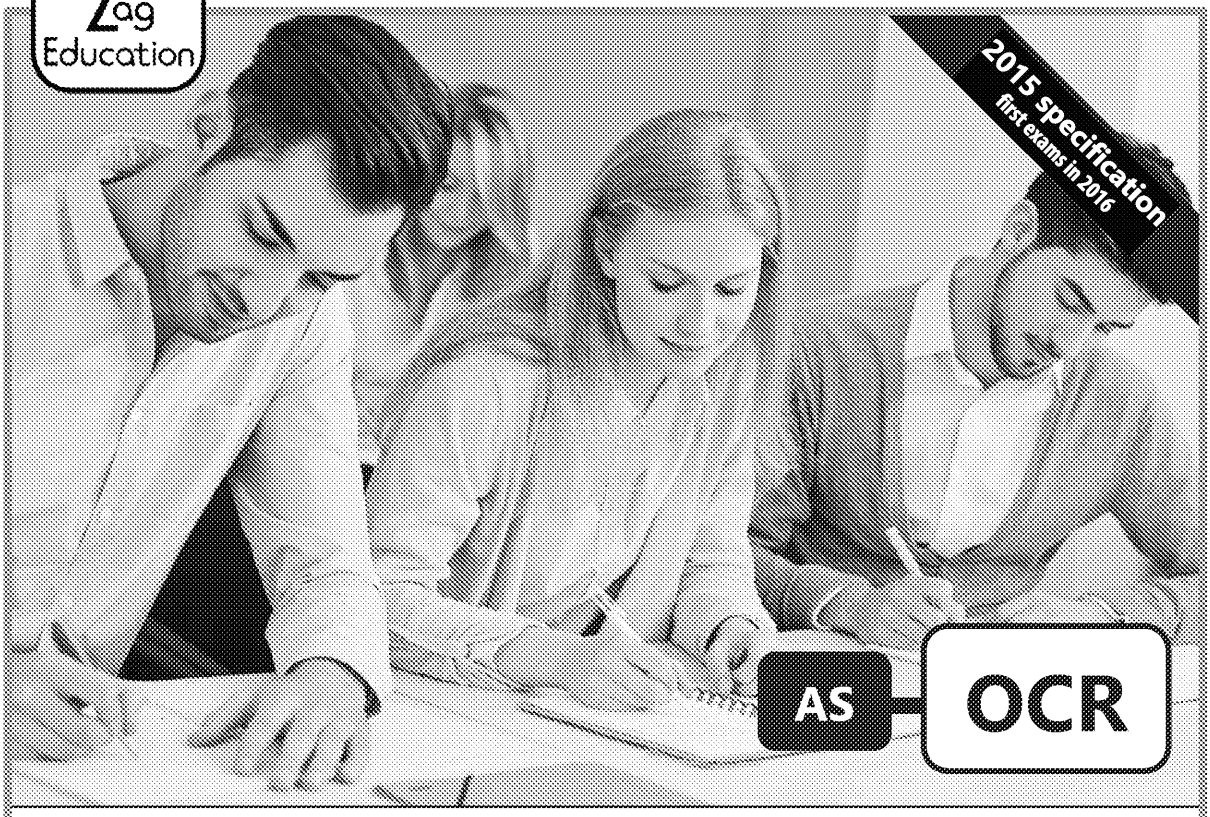
Zig Zag Education

Computer Science

AS | OCR | H046



Topic Tests

for AS OCR Computer Science

Component 1

Update v1.2, January 2022

zigzageducation.co.uk

POD 6298

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Teacher's Introduction

This resource is designed to support teaching and learning of the AS OCR specification (for first teaching in September 2015; first exams from June 2016).

These end-of-topic tests are designed as factual tests to check your students' understanding as they complete each topic*. Their primary focus is not to provide exam-style practice, but instead to test the knowledge, skills and understanding required by the OCR specification in a variety of styles and complexities – ranging from simple short-answer questions through to longer essay-style questions.

**The tests could also be used for homework or revision, but their best use is as summative assessments.*

The tests cover the prescribed specification content for *Component 1* of the AS OCR specification – each provided in worksheet format (with answer lines) and a more photocopy-friendly format (without answer lines), to give you flexibility of use.

