the key and placing it in the correct location.</p> <p>This takes a constant amount of time..</p> <p>..unless there are collisions then there is an overhead which grows with the number of collisions for that location.</p>
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		<p>determine which data structure is suitable.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-4 marks)</p> <p>The candidate demonstrates a basic knowledge of storing and retrieving data from hash tables or linked lists; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides nothing more than an unsupported assertion.</p> <p>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p> <p>0 marks</p> <p>No attempt to answer the question or response is not worthy of credit.</p>		<p>Overall a hash table is likely to be the best option (assuming it has enough space and a good hashing algorithm which produces a hash quickly and with few collisions). It will give very consistent performance even as the whitelist grows.</p> <p><i>NB Big O Notation isn't necessary for full marks as it is paper 2 content (though many of the more able candidates are likely to include it). The question is assessing candidate's knowledge of traversing and adding to the two data structures and their ability to analyse this to determine their suitability for the scenario.</i></p>
6	a	<ul style="list-style-type: none"> – A program with one purpose/piece of system software – ...used for the upkeep/maintenance of the system <p>(1 per -, max 2)</p>	2 AO1.1	
	b	<ul style="list-style-type: none"> – Application performs tasks for the user (rather than computer). – Performs generic (rather than specific) tasks 	1 AO1.2	
	c	<ul style="list-style-type: none"> – Extreme programming is a software 	4	

		<p>development methodology.</p> <ul style="list-style-type: none"> - Focus is on good quality code - It is an agile paradigm - it is designed to allow development to respond to changing user requirements. - Involves paired programming - Program is regularly reviewed/iterative process. <p>Suited to this scenario as...</p> <ul style="list-style-type: none"> - Types of virus/threat is continually changing/updating - In order to detect virus effectively there needs to be an emphasis on code quality. <p>(1 per – Max 4. If no reason given for it being suitable for scenario, max 3)</p>	<p>AO1.1 (2) AO2.1 (2)</p>	
--	--	--	--	--

d	<ul style="list-style-type: none"> - Allows them to run the update on a number of different systems/OSS - ...without needing multiple physical machines. - They can put viruses on the VM to test if the update can catch them - ...but protect the physical machine from the virus/the VM can quickly be reset to its original state. <p>(1 per -, Max 3)</p>	3 AO2.2	
e	<ul style="list-style-type: none"> - FCFS means jobs are completed in the order they arrive - ineffective in catching viruses/the virus may run first - ...the virus checker may never run/take a long time to start running - the virus checker may be continuously running... - ...this will temporarily stall the system/ all other processes have to wait. <p>(1 mark per -, max 2)</p>	2 AO2.2	
f	<ul style="list-style-type: none"> - The computer would not be able to boot/load the OS - Or set up its initial configuration/hardware checks - Making the computer unusable <p>(1 mark per -, max 2)</p>	2 AO2.1	

7	a	<ul style="list-style-type: none"> - Ensuring that changes are consistent across a database - if a record is removed all references to it are removed - A foreign key value must have a corresponding Primary key value in another table. - In this case, a user being removed will result in their reviews being removed/ a restaurant being removed will result in its reviews being removed. <p>(1 mark per -, max 2 marks for explanation)</p>	3 AO1.1 (2) AO2.1 (1)	
	b	<ul style="list-style-type: none"> - A device which provides a central point of control/access 	1 AO1.1	
		<ul style="list-style-type: none"> - Client side processing can be modified - And can sometimes be disabled on the browser - To prevent malicious code (such as an SQL injection/XSS) - To prevent a non-validated review (one with a score of over 5) being sent to the server <p>(1 mark per -, max 2)</p>	2 AO2.1 (1) AO2.2 (1)	
	c	<ul style="list-style-type: none"> - A transaction/review can only fully complete or not complete / cannot partially complete - In this case, it should not be possible for the review to be added without the (average) rating being updated. <p>(1 mark per -, max 2)</p>	2 AO1.1 (1) AO2.1 (1)	

	d	<ul style="list-style-type: none"> - Consistency - Isolation - Durability (1 mark per -, max 3)	3 AO1.1	
	e	Advantage <ul style="list-style-type: none"> - More characters can be represented - may include foreign alphabets - may include emojis Disadvantage <ul style="list-style-type: none"> - Reviews take up more storage (4 times their previous storage size). (1 mark max for advantage, 1 mark max for disadvantage.)	2 AO1.2	
8	a	30 goes into 100 3 times/3	1 AO3.3	
	b	integer	1 AO1.2	
	c	Boolean	1 AO1.2	
	d	String	1 AO1.2	
	e	<ul style="list-style-type: none"> - Calculates remainder - Displays remainder (1 mark per -, max 2)	2 AO3.2	remainder = 100 – (num*count) print(remainder) OR remainder=(100 MOD num) print(remainder)

f	<ul style="list-style-type: none"> - The comments such as those on the first line, (and whitespace) are removed. - Variable names/identifiers like 'count' are added to a symbol table. - Reserved words/statement components are tokenized. For example 'WHILE' <p>(1 mark per -, max 3)</p>	3 AO2.2	
g	Syntax analysis	1 AO1.1	
9	<p>Mark Band 3–High Level (7-9 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of the effect of computers on the environment. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (4-6 marks)</p>	9 AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)	<p>The materials and fuel used in producing and transporting computers has an environmental impact.</p> <p>Digital devices have short life spans and are quickly disposed of...</p> <p>They often end up in landfill or are sent to less economically developed countries to be dismantled due to the value of some of the materials inside them.</p> <p>These devices are often made up of toxic materials (such as mercury)</p> <p>These can harm people disposing of the waste and damage/pollute the area in which they are buried/burned.</p> <p>People have many digital devices. These all need powering/charging.</p> <p>This means there is an increase in demand for electricity.</p> <p>Which means an increase in fossil fuel being burned.</p> <p>Computers are being used to automate the use of things like central heating.</p> <p>This can reduce electricity consumption</p> <p>Computers have encouraged a paperless approach... ..both in the workplace and in terms of companies sending bills to homes</p> <p>This has the potential to reduce the use of paper and as such destruction of trees.</p> <p>Developments in digital storage has reduced the need for physical media to be produced (e.g. CD, DVDs etc)</p> <p>This reduces the need for using plastics.</p>

	<p>The candidate demonstrates reasonable knowledge and understanding of the effect of computers on the environment; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-3 marks)</p> <p>The candidate demonstrates a basic knowledge of the effect of computers on the environment; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides a limited discussion which is narrow in focus.</p>	<p>Computers have allowed people to work from home/ communicate from afar... This means they don't have to commute/travel, reducing traffic and pollution.</p> <p>Computers can analyse data which can be used in improve efficiency – data mining (appropriate example).</p>
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		Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear. 0 marks		
10	a	No attempt to answer the question or response is not worthy of credit. 5E	1 AO1.2	
	b	155 (1 mark for first two digits, 1 mark for final digit)	2 AO1.2	
	c	11010111 (1 Mark for the left most 1, 1 mark for the remaining 7 bits)	2 AO1.2	
	d	1121 022022 04004001- 00101111 00011010	2 AO1.2	
	e	1 mark for correct answer 1 mark for valid method	3 AO1.2	
	f	– Exponent is 3 – Mantissa becomes 0100.11 – Which is 4.75. (accept $4\frac{3}{4}$) (1 per -, max 3) – In fixed point is 1010.11 – Mantissa becomes 1.01011 – Exponent of 3 / 11 – Giving answer of 101011 011 (1 per -, max 4)	4 AO1.2	For MP3 any number of leading 0s is valid (including none)

11	a	<p>Mark Band 3–High Level (7-9 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of the technologies required for web development. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (4-6 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding of the technologies required for web development; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most</p>	<p>9</p> <p>AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)</p>	<p>HTML... ..they understand how to write (i.e. define the structure of) web pages. CSS.. ... they understand how to define the formatting of websites. JavaScript.. ..they understand how to write client side code ...allowing them to add interactivity to the website</p> <p>Understanding of HTML/CSS and JavaScript is essential for the role. Without knowing HTML it is impossible to handcode webpages. Whilst WYSIWYG tools exist these often produce inefficient code and at any rate it will be necessary at some point to hand tweak the code. (As the role is 'programmer' it is <i>reasonable to expect that the site will be coded.</i>)</p> <p>CSS is nearly as essential. Whilst HTML can be used for a lot of the formatting, this is considered bad practice. CSS will allow them to make consistent looking sites.</p> <p>JavaScript is also essential as most websites have an interactive element (e.g. validation of forms)</p> <p>Knowledge of Server-side processing/PHP/ASP etc... ...allowing them to write dynamic websites. This is important if the company wants to produce websites with content that changes</p> <p>Databases... ...allowing them to allow websites to store and retrieve data. Some knowledge of databases will be useful if writing dynamic sites. This will largely be focussed around SQL.</p> <p>Photo editing... ...allowing them to prepare images for the website. This is less essential as in many cases the assets will be pre-prepared. A basic</p>
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	<p>part implicitly relevant to the explanation.</p> <p>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-3 marks)</p> <p>The candidate demonstrates a basic knowledge of the technologies required for web development; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides a limited discussion, which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p> <p>0 marks</p> <p>No attempt to answer the question or response is not worthy of credit.</p>	<p>knowledge (e.g. resizing would be expected).</p> <p>Knowledge of software engineering practices... ...allowing them to work as part of a team when building the website. The importance of this will depend on the size of the team working on the site.</p> <p>May mention more advanced technologies e.g. AJAX, SOAP, JSON etc.</p>
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b	<ul style="list-style-type: none"> - The head contains information about the page and needed to set the page up - Orville's Oranges is displayed in the title bar/tab of the page. - The page is linked to the style sheet mainStyle.css <p>(1 per -, max 2)</p>	2 AO3.3	
c	<pre>.offer{ border-style: solid; border-color: orange; }</pre>	2 AO3.2	<p>Accept div. offer</p> <p>Accept hex/RGB codes that would provide a shade of orange.</p> <p>Closing ; is optional</p>

Question	Assessment Objectives						Total	
	AO1.1	AO1.2	AO2.1	AO2.2	AO3.1	AO3.2		AO3.3
1a		2	2					4
1b	2							2
1ci		2						2
1cii					3			3
1d	2							2
2a	1							1
2b		2						2
2c		3						3
2d						5		5
3a							3	3
3b							1	1
3c				2				2
3d	1							1
3e	2							2
4a	2							2
4b	1							1
4c	1							1
4d		4						4
4e				3				3
5a			1					1
5b			1					1
5c						5		5
5d		4						4
5e*	2	2	3				5	12
6a	2							2
6b		1						1
6c	2		2					4
6d				3				3
6e				2				2
6f			2					2
7a	2		1					3
7bi	1		1					2
7bii			1	1				2

7c	1		1					2
7d	3							3
7e		2						2
8a							1	1
8b		1						1
8c		1						1
8d		1						1
8e						2		2
8f					3			3
8g	1							1
9*	2	2	2				3	9
10am			1					1
10bm		2						2
10cm		2						2
10dm		2						2
10em		3						3
10fm		4						4
11a*	2	2	2				3	9
11b							2	2
11c								2
	30	43	18	14	3	14	18	140

* = extended response

m = mathematical content

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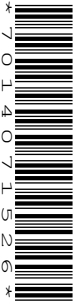


A Level Computer Science

H446/01 Computer Systems

Monday 11 June 2018 – Morning

Time allowed: 2 hours 30 minutes



You may use:

- a ruler (cm/mm)
- an HB pencil

Do not use:

- a calculator



First name										
Last name										
Centre number						Candidate number				

INSTRUCTIONS

- Use black ink. You may use an HB pencil for graphs and diagrams.
- 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 **24** pages.