Each test is worth between 20–40 marks, and can be completed comfortably within a single one-hour lesson. Example answers are provided for every test. *Note that credit should also be given for any valid responses that are not explicitly included in this resource.*

Update v1.1, May 2016

- Corrections made to mark allocations in *1.3.3 Web Technologies* and *1.4.1 Data Types 1*
- A number of improvements made to *Answers* (page 58 onwards)

Update v1.2, January 2022

- Corrected use of <li> and <ul> tags in answer to question 1(c), Test 1.3.3, p 65.

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** resulting from minor specification changes, suggestions from teachers and peer reviews, or occasional errors reported by customers*

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1.1.1 Processors

1. Briefly explain the functional role of a processor in a computer system.

.....

.....

.....

2. Fill in the missing details in the following table:

Name	Role
Data bus	
	Carries processor commands to devices and returns sig
Address bus	

3. A processor consists of multiple components, including the arithmetic an control unit and registers.

   a) Circle the three operations that the ALU typically perform:

ADD	BRANCH	STORE
MULTIPLY	LOAD	SHIFT

   b) Briefly explain the function of each of the following registers.

      i. Program Counter (PC)

.....

.....

      ii. Accumulator (ACC)

.....

.....

      iii. Current Instruction Register (CIR)

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c) Describe the process of *storing* data to main memory. Identify the re

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4. a) Describe in detail each stage of the Fetch-D... ...ecute cycle.

i. Fetch

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ii. Decode

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iii. Execute

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b) Processor performance is dependent on a number of different factor

Give two examples of design techniques u... ...prove processor p... how they provide this improvemen...

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5. Explain the difference between a Von Neumann architecture and a Harva
For each architecture give an example of an application the architecture i

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1.1.2–3 Types of Processor, Input, Output and

1. Modern computer systems often contain a multicore processor.

   a) Complete the following table stating the resources that are shared by c

Resource	Shared between Cores (Yes/No)
Arithmetic and Logic Unit (ALU)	
Random-access Memory (RAM)	
Network Card	
Program Counter (PC) register	

   b) Give one adv a and one disadvantage of rewriting a single-thre
   ad ge ultiple processor cores.

   Advantage: .....

   .....

   .....

   Disadvantage: .....

   .....

   .....

2. Consider the following assembly instruction:

ADDSTA Ra, Rb, Rc	Add the value in Ra to Rb and store the result at th

   a) Is the processor with this instruction a CISC or a RISC processor? Exp

   .....

   .....

   .....

   b) Give **two** reasons why RIS processors are often used in portable de

   1. .....

   .....

   .....

   2. .....

   .....

   .....

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3. When a processor is powered on it immediately loads a boot program fro
The boot program instructs the processor to load an operating system fro
magnetic hard disk, into RAM (random-access memory).

a) Explain why the boot program is stored in a ROM rather than in RAM

.....

.....

.....

b) Instead of being stored using an internal disk, an operating system can
Name two examples of removable media and one advantage and disa
each to store an operating system

.....

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4. A school is considering changing from using paper registers to storing all

a) Name two input devices that could be used to put the data into the
advantage of using each one.

1.....

.....

2.....

.....

b) The school is considering using a virtual storage system to store the
Describe **two** advantages of using a virtual storage system rather tha
network-attached storage to store register da

1.....

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2.....

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1.2.1 Systems Software

1. Operating systems provide computer systems with a wide range of functi

   a) Circle the three tasks that are performed by an operating system:

COMPILATION	I/O DEVICE COMMUNICATION	INTERRU
PROCESS SCHEDULING	WEB PAGE RENDERING	WEB PA

   b) Briefly explain what a real-time operating syste

   .....

   .....

   .....

   c) Briefly explain what a distributed operating system is.

   .....

   .....

   .....

2. When a process is started it is allocated some memory by the operating s
   addressed directly by the process; instead a technique called *virtual mem*

   a) Explain what virtual memory is.

   .....

   .....

   .....

   b) Explain how the use of virtual memory helps to improve the security

   .....

   .....

   .....

   c) Virt me ables paging to a secondary storage device such a
   S e advantage and one disadvantage of using paging.

   1.....

   .....

   2.....

   .....

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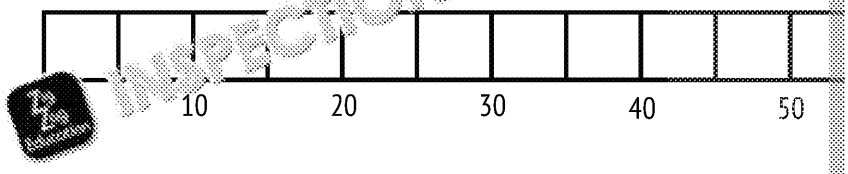
3. A system is running three processes. The processes have the IDs A, B and C. The execution time for each process is listed in the table below:

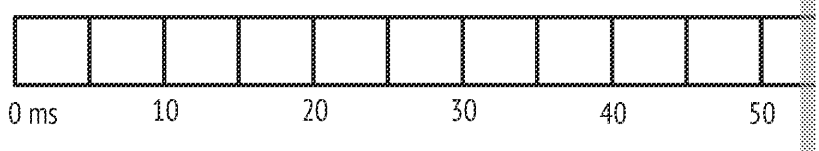
Process ID	Start time	Total execution time
A	10 ms	10 ms
B	0 ms	20 ms
C	5 ms	30 ms

a) Assume that processes can be scheduled in 5 ms time slots. For each of the following algorithms write the ID of the process that will be running in each time slot.

i. First come, first served



ii. Round robin



c) Process C is an operating system response to a key press. The operating system requires that process C needs to be completed as soon as possible.

i. Use your answers to questions (a) and (b) to identify whether *round robin* or *first come, first served* scheduling best meets this requirement.

.....

ii. Now assume that the start and execution times can change. Will the answer you gave as an answer to question (i) always be the best? Explain your answer.

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iii. Give an example of a scheduling algorithm that can prioritise operations such as process C. Explain how this scheduling algorithm works.

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4. Video games designed to run on obsolete game consoles can often be p
using an *emulator*. Emulators are *virtual machines*.

a) Explain the term *virtual machine*.

.....

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.....

b) Games run in an emulator can execute more slowly than the same ga
game console. This can happen even when new hardware that is muc
hardware is used. Explain why this slowdown occurs.

.....

.....

.....

c) State two other uses for virtual machines.

1.....

2.....

5. Some computer systems allow processes to put themselves to sleep for a
can use this functionality to add a delay between function calls. For exam
"..." every 60 seconds:

```
0 while true
1     sleep(60)
2     print("...")
3 endwhile
```

Explain in detail how interrupts could be used to implement this `sleep`
Assume that the processor contains a programmable circuit that can raise
period of time has expired. Ensure that your system can cope with scenari
an interrupt earlier than expected.

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1.2.2 Applications Generation

1. a) Briefly explain the difference between system software and applicatio

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.....

b) Complete the following table stating whether each piece of software is a

Software Name	Type (Application/System)	Software Name
Operating System		Calculator
Word Processor		Sound Card Driver

2. a) A compiler is one type of translator program. Name the other two ty

1..... 2.....

b) Explain the differences between the three different types of translato

.....

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3. Open-source programs are heavily used throughout the computer indust

a) Explain the difference between a closed-source program and an ope

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b) Give one example of a closed-source program and one example of a

Open-source:.....

Closed-source:.....

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c) Describe one advantage and one disadvantage to a company of dist
in open-source form.

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1.2.3 Introduction to Programming

1. Procedural programming languages are very popular and are used to cre

   a) Describe what is meant by a procedural programming language.

   .....

   .....

   .....

   b) Variables of routines declared in a procedural pro ram may be acces
   but not in another.

      i. Give the term used to de ne part of the program a variabl

      .....

      ii cr two major benefits of restricting the accessibility of var
      gramming language.

      1 .....

      .....

      2 .....

      .....

2. a) Explain, using examples, the difference between a constant and a var

   .....

   .....

   .....

   .....

   b) Explain the difference between a procedure and a function.

   .....

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3. a) Perform the following operati

      i. 23 MOD 4

      .....

      ii. IV 4

      .....

   b) Describe, using an example, the concept of concatenation.