Answer **all** the questions.

1 A digital coffee making machine has a CPU that uses the Little Man Computer Instruction Set.

(a) Little Man Computer operates on a computer system based on the Von Neumann Architecture.

(i) State **two** features of the Von Neumann architecture.

1

2

[2]

(ii) Describe **one** feature, **not** part of the standard Von Neumann Architecture, which contemporary CPUs may have in order to improve performance.

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

(b) Part of the coffee making machine's code asks the user to press a button to select strength. The code outputs 1 which will switch on a green light to indicate a valid selection or outputs 0 to indicate an invalid selection.

The code is shown below:

```

                INP
                STA    entry
                LDA    max
                SUB    entry
                BRP    accept
                LDA    redLight
                BRA    printAndEnd
accept         LDA    greenLight
printAndEnd   OUT
                HLT
greenLight    DAT    1
redLight      DAT    0
max           DAT    5
entry         DAT

```

Fig. 1

(iii) Write code in a high-level language or pseudocode that has the same functionality as the code in Fig. 1.

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

(iv)* Discuss the differences between assembly code and high-level languages. You should refer to:

- the advantages and disadvantages of writing programs in assembly code rather than a high-level language
- when each approach might be used
- why the coffee machine was programmed in assembly code.

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..... [9]

2 A software company decides to build an operating system for OCR smart watches.

(a) Memory management is one of the functions of an operating system.

(i) List **three** functions, other than memory management, of an operating system.

- 1
- 2
- 3

[3]

Part of a computer's memory is represented below (Fig. 2). The operating system divides the memory into equally sized chunks.

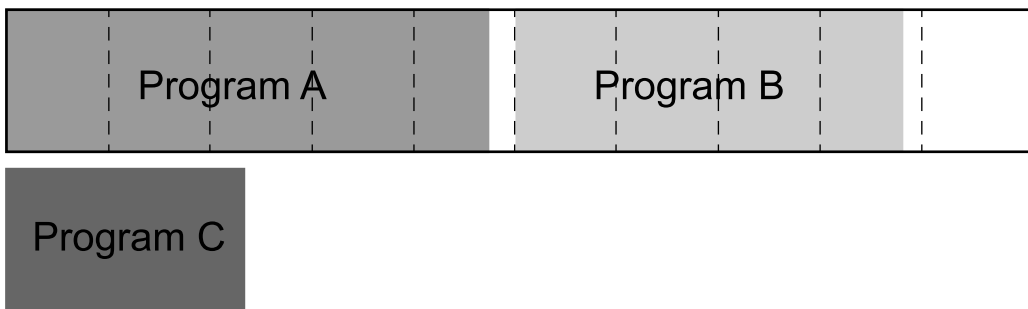


Fig. 2

(ii) State the name of the type of memory management used in Fig. 2.

..... [1]

(iii) The operating system needs to load program C into memory but there is not enough space. Describe how the operating system would use virtual memory to load program C.

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

- (ii) Explain what happens when a search engine indexes the page. You do **not** need to discuss ranking.

.....

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..... [3]

- (iii) Explain why using a RISC processor rather than a CISC processor is likely to result in increased battery life.

.....

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.....

.....

..... [3]

- 3 An airport holds details of flights in a database using the table `Flight`. An extract of the table is shown below.

<u>FlightID</u>	<u>FlightNumber</u>	<u>DestinationCode</u>	<u>DestinationName</u>	<u>DepartureDate</u>	<u>DepartureTime</u>
1355	OC0089	JFK	John F. Kennedy	03/07/18	09:50
1453	CS1573	LHR	Heathrow	03/07/18	10:30
1921	OC7750	JFK	John F. Kennedy	04/07/18	08:30
1331	AM0045	YHZ	Halifax	04/07/18	14:25
1592	HB0326	RTM	Rotterdam	04/07/18	19:10
1659	CS0123	LHR	Heathrow	04/07/18	07:20

- (a) Describe what the SQL statement below does.

```
SELECT FlightNumber FROM Flight WHERE DestinationCode='JFK'
```

.....

 [2]

The airport cancels all its flights to Heathrow on 4th July 2018.

- (b) The SQL statement below shows all the data for flights going to Halifax. Rewrite it so it instead removes all flights to Heathrow on 4th July 2018.

```
SELECT * FROM Flight WHERE DestinationName='Halifax'
```

.....

 [3]

(c) Tables often have primary and secondary keys.

(i) State why `DestinationCode` would **not** be a suitable primary key for the `Flight` table.

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

(ii) State why `DestinationCode` would be a suitable secondary key for the `Flight` table.

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

(d) The airline wishes to ensure the database is normalised.

(i) Describe why the database can be considered to be in First Normal Form.

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

(ii) Describe why the database can be considered to be in Second Normal Form.

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

(iii) Describe why the database can **not** be considered to be in Third Normal form.

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

- (e) The airport wishes to allow airlines to be able to access the data it has on flights via the internet.

Describe **one** format or method the airport could use to provide the data to the airlines so they can use it in their own applications.

.....

.....

.....

..... [2]

4 The internet can be considered an example of a WAN.

(a) Describe what is meant by the term 'WAN'.

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

(b) The internet uses a set of protocols referred to as the TCP/IP stack. The TCP/IP stack consists of four different layers, each with its own set of protocols.

(i) Explain why protocols are important on a network.

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

(ii) State the name of the **four** layers of the TCP/IP stack.

1
2
3
4 [4]

- 5 A software company is producing software that allows users with severe mobility issues to input data into a computer.

The software flashes up letters on the screen one at a time. The user sends a signal to the computer when the letter they want appears on the screen.

- (a) State the name of an input device and describe how it could be used by a user with very limited mobility in their hands and arms to send a signal to the computer.

Device name:

How it would be used:

.....

.....

[2]

- (b) Rather than displaying the whole alphabet, once the first letter has been entered, the program only shows letters that could be possible according to words in its dictionary. All possible words are stored in a tree data structure.

The program is tested on a sample dictionary of four words, represented as a tree in Fig. 3:

BARON
BATHS
BELOW
BELTS

- (i) Annotate Fig. 3 to show how the word BELTS would be removed from the tree. [2]
- (ii) Annotate Fig. 3 to show how the words BEACH and BONE would be added to the tree. [2]

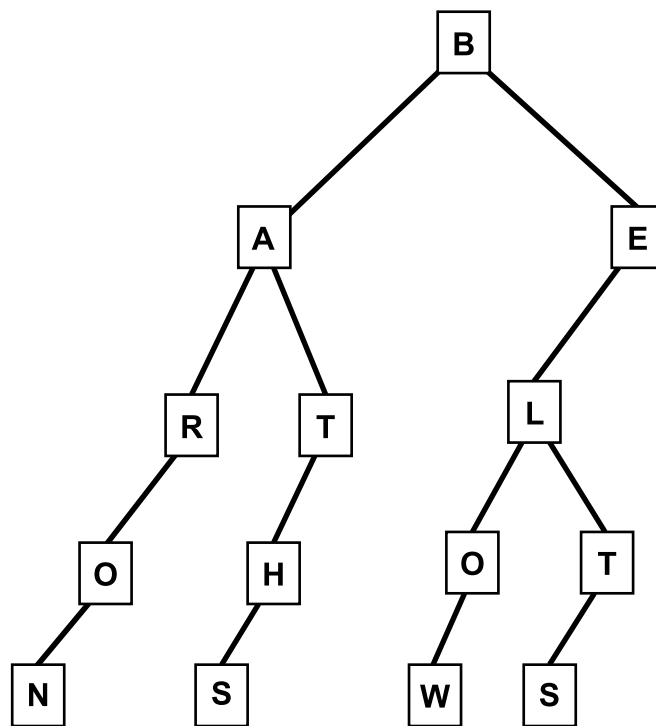


Fig. 3

- (c) The developer decides she wants to make the software program open source.

Explain the benefits to the users of the software being open source.

.....

.....

.....

..... [2]

7 A taxi firm is investigating replacing its drivers with self-driving cars.

(a) Explain why the self-driving system will use a real-time operating system.

.....

.....

.....

.....

.....

.....

..... [3]

- (b) The code for the self-driving system has been written using an object-oriented programming language.

It recognises obstacles in the road and then classifies them.
The class for `Obstacle` is shown below.

```
public class Obstacle
  private moving //Boolean value
  private distance //Real number given in metres
  private direction //Integer given as between 1 and 360 degrees

  public procedure new(givenMoving, givenDistance, givenDirection)
    moving=givenMoving
    distance=givenDistance
    direction=givenDirection
  endprocedure

  public procedure updateDistance(givenDistance)
    distance=givenDistance
  endprocedure

endclass
```

- (i) Write a line of code to create an object called `bollard` of type `Obstacle` which is not moving and is 7.8 metres away in a direction of 8 degrees.

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

- (ii) Describe an example of encapsulation in the class definition code above.

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

- (iii) Describe the advantages of using encapsulation.

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

8 A student writes a program to apply a symmetric encryption algorithm to work on messages of up to 25 ASCII characters.

(a) Describe what is meant by the term 'ASCII'.

.....

.....

.....

..... [2]

The encryption algorithm works in the following way.

A message of up to 25 characters (spaces and punctuation are not included) is placed in a 5×5 array. Any leftover spaces are filled with random letters. The message I LOVE COMPUTER SCIENCE becomes:

I	L	O	V	E
C	O	M	P	U
T	E	R	S	C
I	E	N	C	E
T	O	W	R	M

The key is a sequence of ten numbers.

In this example we will use 1 2 3 4 5 1 2 3 4 5. The first 5 numbers state how many spaces the rows 0 to 4 must be rotated right.

A key with the first 5 digits 1 2 3 4 5 would result in

E	I	L	O	V
P	U	C	O	M
R	S	C	T	E
E	N	C	E	I
T	O	W	R	M

The next 5 digits state how many spaces down the columns 0 to 4 should be rotated.

Applying the last 5 digits 1 2 3 4 5 to the grid above would give

T	N	C	O	V
E	O	C	T	M
P	I	W	E	E
R	U	L	R	I
E	S	C	O	M

Part of the pseudocode for the algorithm is written below.

```
global array grid[5,5]
addMessage()
// letters and random letters have been entered
// into the 2D array, grid

for i = 0 to 4
    x = getNextDigitInKey()
    shiftRow(i,x)
next i

for i = 0 to 4
    x = getNextDigitInKey()
    shiftColumn(i,x)
next i

//Now reassemble array back into string.
```

(b) Show the result of running the algorithm on the grid and key below. [2]

KEY: 3 3 3 3 3 1 1 1 1 1

T	O	P	S	E
C	R	E	T	M
E	S	S	A	G
E	Y	R	P	L
U	O	G	G	Q

Grid after only the rows are shifted:

Grid after columns have also been shifted:

- 9 (a) Demonstrate how the bytes below are added together. Show your working.

$$\begin{array}{r} 01101010 \\ \underline{00111111} + \end{array}$$

[2]

- (b) Demonstrate how the bottom byte below is subtracted from the top byte. Show your working.

$$\begin{array}{r} 11001111 \\ \underline{00111001} - \end{array}$$

[2]

- (c) Convert the binary number shown below to hexadecimal.

0011011100001111

.....

.....

.....

..... [2]

- (d) The number below is represented in floating point format with a 5-bit mantissa in two's complement followed by a 3-bit exponent in two's complement. Calculate the denary value of the number, showing your working.

01001 010

.....

.....

.....

.....

.....

..... [3]

- (e) The numbers below are represented in floating point format with a 5-bit mantissa in two's complement followed by a 4-bit exponent in two's complement. Normalise the numbers shown below, showing your working.

00011 0010

.....

.....

.....

..... [2]

11100 0110

.....

.....

.....

..... [2]

- (f) Show the byte below after having an AND applied with the masking byte.

Byte	1	0	1	1	1	0	0	1
AND	1	1	1	1	1	1	1	1
Result								

[1]

- (g) Show the byte below after having an OR applied with the masking byte.

Byte	1	0	1	1	1	0	0	1
OR	1	1	1	1	1	1	1	1
Result								

[1]

10 (a) Draw a logic gate diagram to represent the Boolean expression

$$Q \equiv \neg A \vee B$$

[2]

(b) Find the Boolean expression represented in the Karnaugh Map below. Show your working.

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

[5]

END OF QUESTION PAPER

OCR

Oxford Cambridge and RSA

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GCE

Computer Science

Unit **H446A/01**: Computer systems

Advanced GCE

Mark Scheme for June 2018

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



This mark scheme is published as an aid to teachers and students, to indicate the requirements of the examination. It shows the basis on which marks were awarded by examiners. It does not indicate the details of the discussions which took place at an examiners' meeting before marking commenced.

All examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the report on the examination.

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Annotations

Annotation	Meaning
	Omission mark
	Benefit of the doubt
	Subordinate clause / consequential error
	Incorrect point
	Expansion of a point
	Follow through
	Not answered question
	No benefit of doubt given
	Point being made
	Repeat
	Correct point
	Too vague
	Zero (big)
	Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
	Level 1
	Level 2
	Level 3

Subject Specific Marking Instructions**INTRODUCTION**

Your first task as an Examiner is to become thoroughly familiar with the material on which the examination depends. This material includes:

- the specification, especially the assessment objectives
- the question paper and its rubrics
- the mark scheme.

You should ensure that you have copies of these materials.

You should ensure also that you are familiar with the administrative procedures related to the marking process. These are set out in the OCR booklet **Instructions for Examiners**. If you are examining for the first time, please read carefully **Appendix 5 Introduction to Script Marking: Notes for New Examiners**.

Please ask for help or guidance whenever you need it. Your first point of contact is your Team Leader.

USING THE MARK SCHEME

Please study this Mark Scheme carefully. The Mark Scheme is an integral part of the process that begins with the setting of the question paper and ends with the awarding of grades. Question papers and Mark Schemes are developed in association with each other so that issues of differentiation and positive achievement can be addressed from the very start.

This Mark Scheme is a working document; it is not exhaustive; it does not provide 'correct' answers. The Mark Scheme can only provide 'best guesses' about how the question will work out, and it is subject to revision after we have looked at a wide range of scripts.

The Examiners' Standardisation Meeting will ensure that the Mark Scheme covers the range of candidates' responses to the questions, and that all Examiners understand and apply the Mark Scheme in the same way. The Mark Scheme will be discussed and amended at the meeting, and administrative procedures will be confirmed. Co-ordination scripts will be issued at the meeting to exemplify aspects of candidates' responses and achievements; the co-ordination scripts then become part of this Mark Scheme.

Before the Standardisation Meeting, you should read and mark in pencil a number of scripts, in order to gain an impression of the range of responses and achievement that may be expected.

In your marking, you will encounter valid responses which are not covered by the Mark Scheme: these responses must be credited. You will encounter answers which fall outside the 'target range' of Bands for the paper which you are marking. Please mark these answers according to the marking criteria.

Please read carefully all the scripts in your allocation and make every effort to look positively for achievement throughout the ability range. Always be prepared to use the full range of marks.

LEVELS OF RESPONSE QUESTIONS:

The indicative content indicates the expected parameters for candidates' answers, but be prepared to recognise and credit unexpected approaches where they show relevance.
Using 'best-fit', decide first which set of BAND DESCRIPTORS best describes the overall quality of the answer. Once the band is located, adjust the mark concentrating on features of the answer which make it stronger or weaker following the guidelines for refinement.

- **Highest mark:** If clear evidence of all the qualities in the band descriptors is shown, the HIGHEST Mark should be awarded.
- **Lowest mark:** If the answer shows the candidate to be borderline (i.e. they have achieved all the qualities of the bands below and show limited evidence of meeting the criteria of the band in question) the LOWEST mark should be awarded.
- **Middle mark:** This mark should be used for candidates who are secure in the band. They are not 'borderline' but they have only achieved some of the qualities in the band descriptors.

Be prepared to use the full range of marks. Do not reserve (e.g.) high Band 3 marks 'in case' something turns up of a quality you have not yet seen. If an answer gives clear evidence of the qualities described in the band descriptors, reward appropriately.

	AO1	AO2	AO3
High (thorough)	Precision in the use of question terminology. Knowledge shown is consistent and well-developed. Clear appreciation of the question from a range of different perspectives making extensive use of acquired knowledge and understanding.	Knowledge and understanding shown is consistently applied to context enabling a logical and sustained argument to develop. Examples used enhance rather than detract from response.	Concerted effort is made to consider all aspects of a system / problem or weigh up both sides to an argument before forming an overall conclusion. Judgements made are based on appropriate and concise arguments that have been developed in response resulting in them being both supported and realistic.
Middle (reasonable)	Awareness of the meaning of the terms in the question. Knowledge is sound and effectively demonstrated. Demands of question understood although at times opportunities to make use of acquired knowledge and understanding not always taken.	Knowledge and understanding applied to context. Whilst clear evidence that an argument builds and develops through response there are times when opportunities are missed to use an example or relate an aspect of knowledge or understanding to the context provided.	There is a reasonable attempt to reach a conclusion considering aspects of a system / problem or weighing up both sides of an argument. However the impact of the conclusion is often lessened by a lack of supported judgements which accompany it. This inability to build on and develop lines of argument as developed in the response can detract from the overall quality of the response.
Low (basic)	Confusion and inability to deconstruct terminology as used in the question. Knowledge partial and superficial. Focus on question narrow and often one-dimensional.	Inability to apply knowledge and understanding in any sustained way to context resulting in tenuous and unsupported statements being made. Examples if used are for the most part irrelevant and unsubstantiated.	Little or no attempt to prioritise or weigh up factors during course of answer. Conclusion is often dislocated from response and any judgements lack substance due in part to the basic level of argument that has been demonstrated throughout response.

	Assessment Objective
AO1	Demonstrate knowledge and understanding of the principles and concepts of computer science, including abstraction, logic, algorithms and data representation.
AO1.1	Demonstrate knowledge of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO1.2	Demonstrate understanding of the principles and concepts of abstraction, logic, algorithms, data representation or other as appropriate.
AO2	Apply knowledge and understanding of the principles and concepts of computer science including to analyse problems in computational terms.
AO2.1	Apply knowledge and understanding of the principles and concepts of computer science.
AO2.2	Analyse problems in computational terms.
AO3	Design, program and evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.
AO3.1	Design computer systems that solve problems.
AO3.2	Program computer systems that solve problems.
AO3.3	Evaluate computer systems that solve problems, making reasoned judgements about these and presenting conclusions.