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4. Consider the following assembly program written for a Little Man compu
positive numbers together:

```
        INP
        STA   A
        INP
        STA   B
LOOP    LDA   A
        BRZ   QUIT
        SUB   ONE
        STA   A
        LDA   RESULT
        ADD   B
        STA   RESULT
        BRA   LOOP
QUIT    LDA   RESULT
        OUT
        HLT
ONE     DAT   1
A       DAT
B       DAT
RESUL
T       DAT   0
```

a) Describe the algorithm that this program implements.

.....

.....

.....

b) Suppose one of the inputs to this program is 0. Will the program pro
Explain your answer.

.....

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c) What are LOOP, QUIT, ONE, A, B and RESULT examples of? Briefly ex
identifiers serve in an assembly program.

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d) Modify the assembly program given to produce the result of `A MOD B`

Assume that A and B are positive integers. Provide the pseudocode f

Pseudocode:

Assembly program:

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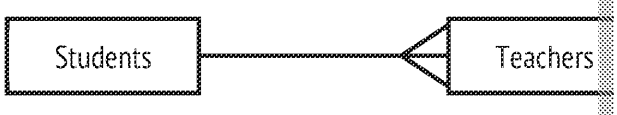
1.3.1 Databases

1. Consider the following entity relationship diagram representing the relati
teachers at a school:



Each student has only one teacher, and there are usually about 30 studen

a) Identify the type of relationship described by the entity relationship d

.....

b) Identify and explain the mistake in the entity relationship diagram gi

.....

.....

.....

c) Each student and teacher attends a single school. Extend the entity r
include *Schools* and update all the relationships.

2. Describe what is meant by each of the following terms:

a) Primary key

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b) Secondary key

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c) Foreign key

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.....

3. Consider the following entity description for a flat-file shop orders databa

Order(OrderNum, CustNum,Title, FirstName, Surname, Address, PostCod
Price, Manufacturer, OrderDate, OrderTime, Dispatched)

a) i. Identify the primary keys

.....

ii. Identify the foreign keys and their location

.....

b) Dr entity relationship diagram for your database

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c) i. Assuming a three-table structure has been used to represent the
this question, what restriction does this place on the database th
day-to-day running of a shop?

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ii. Describe a possible solution for this problem.

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iii. Draw an Entity Relationship Diagram for your new structure.

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1.3.2 Networks

1. A home user is trying to set up a local area network (LAN) that will be con
They have asked you to help them set it up.

   a) They have a printer with a network port. Suggest an appropriate stat
   assuming a subnet mask of 255.255.255.0.

   .....

   b) The network has been set up and the router has successfully obtaine
   ISP. Unfortunately the user isn't able to acce[illegible]y websites. You ask
   of a well-known web server into their browser and the website loads

   What is the name and purpose of the service that is not working cor

   .....

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   .....

2. The Transmission Control Protocol (TCP) is a common low-level networki

   a) TCP uses packets to send data across a link. Explain what a packet is
   information a packet contains.

   .....

   .....

   .....

   .....

   .....

   b) A client is uploading a large amount of data to a server using the TC
   transfer one of the Internet service provider's network switches fails.
   through a different switch; however, several packets are lost. Explain
   detect and react to this packet loss.

   .....

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c) The Hypertext Transfer Protocol (HTTP) is the protocol most commo
HTTP is commonly implemented on top of TCP/IP.

Explain the advantages of implementing HTTP as a layer above TCP/I
standalone protocol.

.....

.....

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.....

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3. A new ny entering the voice over IP (VOIP) telephony market is deci
voice data between customers. They have two options: a client-server mod

Explain which model you would recommend the company use and why.
Provide advantages and disadvantages for both models.

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1.3.3 Web Technologies

1. A software developer is making a personal website that she wants to use s she has worked on and some of the things that interest her. The website following snippet of HTML listing her favourite things:

```
<p>My favourite website is BBC News.</p>
<p>My favourite TV show is Downton Abbey.</p>
```

a) Rewrite the first paragraph to replace 'BBC News' with a link to *http:/* should still display the text 'BBC News'.

.....

.....

b) Ti site author wants to add the heading 'About Me' above the Re mmend an appropriate HTML tag to use for this purpose. Expla her to use this tag for the heading rather than using the <p> tag.

.....

.....

.....

c) The website author has decided to refactor her favourite things into written the following HTML:

```
<li>My favourite website is BBC News.</li>
<li>My favourite TV show is Downton Abbey.</li>
```

Unfortunately the website is not rendering the way she had intended with the HTML provided and rewrite the list so that it renders correct

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d) At the bottom of th ge the author wants to add a form to allow r form shou n two text boxes – one for the comment and one c ti g – and a submit button. Write the HTML for the form be

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2. Cascading style sheets (CSS) are commonly used to format a web page.

   a) Style information can be added to a HTML file in a few different ways external file.

      i. Write the mark-up required to import a CSS file called style.css i

      .....

      .....

      ii. Explain the advantages of using an external file to store style inf embedding style information into a static HTML file directly.

      .....

      .....

      .....

   b) Consider the following HTML snippet:

```
<p style="color:red;">Coursework is due on Tuesd
```

   The style has been written directly into the HTML element because th the deadline for the coursework without modifying the style of other

   The author now wants to move this style into an external CSS file and times in each page. Explain one way this could be achieved while kee Your answer should include the HTML and CSS required to implemen

   .....

   .....

   .....

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   .....

3. JavaScript can be embedded into HTML pages to provide dynamic behav

   a) Explain where JavaScript embedded into web pages is executed.

   .....

   .....

   b) Consider the following HTML:

```
<p id="name">Michael</p>
```

   Write a line of JavaScript that will change the contents of the paragra

   .....

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c) You have been placed in charge of writing a website that requires us
website currently consists of a simple HTML file containing a form:

```
<!DOCTYPE html>
<html lang="en-GB">
<body>
    <form>
        <input id="pswd" type="password" name="p
    </form>
    <script>
        document.getElementById("pswd").onkeydow
    </script>
</body>
</html>
```

The password that the user enter should be at least eight characters
checkPassword will be called whenever a new character is added to
in[illegible]ntation of the `checkPassword` function that checks the len
m[illegible] the background colour of the input to be green if the passw
long, and red otherwise.

The contents of the password input can be retrieved using its value p
string can be retrieved using its length property. The background co
modified using its `style.backgroundColor` property.

```
function checkPassword() {
```

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4. There are two categories of data compression: lossless and lossy.

a) Explain the difference between lossless and lossy data compression.

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b) Give an example of a type of data that is suitable for lossy data comp
Explain why this type of data is suitable for lossy data compression.

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c) It is possible to combine lossless and lossy compression techniques.
Explain why lossy techniques MUST be applied before lossless techni

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1.4.1 Data Types 1

1. a) Describe the representation of unsigned denary integers in binary fo

.....

.....

b) Complete the table for the binary and hexadecimal representations o numbers:

Denary	Bina	Hexadecima
0		
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		

2. Evaluate the following binary expressions. Show your working:

a) 0111 + 0010

b) 1011 - 0101

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3. a) Convert the following unsigned binary numbers into denary.

i. 01100110

.....

ii. 10111001

.....

iii. 11000101

.....

b) Convert the following denary numbers into 8-bit unsigned binary.

i. 78

.....

ii.

.....

iii. 228

.....

c) Convert the following 8-bit two's complement binary into denary.

i. 00101101

.....

ii. 10100111

.....

d) Convert the following unsigned binary fractions into denary decimal

i. 0100.1100

.....

ii. 1011.1001

.....

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Questions continue on the following page

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4. Convert the following values into each of the formats requested.

a) 204 (base 10)

i. Binary:

.....

ii. Hexadecimal:

.....

b) 11000111 (base 2)

i. Denary:

.....

ii. Hexadecimal:

.....

c) E7 (base 16)

i. Denary:

.....

ii. Binary:

.....

d) Represent -19 in binary as an 8-bit signed integer using the following

i. Sign and magnitude:

.....

ii. Two's complement:

.....

e) Represent $\frac{-3}{16}$ in binary as an 8-bit signed integer with four fractional

formats:

i. Sign and magnitude:

.....

ii. Two's complement:

.....