Question	Answer	Mark	Guidance
1 a	<ul style="list-style-type: none"> - (Single) Control Unit - (Single) Arithmetic Logic Unit - (Special) registers within CPU - Instructions and Data stored in same area of memory - Instructions and Data stored in same format - A single set of buses / same bus for instructions & data (to connect CPU to Memory and I/O) (1 Mark per -, Max 2)	2 (AO1.1)	Accept acronyms ALU,CU

Question	Answer	Mark	Guidance
ii	<p>Two separate areas of memory... ...one for instructions & one for data./instructions and data can be accessed concurrently.</p> <p>Different (sets of) buses... ... one for instructions & one for data./ instructions and data can be accessed concurrently.</p> <p>Pipelining... ...whilst an instruction is being executed the next can be decoded and the subsequent one fetched.</p> <p>Use of Cache... ...A small amount of high performance memory is (next to the CPU) / which stores frequently used data/instructions</p> <p>Virtual cores/Hyper-threading™Treating a physical core as two virtual cores.</p> <p>Multiple Cores... ...Each core acts as a separate processing unit.</p> <p>Onboard Graphics... ... Built in circuitry for graphics processing.</p> <p>(1 Mark for identifying feature, 1 mark for description)</p>	2 (AO1.2)	<p>Accept any reasonable description. Do not accept "64-bit"</p> <p>e.g. Performance boosting mode... ...Clock speed can be temporarily increased for performance boost.</p> <p>Out of Order Execution... ...Instructions can be executed before earlier ones if they are ready.</p> <p>Super Scalar... ...Multiple instructions can be executed simultaneously.</p>

Question	Answer	Mark	Guidance																														
b	<table border="1" data-bbox="970 439 1326 987"> <thead> <tr> <th>Input</th> <th>Green Light</th> <th>Red Light</th> </tr> </thead> <tbody> <tr><td>1</td><td>✓</td><td></td></tr> <tr><td>2</td><td>✓</td><td></td></tr> <tr><td>3</td><td>✓</td><td></td></tr> <tr><td>4</td><td>✓</td><td></td></tr> <tr><td>5</td><td>✓</td><td></td></tr> <tr><td>6</td><td></td><td>✓</td></tr> <tr><td>7</td><td></td><td>✓</td></tr> <tr><td>8</td><td></td><td>✓</td></tr> <tr><td>9</td><td></td><td>✓</td></tr> </tbody> </table> <p data-bbox="871 439 935 958">Rows 1-4 correct 1 Mark Rows 5-9 correct 1 Mark</p>	Input	Green Light	Red Light	1	✓		2	✓		3	✓		4	✓		5	✓		6		✓	7		✓	8		✓	9		✓	2 (AO3.3)	Accept T for a tick. Penalise if blank table elements have content.
Input	Green Light	Red Light																															
1	✓																																
2	✓																																
3	✓																																
4	✓																																
5	✓																																
6		✓																															
7		✓																															
8		✓																															
9		✓																															
i	<ul style="list-style-type: none"> - The value 11 is stored in the MAR. - 11 is sent down the address bus. - A read signal is sent down the control bus. - <u>0</u> is sent (back from memory) down the data bus. - 0 is stored in the MDR... - ...and then copied to the ACC <p data-bbox="560 439 592 712">(1 Mark per -, max 6)</p>	6 (AO1.2)																															
ii																																	

Question	Answer	Mark	Guidance
iii	<ul style="list-style-type: none"> - Takes in a value from user. - If value is 5 or less it shows green - Otherwise it shows Red <p>(1 Mark per -, max 3)</p>	3 (AO 3.2)	<p>Do not credit structured English</p> <p>Example</p> <pre>value = input("Enter a Value") if value <=5 then print("GREEN") else print("RED") endif</pre> <p>Accept equivalents to <=5 (e.g. <6)</p> <p>For Green/Red (or 1/0) accept any pseudocode equivalent (GreenLightOn(), Output 1, print(1) Output Green etc.) as long as the logic is correct.</p>

Question	Answer	Mark	Guidance
iv	<p>Mark Band 3–High Level (7-9 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of assembly code and high level languages. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (4-6 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding assembly code and high level languages; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed.</p> <p>Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p>	<p>9</p> <p>AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)</p>	<p>AO1</p> <p>Assembly code uses mnemonics to represent machine code instructions/opcodes. High level languages use more natural/mathematical notation. Assembly code consists of simple instructions As such many more lines of assembly code are required to perform the same task as a few lines of a high level language. Assembly code is specific to the instruction set of a given processor. High Level languages are not architecture specific.</p> <p>AO2</p> <p>Assembly code allows the programmer to choose the exact instructions so they can write code that is highly efficient. It also allows them to have direct control of how memory is used via addressing modes. Direct control of hardware. High level language compilers have optimisers that can also try and do this (and in some cases may outperform a human writing in assembly code).</p> <p>As high level code is more intuitive and easier to read it is easier to follow, debug and build as part of a team. It can also be written in a much shorter time frame. The high level code can be recompiled for different architectures. High level languages come in a variety of paradigms so programmers can choose according to the problem/their preference.</p> <p>AO3</p> <p>Assembly language is best suited to situations such as:</p>

Question	Answer	Mark	Guidance
	<p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-3 marks)</p> <p>The candidate demonstrates a basic knowledge assembly code and high level languages; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p> <p>0 marks</p> <p>No attempt to answer the question or response is not worthy of credit.</p>		<ul style="list-style-type: none"> -compilers or interpreters don't exist for the target CPU i.e. embedded systems -highest possible performance is critical -memory is very limited. <p>For larger projects which don't fall under the constraints above high level languages are likely to be preferable.</p>

Question	Answer	Mark	Guidance						
2	a <table border="0" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; border: none;">i</td> <td style="border: none;"> <ul style="list-style-type: none"> - Provide a (user) interface - Manage hardware/peripherals - Manage CPU usage / handles interrupts - Provide security - Provide platform to run other software - Provide utilities for system maintenance (1 Mark per -, Max 3) </td> </tr> <tr> <td style="border: none;">ii</td> <td style="border: none;">Paging</td> </tr> <tr> <td style="border: none;">iii</td> <td style="border: none;"> <ul style="list-style-type: none"> - Operating system uses area of secondary storage as virtual memory. - Move unused pages/parts (of program A and/or B) into virtual memory - Load program C into (physical) memory. (1 Mark per -, Max 3) </td> </tr> </table>	i	<ul style="list-style-type: none"> - Provide a (user) interface - Manage hardware/peripherals - Manage CPU usage / handles interrupts - Provide security - Provide platform to run other software - Provide utilities for system maintenance (1 Mark per -, Max 3)	ii	Paging	iii	<ul style="list-style-type: none"> - Operating system uses area of secondary storage as virtual memory. - Move unused pages/parts (of program A and/or B) into virtual memory - Load program C into (physical) memory. (1 Mark per -, Max 3)	3 (AO1.1)	If candidate names utility software, allow BP6
i	<ul style="list-style-type: none"> - Provide a (user) interface - Manage hardware/peripherals - Manage CPU usage / handles interrupts - Provide security - Provide platform to run other software - Provide utilities for system maintenance (1 Mark per -, Max 3)								
ii	Paging								
iii	<ul style="list-style-type: none"> - Operating system uses area of secondary storage as virtual memory. - Move unused pages/parts (of program A and/or B) into virtual memory - Load program C into (physical) memory. (1 Mark per -, Max 3)								
		1 (AO1.1)							
		3 (AO2.1)							

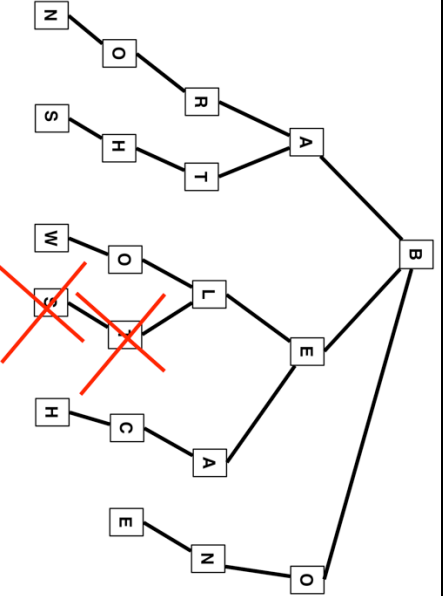
Question	Answer	Mark	Guidance
b	i <ul style="list-style-type: none"> - Tags to make "Features" a heading (accept h1, h2, h3 etc.) - Correct use of ol - Correct use of li tags - Use of <a tag Around the text "Download the Factsheet" - correct use of href="factsheet.pdf" (1 Mark per -, max 5)	5 (AO3.2)	For making Features a heading only accept <code>strong/b</code> if accompanied by code to increase font size. <pre> <h1>Features</h1> The new OCR Smart Watch: Uses the CB2 RISC processor for long battery life Stores up to 20hrs of music Tracks fitness Download The Factsheet </pre> Li close tags are optional
	ii <ul style="list-style-type: none"> - A program called a spider/crawler/bot - Traverses the web / following the links. - It takes each word in the document - ...It adds an entry for the page (under the word) in the index... - ...alongside the word's position on the page. (1 Mark per -, Max 3)	3 (AO2.1)	
	iii <ul style="list-style-type: none"> - RISC has a smaller instruction set (than CISC) - Requires fewer transistors / less complex circuitry - Means less power is required. (1 Mark per -, Max 3)	3 (AO1.2)	

Question	Answer	Mark	Guidance
3			
a	<ul style="list-style-type: none"> - Gets/selects/outputs the flight numbers from the 'Flight' table - Of flights with the destination JFK - It returns OC0089 and OC7750 (1 Mark per -, Max 2)	2 (AO2.2)	
b	<ul style="list-style-type: none"> - SELECT * changed to DELETE - Halifax changed to Heathrow DestinationName='Heathrow' / DestinationCode='LHR' - Added AND DepartureDate=4/7/18 (1 Mark per -, Max 3)	3 (AO3.2)	DELETE FROM Flight WHERE DestinationName='Heathrow' AND DepartureDate=4/7/18 Accept quotation marks or #s around the date. Do not give first mark if asterisk is kept (i.e. DELETE *) The Departure Date condition could be placed before the Destination Name.
c	<ul style="list-style-type: none"> i It is not unique/ the same value can appear in multiple records 	1 (AO2.1)	
	<ul style="list-style-type: none"> ii It is likely to be used to search for / index / sorted on 	1 (AO2.1)	
d	<ul style="list-style-type: none"> i -No Repeating fields/data -Data is atomic -Has a primary Key (1 Mark per -, max 2)	2 (AO2.1)	