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1.4.1 Data Types 2

1. ASCII is a widely used standard for encoding characters as binary values.

   a) Knowing that A is character 65 (base 10) in the ASCII table, give the A following letters.

      i. F .....

      ii. M .....

      iii. X .....

   b) How many ASCII characters are in the following phrase? You must ex answer.

      I love OCR Computer Science!

      .....

      .....

   c) How many characters can 7-bit ASCII represent?

      .....

2. Unicode is a set of standards for encoding characters as multi-byte binary

   a) Explain the benefit of using Unicode instead of ASCII to encode char

      .....

   b) UTF-8 is a very popular type of Unicode encoding that uses a variabl each character. For example, the character A is encoded using one by be encoded using two bytes. Explain one advantage and one disadva number of bytes to represent each character.

      .....

      .....

      .....

   c) How many characters can a 16-bit number represent?

      .....

Questions continue on the following page

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3. An IEEE754 floating-point number consists of three component parts: a m
a sign bit (S). The following diagram shows how these three parts are co
precision floating-point number:

S	E_4	E_3	E_2	E_1	E_0	M_9	M_8	M_7	M_6	M_5	M_4	M

a) The following equation can be used to calculate the value of a non-z

$$(1 - 2a)(1 + b)2^{c-15}$$

Write the component each variable in the equation represents below

a: .....

b: .....

c: .....

b) The number of bits allocated to the exponent and mantissa can be c
that is made when the number of bits used to represent the exponen
of bits used to represent the mantissa is reduced.

.....

.....

.....

.....

4. Floating-point numbers can be represented as two two's complement int
exponent and one representing the mantissa. Use this floating-point form

a) Convert the following binary floating-point numbers into denary:

i.

0	1	0	1	0	1	0	1

Exponent | **Mantissa**

.....

ii.

1	1	0	0	1	0	0	0

Exponent | **Mantissa**

.....

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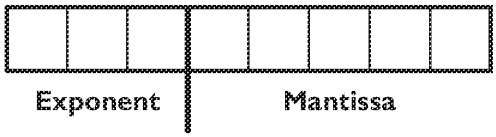
b) Convert the following denary numbers into binary floating-point nu
a 5-bit mantissa:

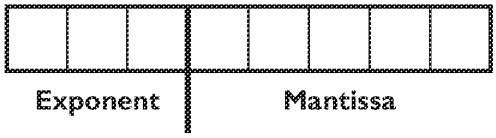
i. 0.75



ii. -7.5

c) Fi highest number that can be represented using a 3-bit expon

i. In floating-point binary:

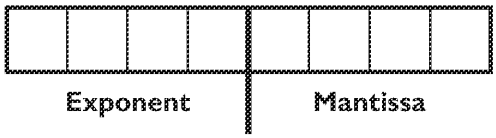


ii. In denary:

.....

d) Find the lowest number that can be represented using a 4-bit expon

i. In floating-point binary:

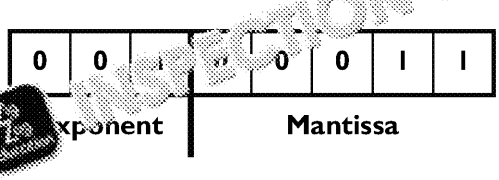


ii. In denary:

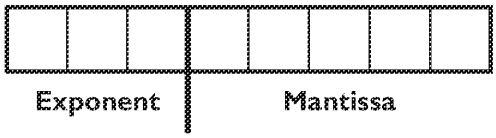
.....

e) Normalise the following floating point number

i.



Answer:



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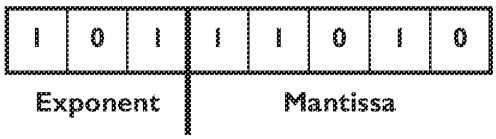
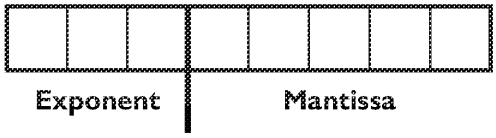
ii.

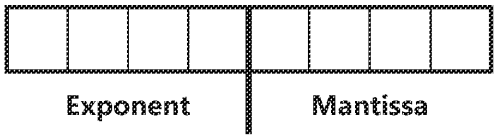


Answer:



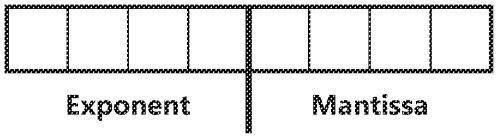
f) Add the following two numbers and normalise the result. Show your

Answer:



g) Subtract the number on the right from the number on the left and n
Show your working.

Answer:



5. Is it possible to represent 0.3 exactly in floating-point binary? Explain you

.....

.....

.....

.....

.....

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1.4.2 Data Structures

1. Arrays are a very popular and commonly used data structure in programm
language of your choice on this question wherever required.

   a) Write the code that would create a one-dimensional array (named 's
   five sports that are played at a school: rugby, football, hockey, netba

   .....

   b) In the majority of languages, arrays are said to be 0-based. What doe

   .....

   .....

   c) W e t hat would output the first and last element.

   .....

   .....

   d) It has been decided that football will no longer be played and they a
   Write the code that would update the array with this information.

   .....

2. Take the following example of a stack that is currently stored in memory.

Memloc	Data	TopOfStac
6		
5		
4		
3	Fish	←
2	Cat	
1	Dog	

   a) Complete the table after the following c m ds.

   Push 'Mouse', Push 'Rat', Po

Memloc	Data	TopOfStac
6		
5		
4		
3		
2		
1		

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b) Complete the table after the following further commands:

Pop, Pop, Push 'Rabbit'

MemLoc	Data	TopOfStac
6		
5		
4		
3		
2		
1		

3. Queues are a p... way of representing data within a computer.

a) E... the difference between a queue and a stack.

.....

.....

.....

.....

b) Describe how a circular queue works.

.....

.....

.....

.....

c) Complete the following table showing the state of the queue at each ... the queue at each state. You must complete the state of the queue a... NextFree values at each stage.

State 1	State 2	State 3	St...
start state	H joins queue	...er...ed from queue	J joi...
1 2 3 4 5 A ...	1 2 3 4 5 A B C	1 2 3 4 5	1 2
FrontPtr = 1 NextFree = 4	FrontPtr = NextFree =	FrontPtr = NextFree =	FrontP... NextF...

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1.4.3 Boolean Algebra

1. a) Explain the function of applying the following logical operators to a c

   i. NOT

   .....

   .....

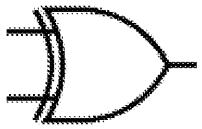
   ii. OR

   .....

   .....

   b) W[illegible]e t[illegible] functions of the following logic gates?

   i. .....

   ii.  .....

2. Complete the following truth table:

A	B	A NAND B	A OR B	A XOR B
FALSE	FALSE			
FALSE	TRUE			
TRUE	FALSE			
TRUE	TRUE			

3. Calculate the results of the following logic expressions:

   a) $0 \vee 1 \wedge 1 \vee$ [illegible]

   .....

   b) $1 \wedge 0$

   .....

   c) $(0 \vee 0 \vee 0) \vee (0 \vee (1 \wedge 1))$

   .....

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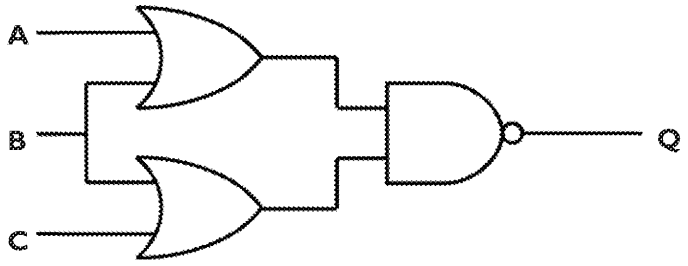
4. Consider the following logic diagram:



Write the logic equation for Q.