Question	Answer	Mark	Guidance
	<p>ii</p> <p>-Is in First Normal Form -Every field is dependent on the primary key.</p> <p>(1 Mark per -, max 2)</p>	2 (AO2.1)	
	<p>iii</p> <p>Has a transitive relationship/ A non-key field depends on another non-key field: - DestinationName depends on DestinationCode</p> <p>(1 Mark per -, max 2)</p>	2 (AO1.2)	
e	<ul style="list-style-type: none"> - CSV/Comma Separated Value (file)... - A (text) file/format with values separated by commas (or some other delimiter) - XML/Extensible Markup Language... - ...A markup language that uses tags to denote data. - SQL/Structured Query Language... - ...A language for creating/querying databases <p>Accept any reasonable answer. 1 mark for naming method, 1 mark for valid description.</p>	2 (AO2.1)	<p>Other examples include:</p> <ul style="list-style-type: none"> - RSS/Really Simple Syndication/Rich Site Summary... - ...A URL is given which points to an XML file which is periodically checked by a browser/program. - API/Application Programming Interface... - ...A rewritten set of subroutines/interfaces that provide access to the company's data. - JSON/JavaScript Object Notation... - ...text format that can easily be changed to and from JavaScript Objects. <p>Candidates may provide other valid answers (e.g. REST, SOAP etc.).</p> <p>Descriptions may differ from those given. Accept any valid description.</p>

Question	Answer	Mark	Guidance
4	<ul style="list-style-type: none"> - Wide Area Network - Collection of connected computers/devices over a large geographical area - Often using 3rd party communications channels (1 Mark per -, max 2)	2 (AO1.1)	
a	<ul style="list-style-type: none"> - Allowing them to communicate - By ensuring all devices follow the same rules/standards - So they interpret data/signals in the same way (1 Mark per -, max 2)	2 (AO1.2)	
b	<ul style="list-style-type: none"> - Application - Transport - Internet - Network Interface/(Data) Link/Physical (1 Mark per -, max 4)	4 (AO1.1)	

Question		Answer	Mark	Guidance
5	a	Foot mouse/pedal... ... press key/click button to send signal. Camera/eye tracker... ...Move/blink to send signal Microphone... ...Make sound to send signal Puff/suck switch... ..blow/suck to send signal. Accept any sensible answer. 1 mark for naming of input device, 1 mark for use.	2 (AO2.1) Identify (1), AO2.2) Describe (1)	First mark must be hardware not software
	b	- T and S removed /T removed/Link between L and T removed... - ...No further nodes removed (1 Mark per -, Max 2)	2 (AO2.1)	

Question	Answer	Mark	Guidance
ii	<ul style="list-style-type: none"> - BEACH added - BONE added (1 Mark per -, Max 2)	2 (AO2.1)	 <p>Whether branches point left or right or order of branches is irrelevant. As long as branches form the words without unnecessary repetition of nodes, award the marks.</p>
c	<ul style="list-style-type: none"> - Free of cost - Right to <u>inspect/amend/recompile source code</u> - Can tailor the program to their <u>specific needs</u> - Code open for bugs to be spotted and fixed. (1 Mark per -, Max 2)	2 (AO1.2)	

Question	Answer	Mark	Guidance
6	<p>Mark Band 3–High Level (9-12 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of computing related laws and modern issues that fall under them. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate is able to assess the extent to which the law is able to keep up with changes in technology.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (5-8 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding of computing related laws and modern issues that fall under them; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate makes a reasonable attempt to come to a conclusion as to whether the law is able to keep up with changes in technology.</p>	<p>12</p> <p>AO1.1 (2) AO1.2 (2) AO2.1 (3) AO3.3 (5)</p>	<p>Points may include but aren't limited to:</p> <p>AO1 Knowledge and Understanding</p> <p>Laws that regulate technology include: the Data Protection Act... ...which regulates how personal data is stored. The Computer Misuse Act... ...which regulates unauthorised access. The Copyright and Patents Act... ...regulated intellectual property. Regulation of Investigatory Powers Act... ...Regulates how government agencies can use IT for surveillance</p> <p>AO2 Application</p> <p>Computer Misuse Act is harder to enforce with the increased use of DDoS attacks (often involving unwitting participants). The Internet of things is likely to make such attacks even more common place. People are connecting to the internet in new ways using mobile networks/public Wi-Fi making attacks potentially difficult to track.</p> <p>Films/Music etc. are being shared in new ways. Streaming is common – often this is legitimate but the global nature of it can bring licensing issues into play. Fast internet speeds, peer to peer and the dark web all contribute to making piracy more prevalent and harder to track. Digital watermarking can be used to track piracy. End to end encryption makes government monitoring of communications trickier.</p>

Question	Answer	Mark	Guidance
	<p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-4 marks)</p> <p>The candidate demonstrates a basic knowledge of computing related laws and modern issues that fall under them; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides nothing more than an unsupported assertion.</p> <p>The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p> <p>0 marks</p> <p>No attempt to answer the question or response is not worthy of credit.</p>		<p>AO3 Evaluation</p> <p>May conclude that although technology develops quickly the laws are broad enough to cover all eventualities.</p> <p>Alternatively, may conclude that people are always looking for ways of using technology to access loophole in the law / to avoid detection.</p> <p>Look for a well-reasoned conclusion. Could decide either for or against but should be backed up with examples.</p>

Question		Answer	Mark	Guidance
7	a	<ul style="list-style-type: none"> - Needs to be able to respond instantly to changes... - ...such as someone stepping in front of car (or other sensible example) - RTOS offers a guaranteed response time. - A non RTOS might be busy dealing with other tasks and not respond until it is too late. 	3 (AO1.2)	
	b	<p>(1 Mark per -, Max 3)</p> <ul style="list-style-type: none"> - Created Obstacle object called bollard - Has put the correct arguments in, in the correct order. <p>(1 Mark per -, Max 2)</p>	2 (AO3.2)	<p>Examples</p> <pre> bollard=new Obstacle(false, 7.8, 8) Obstacle bollard = Obstacle(false, 7.8, 8); bollard=Obstacle(false, 7.8, 8) </pre> <p>Do not penalise for use of self parameter as used by languages such as Python.</p>
		<ul style="list-style-type: none"> ii -The attribute <code>distance</code> is private... -...and therefore updated with the method <code>update distance</code> 	2 (AO3.2)	

Question	Answer	Mark	Guidance
iii	<ul style="list-style-type: none">- Reduces the chance of errors/inconsistences- Ensures objects can only be changed in the way intended/ Ensuring changes are consistent with how the object should behave- Protecting data/ Can't be changed accidentally (1 Mark per -, Max 2)	2 (AO1.2)	Read 'securing' as 'protecting'

Question	Answer	Mark	Guidance
C	<p>- First line Clear use of inheritance of Obstacle. E.g.: Person inherits Obstacle / Person extends Obstacle / Person : Obstacle / Person(Obstacle)</p> <p>In the method</p> <ul style="list-style-type: none"> - Less than 2 metres triggers brake - Equal to but not greater than 2 metres triggers brake. - Less than or equal to 2 metres triggers horn - Less than or equal to 5 metres triggers horn <p>(1 Mark per -, Max 5)</p>	5 (AO3.2)	<p>class Person inherits Obstacle</p> <pre> public procedure updateDistance(givenDistance) if givenDistance<=5 then Controls.beepHorn () if givenDistance<=2 then Controls.applyBrakes () endif endif distance = givenDistance endprocedure endclass </pre> <p>NB a number of ways exist of writing the method – be careful of the logic. Two such correct examples are below.</p> <pre> if givenDistance<=5 then Controls.beepHorn () endif if givenDistance<=2 then Controls.applyBrakes () endif if givenDistance<=2 then Controls.beepHorn () endif </pre> <pre> if givenDistance<=2 then Controls.beepHorn () Controls.applyBrakes () elseif givenDistance<=5 then Controls.beepHorn () endif </pre>

Question	Answer	Mark	Guidance
d	<p>Advantages of an automated driver are it is potentially:</p> <ul style="list-style-type: none"> - safer than a human driver (due to quicker reaction speeds etc.). - cheaper as no wage to cover. - less likely to make mistakes with route. <p>Disadvantages of an automated driver are it is potentially:</p> <ul style="list-style-type: none"> - May not be able to understand natural speech. - May be limited in terms of the roads on which it can operate. - Vulnerable to hacking. - Only as good as the program running it – a bug in the code could cause catastrophic accidents. - May prioritise safety of pedestrians over that of the passenger. (e.g. may take actions that may put the passenger at risk to save the lives of numerous people outside the car.) - No discussion possible with the driver / no "human presence" to reassure nervous customers. <p>Max 1 advantage and max 1 disadvantage</p>	2 (AO2.2)	

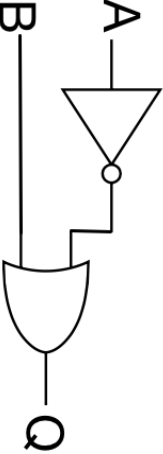
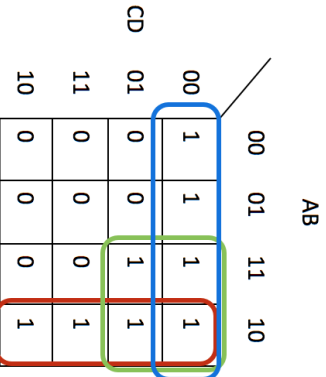
Question	Answer	Mark	Guidance																																																		
8	<p>a</p> <ul style="list-style-type: none"> - American Standard Code for Information Interchange - A character set - Maps values to characters - Uses 7-bits/ 8-bits per character <p>(1 Mark per -, Max 2)</p>	2 (AO1.1)																																																			
b	<p>Row shift as below (1 Mark)</p> <table border="1" data-bbox="754 439 1051 725"> <tr><td>P</td><td>S</td><td>E</td><td>T</td><td>O</td></tr> <tr><td>E</td><td>T</td><td>M</td><td>C</td><td>R</td></tr> <tr><td>S</td><td>A</td><td>G</td><td>E</td><td>S</td></tr> <tr><td>R</td><td>P</td><td>L</td><td>E</td><td>Y</td></tr> <tr><td>G</td><td>G</td><td>Q</td><td>U</td><td>O</td></tr> </table> <p>Column Shift as below (1 Mark)</p> <table border="1" data-bbox="355 439 652 725"> <tr><td>G</td><td>G</td><td>Q</td><td>U</td><td>O</td></tr> <tr><td>P</td><td>S</td><td>E</td><td>T</td><td>O</td></tr> <tr><td>E</td><td>T</td><td>M</td><td>C</td><td>R</td></tr> <tr><td>S</td><td>A</td><td>G</td><td>E</td><td>S</td></tr> <tr><td>R</td><td>P</td><td>L</td><td>E</td><td>Y</td></tr> </table>	P	S	E	T	O	E	T	M	C	R	S	A	G	E	S	R	P	L	E	Y	G	G	Q	U	O	G	G	Q	U	O	P	S	E	T	O	E	T	M	C	R	S	A	G	E	S	R	P	L	E	Y	2 (AO1.2)	cao
P	S	E	T	O																																																	
E	T	M	C	R																																																	
S	A	G	E	S																																																	
R	P	L	E	Y																																																	
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E	T	M	C	R																																																	
S	A	G	E	S																																																	
R	P	L	E	Y																																																	

Question	C	Answer	Mark	Guidance
		<p>- Procedure correctly defined with parameters. - Procedure manipulates the correct row of grid. - Sensible use of for loop to iterate through the array without generating out of bounds exception. - Correctly shifts each row. (1 Mark per -, Max 4)</p>	4 (AO3.1)	<p>When checking to see if out of bounds exception keep in mind that in some languages the loop boundaries are exclusive. When unsure give the benefit of the doubt. The final mark is meant to offer stretch and challenge. Be cautious of wrong answers on face value seems to work. For example, the following will not work:</p> <pre> procedure shiftRow(rowNumber, places) for i = 0 to places grid[rowNumber, i+1] = grid[rowNumber, i] next i endprocedure </pre> <p>Possible solutions include...</p> <pre> procedure shiftRow(rowNumber, places) array temp[5] for i=0 to 4 temp[i]=grid[rowNumber, i] next i for i=0 to 4 newPos=(i+places)MOD 5 ///<i>is the same</i> next i grid[rowNumber, newPos]=temp[i] endprocedure </pre> <p>And..</p> <pre> procedure shiftRow(rowNumber, places) for i=1 to places temp1=grid[rowNumber, 4] temp2=0 for j =0 to 4 temp2=grid[rowNumber, j] grid[rowNumber, j]=temp1 temp1=temp2 next j next i end procedure </pre> <p>Note: within solutions, allow for columns to be referenced first eg grid[i, rowNumber]</p>

Question	Answer	Mark	Guidance
d	<p>Mark Band 3–High Level (7-9 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of modern encryption and the difference between symmetric and asymmetric encryption. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (4-6 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding of modern encryption and the difference between symmetric and asymmetric encryption; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p>	<p>9</p> <p>AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3)</p>	<p>AO1</p> <p>Modern encryption is many orders stronger than that used in a pre-computer era. Asymmetric encryption uses different keys for encryption and decryption. Symmetric encryption uses the same key for encryption and decryption. Asymmetric encryption algorithms tend to involve more processing than symmetric algorithms.</p> <p>AO2</p> <p>Modern encryption can be used without specialist knowledge. Often users may not even be aware their data is being encrypted (e.g. HTTPS, messaging systems) Asymmetric encryption is often used when exchanging data. For example credit card details over the internet. Symmetric encryption is best suited when the same person is encrypting and decrypting. For example when backing up data.</p> <p>AO3</p> <p>The strength and ease of use of encryption has made it widely used on the Internet. E-Commerce would not be possible without it. Governments are no longer able to easily crack encrypted messages they intercept (as far as we know). This gives individuals unprecedented levels of privacy. But also means those communicating for nefarious purposes can do so undetected.</p>

Question	Answer	Mark	Guidance
	<p>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-3 marks)</p> <p>The candidate demonstrates a basic knowledge of modern encryption and the difference between symmetric and asymmetric encryption; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p> <p>0 marks</p> <p>No attempt to answer the question or response is not worthy of credit</p>		

Question	Answer	Mark	Guidance
9	10101001 111111	2 (AO1.2)	
a	← Answer, 1 Mark ← Carry bits, 1 Mark		
b	1 022 ← Borrowed bits, 1 Mark 1100 1111 00111001 <u>10010110</u> ← Answer, 1 Mark	2 (AO1.2)	Allow 2 marks for any other valid method with working shown. If converted to denary and calculated, no marks.
c	370F 1 Mark for the first two digits (i.e. 37) 1 Mark for the last two digit (i.e. 0F)	2 (AO1.2)	
d	-Exponent is 2 -Mantissa becomes 010.01 -Value is 2.25 (1 Mark per -, Max 3)	3 (AO1.2)	
e	01100 0000 1 Mark for mantissa, 1 mark for exponent. 10000 0100 1 Mark for mantissa, 1 mark for exponent.	4 (AO1.2)	
f	10111001	1 (AO1.2)	cao
g	111111111	1 (AO1.2)	cao

Question		Answer	Mark	Guidance
10	a	 <p>- A going into NOT gate. - B and NOT A going into OR gate (and Q coming out of it) (1 Mark per -, Max 2)</p>	2 (AO1.2)	
	b	<p>-Groups correctly identified (with no further groups). - Answer includes $\neg C \wedge \neg D$ - Answer includes $A \wedge \neg B$ - Answer includes $A \wedge \neg C$ - All three sections joined with \vees in any order but with no further sections. E.g. $(A \wedge \neg B) \vee (A \wedge \neg C) \vee (\neg C \wedge \neg D)$ The brackets aren't necessary (1 Mark per -, Max 5)</p>	5 (AO1.2)	

Question	Assessment Objectives							Total
	AO1.1	AO1.2	AO2.1	AO2.2	AO3.1	AO3.2	AO3.3	
1ai	2							2
1aii		2						2
1bi							2	2
1bii		6						6
1biii						3		3
1biv	2	2	2				3	9
2ai	3							3
2aii			1					1
2aiii		3						3
2bi					5			5
2bii			3					3
2biii		3						3
3a				2				2
3b					3			3
3ci			1					1
3cii			1					1
3di			2					2
3dii			2					2
3diii		2						2
3e			2					2
4a	2							2
4bi		2						2
4bii	4							4

5a				1	1							2
5bi				2								2
5bii				2								2
5c			2									2
	6	2	2	3						5		12
7a			3									3
7bi						2						2
7bii					2							2
7biii			2									2
7c						5						5
7d					2							2
8a		2										2
8b			2									2
8c						4						4
8d		2	2	2						3		9
9a			2									2
9b			2									2
9c			2									2
9d			3									3
9e			2									2
9f			2									2
9g			1									1
9h			1									1
10a			2									2
10b			5									5
												0
												0

											0
											0
											0
TOTALS	19	55	24	7	19	3	13				140

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 **Cambridge
Assessment**





Oxford Cambridge and RSA

A Level Computer Science

H446/01 Computer Systems

Friday 16 June 2017 – Morning

Time allowed: 2 hours 30 minutes



Do not use:

- a calculator



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.

.....
..... [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]

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.

*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]

.....
.....
.....
.....
.....
.....
.....
.....

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

[4]

(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]

(b) The complete program is shown below:

```

main      INP
          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]

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.

<code>userID</code>	<code>username</code>	<code>passwordHash</code>	<code>locked</code>
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.

.....
 [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’.

.....

 [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]

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]

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[])
```

.....

.....

.....

.....

.....

.....

.....

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.....

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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.

1

.....

2

.....

[2]

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.

		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

[4]

END OF QUESTION PAPER

26
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Oxford Cambridge and RSA

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GCE

Computer Science

Unit **H446A/01**: Computer systems

Advanced GCE

Mark Scheme for June 2017

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Mark schemes should be read in conjunction with the published question papers and the report on the examination.

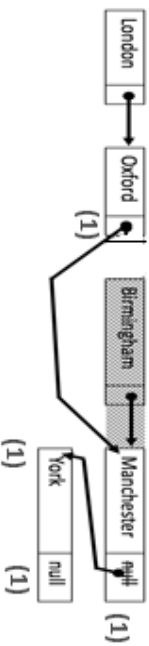
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These are the annotations, (including abbreviations), including those used in scoris, which are used when marking

Annotation		Meaning
		Omission mark
		Benefit of the doubt
		Subordinate clause / consequential error
		Incorrect point
		Expansion of a point
		Follow through
		Not answered question
		No benefit of doubt given
		Point being made
		Repeat
		Correct point
		Too vague
		Zero (big)
		Blank Page – this annotation must be used on all blank pages within an answer booklet (structured or unstructured) and on each page of an additional object where there is no candidate response.
		Level 1
		Level 2
		Level 3

c	i	<p>Advantage:</p> <ul style="list-style-type: none"> - Centrally administered in one location. (1) - One location to back up. (1) <p>Disadvantage:</p> <ul style="list-style-type: none"> - Central point of failure. (1) - Can be expensive to maintain/set up (e.g. cabling costs, specialist staff.) (1) <p>(Max 1 Advantage, 1 Disadvantage)</p>	2 (AO1.2)	Accept for MP1 better security Do not credit quick access as an advantage
	ii	<p>A hardware device/piece of software that monitors (and filters/blocks) traffic/packages <u>going to and from</u> a network. (1) (Max 1)</p>	1 (AO1.1)	Accept 'content' for 'traffic/packages'
	iii	<p>Prevent unauthorised access to a network. (1) To restrict applications that are used internally that have internet access. (1) To restrict websites that can be accessed from within the company. (1) To protect the company's data/intellectual property. (1) (Max 1)</p>	1 (AO 1.2)	Accept for MP1 malicious attacks/traffic
2	a	<p>A dynamic/data structure (1) Each node/item consists of data and pointer (1) Pointer gives location of next node. (1)</p>	3 (AO1.2)	Accept 'element' instead of 'node/item'

	ii	<p>Description can be written:</p> <ul style="list-style-type: none"> - Oxford pointer changed to bypass Birmingham and point to Manchester. (1) - A node is created holding the data York/York is placed in next free space/node/item (1) - Manchester remains in original position and pointer changed to point to the York node. (1) - The York node points to null (or terminator). (1) <p>OR via diagram eg.:</p> 	4 (AO2.1)	<p>On diagram don't penalise if the pointer from Birmingham is left intact. It should be clear in both diagram and text that Oxford no longer points to Birmingham.</p> <p>In diagram solution, London, Oxford and Manchester must remain in the same positions.</p>	
	b	<p>A linked list requires every node to be checked (until the desired record is found). (1) A linked list will take longer to search (as more nodes are added). (1) A hash table enables direct access to the location of the record. (1) A hash table will take the same time to search (as more nodes are added)/it takes no longer as more records are added. (1)</p>	4 AO1.2 - 2 marks AO2.2 - 2 marks)	<p>Some candidates may talk about time complexity: linked lists being linear/$O(n)$ and hash table being constant/$O(1)$ Accept these as points 1 & 2 and 3 & 4 conjoined i.e. full marks.</p>	
3	a	i	<p>Downloads quicker. (1) Saves user money by using less bandwidth/ on data usage. (1) (Max 1)</p>	1 (AO1.2)	<p>Do not accept 'saves the user space on their device'.</p>

	ii	Lossy takes away some of the information from the original. (1) Lossless preserves all the information from the original. (1) With text the loss of small amounts of information will make it unreadable. (1)	3 (AO1.1 – 2 marks AO2.1 - 1 mark)	
--	----	---	--	--

b	<p>Mark Band 3–High Level (9-12 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of dictionary and run length encoding for compression. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate is able to weigh up both forms of compression and justify dictionary encoding being the better choice.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2-Mid Level (5-8 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding of dictionary and run length encoding for compression; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate makes a reasonable attempt to come to a conclusion as to which form of compression is better</p>	<p>AO1.1 (2)</p> <p>AO1.2 (2)</p> <p>AO2.1 (3)</p> <p>AO3.3 (5)</p> <p>12</p>	<p>Points may include but aren't limited to:</p> <p>AO1 Knowledge and Understanding</p> <p>Run length encoding relies on consecutive pieces of data/characters being the same.</p> <p>Each set of consecutive symbols can be represented by the symbol and its number of occurrences e.g. AAAAABBBBBBCCC could be represented as 4A5B3C (or A4B5C3 or any sensible RLE encoding)</p> <p>In dictionary encoding frequently occurring pieces of data/groups of characters are replaced by symbols/tokens/smaller groups of characters/indexes.</p> <p>A dictionary is then used to say which symbols/tokens/characters/indexes match which groups of characters. When decompressed the dictionary is used to replace the tokens with the original text.</p> <p>AO2.1 Application</p> <p>Run Length Encoding is very unsuitable for the example text There are very few consecutive repeating symbols in the text. only instances being ll and ee these still require 2 characters to represent them 2l and 2e</p> <p>Dictionary encoding is well suited. There are lots of repeating groups of characters For example 'call' 'name' '[SPACE]we' 'Romeo' We could for example have: What's in53? that which2 15 rose</p>
---	---	---	---

	<p>sued.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-4 marks)</p> <p>The candidate demonstrates a basic knowledge of dictionary and run length encoding for compression; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides nothing more than an unsupported assertion.</p> <p>0 marks No attempt to answer the question or response is not worthy of credit.</p>		<p>By5ny other3 would smell5s sweet; So4would;2re he not4'1'd 1:call 2:[space]we 3:[space]name 4:[space]Romeo[space] 5:[space]a</p> <p>(NB candidates are unlikely to show full compression, just a demonstration of the principle is sufficient. The best candidates are likely to show an awareness that space is a character that can be used in compression and that upper and lowercase letters are different. Demonstrating this is indicative of but not a requisite of the band.)</p> <p>AO3.3: Evaluation</p> <p>Run length encoding is not suited to natural language (more likely to be used in simple images).</p> <p>Applying it to the example the resulting text would be the same size as the original/worse than the original (if we use 1s to represent every individual instance of a character).</p> <p>Dictionary encoding works well. We can already see benefit on small piece of text. Would fare substantially better on full works.</p> <p>Dictionary encoding is the best compression method for this scenario.</p>
--	---	--	---

4	a	$Q \equiv (A \wedge B) \vee (C \wedge D)$ 1 mark for $(A \wedge B)$ 1 mark for $(C \wedge D)$ 1 mark for the \vee joining the two parts.	3	Accept $(C \wedge D) \vee (A \wedge B)$ Accept $(B \wedge A)$ instead of $(A \wedge B)$ Accept $(D \wedge C)$ instead of $(C \wedge D)$ Accept alternative notations (e.g. +, . OR/AND) Accept AB as $(A.B)$ and CD as $(C.D)$ Accept answers without brackets																																																						
b	i	<table border="1" data-bbox="742 353 1018 1187"> <thead> <tr> <th>E</th> <th>F</th> <th>G</th> <th>$(E \wedge F)$</th> <th>$(E \wedge G)$</th> <th>$(E \wedge F) \vee (E \wedge G)$</th> </tr> </thead> <tbody> <tr><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr> </tbody> </table> 1 mark for each of the pairs of rows.	E	F	G	$(E \wedge F)$	$(E \wedge G)$	$(E \wedge F) \vee (E \wedge G)$	1	1	1	1	1	1	1	1	0	1	0	1	1	0	1	0	1	1	1	0	0	0	0	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4	(AO1.2)
E	F	G	$(E \wedge F)$	$(E \wedge G)$	$(E \wedge F) \vee (E \wedge G)$																																																					
1	1	1	1	1	1																																																					
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0	0	0	0	0	0																																																					

	ii	(FVG) \wedge E One mark for the (FVG) One mark for the \wedge E	2 (AO2.2)	Accept: (GVF) \wedge E E \wedge (FVG) E \wedge (GVF)								
4	c	Encrypt the film (1) Send the key/password out on the release date (1)	2 (AO2.2)	Accept Use Digital Rights Management/DRM... ..To keep content encrypted until given date.								
5	a	i - Stores the value 10 (1) - In a memory location (1) - Given the label/symbolic address ten (1)	3 (AO1.2)	MP3 Accept Identifier								
	ii	<table border="1"> <thead> <tr> <th>Starting value in Accumulator</th> <th>Pass Or Fail</th> </tr> </thead> <tbody> <tr> <td>29</td> <td>Fail</td> </tr> <tr> <td>30</td> <td>Pass</td> </tr> <tr> <td>31</td> <td>Fail</td> </tr> </tbody> </table> 1 Mark per row	Starting value in Accumulator	Pass Or Fail	29	Fail	30	Pass	31	Fail	3 (AO2.1)	
Starting value in Accumulator	Pass Or Fail											
29	Fail											
30	Pass											
31	Fail											
	b	i LDA (1) SUB (1) ADD (1) INP (1) (Max 1)	1 (AO1.2)									

	ii	BRA (1) BRP (1) BRZ (1) (Max 1)	1 (AO1.2)	
	iii	20	1 (AO2.1)	
	iv	40	1 (AO2.1)	
	v	Rounds up (the number input)... (1) ...To the nearest multiple of ten (and outputs it) (1)	2 (AO2.2)	Rounds to multiple of ten gets one mark.
6	a	i	10111100	1 (AO1.2)
		ii	BC	1 (AO1.2)
	b	i	10101100	1 (AO1.2)

	ii	11010100	1 (AO1.2)	
c		Shift Right (1) Two Places (1)	2 (AO1.2)	Allow one mark for correct number of places but wrong direction.
d		Binary point: shifted four places gives: 01001.0 (1) Binary point shifted two places gives: 010.010 (1) Subtraction carried out ... 01001.000 - 010.010 (1) ...‘Borrowing’ shown... (1) ...Answer: 0110.110 (1) Normalised to: Mantissa 011011 (1) Exponent 0011 (1)	6 (AO1.2)	Correct answer with clear binary subtraction/2’s complement addition calculation gives full marks.
7 a		A field which has a unique value for every record/A unique identifier. (1)	2 (AO1.1 –	

	E.g. userID (1)	1, AO2.1 -1)	
b	i A result generated by applying an algorithm/numeric process to a value. (1)	1 (AO1.1)	
	ii Hash functions are one way/can't be reverse (1) If someone gains access to the database they cannot access user's password. (1)	2 (AO1.2 1 mark, AO2.1 1 mark)	
c	SELECT passwordHash, locked (1) FROM Users (1) WHERE username='Apollo' (1)	3 (AO 3.2)	Do not award first mark for SELECT *
d	UPDATE Users (1) SET locked=1(1) WHERE username='Hades' (1)	3 (AO 3.2)	Allow other updating method e.g. a DELETE statement followed by an INSERT statement, for full marks e.g. DELETE FROM Users WHERE username = 'Hades' (1 mark) INSERT INTO Users (1 mark) VALUES (<userID value>, 'Hades', <passwordHash value>, 1) (1 mark)

e	<p>Takes a hash of givenPassword (NB this may be done inline e.g. if hash (givenPassword) ==passwordHash and locked==0 then (1) Returns true if password is correct and account is unlocked. (1) Returns false if account is locked (1) Returns false if password is incorrect (1)</p>	4 (AO 3.2)	<p>Example code:</p> <pre>temp = hash(givenPassword) if temp==passwordHash and locked==0 then return true else return false endif</pre> <p>Candidates may have taken a different approach – any solution that fulfils the criteria on the left should get them marks.</p>
8	<p>Mark Band 3–High Level (7-9 marks) The candidate demonstrates a thorough knowledge and understanding issues around computers and the workforce and Artificial Intelligence. The material is generally accurate and detailed. The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation. The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered. There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated. Mark Band 2-Mid Level (4-6 marks) The candidate demonstrates reasonable</p>	<p>AO1.1 (2) AO1.2 (2) AO2.1 (2) AO3.3 (3) 9</p>	<p>Points may include but aren't limited to:</p> <p>AO1 Knowledge and Understanding Artificial Intelligence (AI) is the study of computers displaying intelligent behaviour (usually characterised by decision making). AI techniques include neural networks, evolutionary computation, Bayesian networks etc. Computers are well suited to certain jobs and as AI techniques improve the range of jobs they can do is likely to increase. AO2.1 Application For the argument: Many jobs have already been taken over by computers. Manual job such as work in the automotive industry has been replaced by robots.</p>

		<p>knowledge and understanding issues around computers and the workforce and Artificial Intelligence; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p> <p>Mark Band 1-Low Level (1-3 marks)</p> <p>The candidate demonstrates a basic knowledge around computers and the workforce and Artificial Intelligence.; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p> <p>0 marks</p> <p>No attempt to answer the question or response is not</p>		<p>Computer based systems are attractive to employers, they don't require paying, don't get sick and can work 24/7 without making mistakes.</p> <p>Computer systems can be used for work that is considered dangerous for humans</p> <p>And for repetitive and mental tasks.</p> <p>Future developments may make computers better at highly skilled tasks making computers preferable</p> <p>And in the case of certain tasks (e.g. surgery) would make the use of human workers unethical.</p> <p>May cite recent developments in AI (e.g. beating world Go Champion)</p> <p>Against the argument:</p> <p>As technology develops people will be required to design these new systems.</p> <p>It is likely to assist but not take over all roles</p> <p>Producing a more skilled workforce</p> <p>Developments in AI have been forecast for many decades but never materialised.</p> <p>Forecasts as to the development of AI have always been wildly optimistic</p> <p>There is debate as to whether AI will ever be able to show human levels of intelligence.</p> <p>Tasks that humans find inherently 'easy' are still beyond the reach of computers.</p> <p>Crucially for many areas of work computers will have to pass the Turing Test – i.e. converse to such a level that will enable them to pass as</p>
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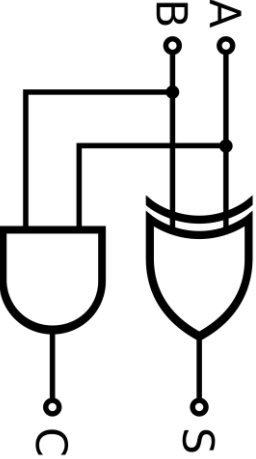
		worthy of credit.		human... ...Most believe this is still well beyond our current understanding. Laws would need changing as currently people have the right to have automated decisions checked over by humans (DPA) AO3.3 Evaluation Candidate should have come to a well reasoned conclusion for or against the argument. They could come down on either side, the important thing is they have considered both points of view and based their conclusion on the evidence they have discussed.
9	a	Only one element can have a given id/id is unique. (1) Class can be used assigned to multiple elements/used multiple times. (1)	2 (AO1.1)	
	b	h1{ (1 mark for open and close) font-family:Arial(;) (1 mark) } .customerQuote{ (1 mark) background-color: #E8C3E1(;) (1 mark) } #intro{ (1 mark) (font-)color: darkRed(;) (1 mark) }	6 (AO3.1)	.customerQuote must have . and opening and closing {} for 3rd mark. #intro must have # and opening and closing {} for 4th mark Must match case sensitivity, except for 'Arial' and 'darkRed' and colour code Allow quotes around Arial and darkRed

c	i	JavaScript	1 (AO1.1)	Gao do not accept Java
	ii	Change line <code>if (hour>9 && hour<17) ...</code> ... To <code>if (hour>8 && hour<17)</code> (1 Mark) or ... <code>if (hour>=9 && hour<17)</code> (1 Mark)	1 (AO3.3)	Accept Change 'greater than' to 'great than or equal to' or similar
	iii	<ul style="list-style-type: none"> - Won't work if JavaScript is disabled. (1) - Shows incorrect message if user's computer's clock is wrong/in different time zone. (1) - (Source) code is visible allowing it to be copied/modified. (1) (Max 1)	1 (AO2.2)	
10	a	<ul style="list-style-type: none"> - Prototype is created (1) - (Evaluated and) feedback used to inform next iteration (1) - Any changes are made (1) - Process repeated until...(1) ... prototype becomes final product. (1) (Max 4)	4 (AO1.1)	

b	<ul style="list-style-type: none"> - Function traverses every letter of answer (1) - Function traverses every randomLetters (1) - Correctly checks each letter of answer against each of randomLetters (1) - Returns 0 if answer contains a letter that doesn't occur in randomLetters (1) - Returns 0 if letter occurs more times in answer than randomLetters (1) - Returns answer length for a valid word.(1) 	6 (AO3.2)	<pre> i=0 while i<answer.length j=0 letter=answer.substring(i,1) while j<10 and randomLetters[j]!=letter j=j+1 endwhile if j<10 then randomLetters[j]="i" else return 0 endif i=i+1 endwhile return answer.length </pre>
c	BS Tree can be searched quicker than an array.	1 (AO1.2)	Accept $O(\log n)$ search time rather than $O(n)$

di	<p>Saves time/money as prewritten (1)</p> <p>Draws on expertise of other programmers (1)</p> <p>Pre-tested (so likely to work) (1)</p> <p>Can have been written in a different language (1)</p> <p>(Max 2)</p>	2 (AO1.2)	
dii	<p>Mark Band 3–High Level (7-9 marks)</p> <p>The candidate demonstrates a thorough knowledge and understanding of how source code is compiled and library code incorporated. The material is generally accurate and detailed.</p> <p>The candidate is able to apply their knowledge and understanding directly and consistently to the context provided. Evidence/examples will be explicitly relevant to the explanation.</p> <p>The candidate provides a thorough discussion which is well balanced. Evaluative comments are consistently relevant and well-considered.</p> <p>There is a well-developed line of reasoning which is clear and logically structured. The information presented is relevant and substantiated.</p> <p>Mark Band 2–Mid Level (4-6 marks)</p> <p>The candidate demonstrates reasonable knowledge and understanding of how source code is compiled and library code incorporated; the material is generally accurate but at times underdeveloped.</p> <p>The candidate is able to apply their knowledge and understanding directly to the context</p>	<p>AO1.1 (2)</p> <p>AO1.2 (2)</p> <p>AO2.1 (2)</p> <p>AO3.3 (3)</p> <p>9</p>	<p>Points may include but are not limited to:</p> <p>AO1 Knowledge and Understanding</p> <p>The compiler is effectively a group of programs.</p> <p>The stages of compilation are: lexical analysis, syntax analysis, code generation and optimisation.</p> <p>A linker is then used to combine the object code with the library code to make the final executable.</p> <p>AO2.1 Application</p> <p>Source code is input into a compiler program.</p> <p>The first stage is lexical analysis in which..</p> <p>Comments and whitespace are removed</p> <p>Variables, and subroutines stored in symbol table</p> <p>Which also holds data such as scope and data type</p> <p>Code is converted to a series of tokens</p> <p>The series of tokens and symbol table is passed onto the next stage, syntax</p>

<p>provided although one or two opportunities are missed. Evidence/examples are for the most part implicitly relevant to the explanation.</p> <p>The candidate provides a sound discussion, the majority of which is focused. Evaluative comments are for the most part appropriate, although one or two opportunities for development are missed.</p> <p>There is a line of reasoning presented with some structure. The information presented is in the most part relevant and supported by some evidence.</p>	<p>analysis: Here the code is checked to ensure it follows the rules of the language. This is often accomplished by placing the tokens into a (abstract syntax) tree. Where it breaks the rules of the language errors are generated. If no rules are broken then it's passed on to the next stage... ..Which is code generation. Here the object code (accept machine code) is created. (i.e. the binary that is executed by the processor) This code may be inefficient.. .. it may contain unnecessary instructions or groups of instructions that can be replaced by simpler ones. Code from the library is likely already compiled. And may well have been written in a different language to the main program. The main program source code will have contained lines importing the library code. A program called a linker can incorporate the code from the library with the main program... ...into a single executable file. An alternative approach is for the main executable to link to the compiled library code (i.e. dynamic linking).</p>
<p>Mark Band 1-Low Level (1-3 marks) The candidate demonstrates a basic knowledge of how source code is compiled and/or library code incorporated; the material is basic and contains some inaccuracies. The candidate makes a limited attempt to apply acquired knowledge and understanding to the context provided.</p> <p>The candidate provides a limited discussion which is narrow in focus. Judgments if made are weak and unsubstantiated. The information is basic and communicated in an unstructured way. The information is supported by limited evidence and the relationship to the evidence may not be clear.</p>	<p>AO3.3 Evaluation Lexical analysis is necessary to put the code into a format which can be</p>
<p>0 marks No attempt to answer the question or response is not worthy of credit.</p>	

				<p>read and processed (i.e. parsed) by the syntax analyser.</p> <p>Syntax Analysis is necessary to ensure the code is valid in as much as it meets all the structural rules of the language. This guarantees it will run (though it might not do as expected and may still have occurrences of run-time errors).</p> <p>Code generation is necessary to turn the code into a format that the processor can understand (i.e. binary machine code).</p> <p>The code optimisation whilst not necessary, does ensure the code runs quicker or using less memory.</p> <p>Linking is necessary to ensure the library code is incorporated into the final program.</p>
11	a	 <p>XOR Gate (1) AND Gate (1) Correct connections and no additional gates (1)</p>	3 (AO1,1)	

11 b

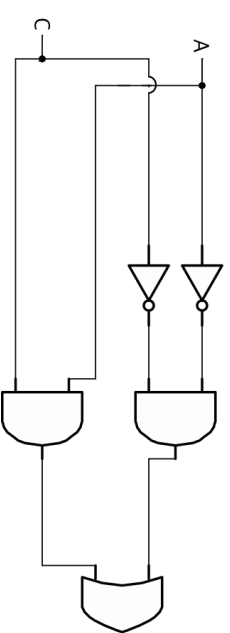
- Correctly identified groups on Karnaugh map/Correct boolean statement.(1)
- NOT A AND NOT C Gates (1)
- A AND C gates (1)
- Both sets of gates joined by OR gate (with no other gates used). (1)

4
(AO2.2)

		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

$(\neg A \wedge \neg C) \vee (A \wedge C)$

Or equivalent:



Or equivalent:

Question	Assessment Objectives							Total
	AO1.1	AO1.2	AO2.1	AO2.2	AO3.1	AO3.2	AO3.3	
1ai			1					1
1aai	2							2
1aiii	1							1
1bi	4							4
1bii	1	1						2
1ci		2						2
1cii	1							1
1ciii		1						1
2ai		3						3
2aai			4					4
2b		2		2				4
3ai		1						1
3aai	2		1					3
3b*	2	2	3				5	12
4am		3						3
4bim		4						4
4biim				2				2
4c				2				2
5ai		3						3
5aai			3					3
5bi		1						1
5bii		1						1
5biii			1					1
5biv			1					1
5bv				2				2
6aim		1						1
6aiim		1						1
6bim		1						1
6biim		1						1
6cm		2						2
6dm		6						6
7a	1		1					2
7bi	1							1
7bii		1	1					2
7c						3		3
7d						3		3
7e						4		4
8*	2	2	2				3	9
9a	2							2
9b					6			6
9ci	1							1

9cii							1	1
9ciii				1				1
10a	4							4
10b						6		6
10c		1						1
10di		2						2
10dii*	2	2	2				3	9
11am	3							3
11bm				4				4
	29	44	20	13	6	16	12	140

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