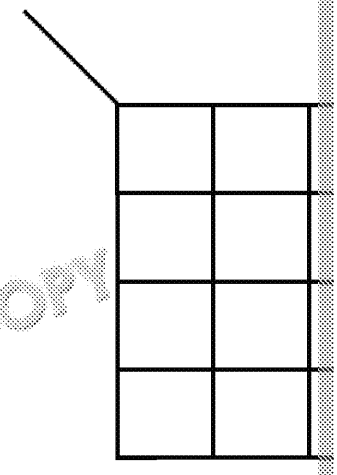
.....

5. Draw the logic diagram for this expression.

¬ ((A C)

6. a) Complete the Karnaugh map using the truth table below.

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1



b) Use the Karnaugh map to produce a simplified equation for Q.

.....

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1.5.1 Computing-related Legislation

1. The Computer Misuse Act 1990 introduced three new criminal offences.

   a) State the three new criminal offences introduced in the act.

   1 .....

   2 .....

   3 .....

   b) Explain the concept of phishing and gi[illegible] example of a way a crim[illegible] gain access to a computer syst[illegible]

   .....

   .....

   .....

2. The Data Protection Act 1998 sets out the laws that govern the way perso[illegible]

   a) Explain what is meant by personal data according to the act.

   .....

   .....

   .....

   b) The act contains eight principles that should be followed by organisa[illegible] data. State three of these principles.

   1.....

   2.....

   3.....

   c) Does the UK government have to abide by the principles laid out in t[illegible]

   .....

   d) A marketing company w[illegible] collect data about potential custome[illegible] information such [illegible] person's name, date of birth and contact det[illegible] and [illegible] database. Does the Data Protection Act forbid this[illegible]

   .....

   .....

   .....

   .....

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3. The Copyright, Designs and Patterns Act 1988 sets out some of the laws t
content owners.

a) Give one example of a type of work that can be protected by each of

i. Patents

.....

ii. Copyright

.....

iii. Designs

.....

iv. Trademarks

.....

b) In most cases it is illegal for a programmer to copy code that someo
her company's code without the owner's permission.

i. What type of protection applies to computer code?

.....

ii. The computer code does not contain a notice displaying the na
protected?

.....

c) Explain the concept of *fair dealing*.

.....

.....

.....

d) A company is developing a new software product that includes a new
company. They are unsure how they should protect their new softwa
Discuss the advantages and disadvantages of the protections they co

.....

.....

.....

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4. The Regulation of Investigatory Powers Act 2000 governs surveillance and
and postal communication.

a) Encrypted communications are useless when they are intercepted un
Explain the provisions the act contains to mitigate this problem.

.....

.....

.....

b) The act has been widely criticised by privacy campaigners. Explain wh
and compare the benefits of the act with its effect on civil liberties.

.....

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1.5.2 Moral and Ethical Issues

1. a) Peer-to-peer networks are frequently used to share large files on the

   i. Explain what a peer-to-peer network is.

   .....

   .....

   ii. Give two reasons why peer-to-peer networks are more popular networks for distributing pirated videos.

   .....

   .....

   .....

   .....

   b) Explain what Digital Rights Management (DRM) is.

   .....

   .....

   c) Give four ways DRM might restrict the way a video file can be used.

   .....

   .....

   .....

   .....

2. Give two advantages and two disadvantages of utilising robots for work i

   .....

   .....

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   .....

   .....

   .....

   .....

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3. There has been a huge push in recent years into the development of com
software by companies such as Google, Facebook and Apple.

If a human is shown two pictures, they will be able to identify if the same
an accuracy of 97.53% on average. Facebook has developed an algorithm

Discuss the uses of this technology and any ethical issues surrounding its
You may wish to consider what the technology would be used for, privacy
information and the impact of wearable technology.

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Questions continue on the following page

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4. 'According to a well written and thorough article in the ***Virginia Journal*** s
we've been saying for over three years has been determined to be true: W

In September 2004, this statement was written by Marius Milner. Marius w
NetStumbler, which is a tool used to map Wi-Fi networks using a Wi-Fi ca
known as 'WarDriving'.

Marius Milner also worked for Google and his code for gathering this info
the street-view cars which were used to gather data on mapping network
from open networks as street-view information was being gathered.

Discuss the ethics and legality of WarDriving. You may wish to consider h
WarDriving yourself – what information could be gathered, what the end
such information, what happens to the information later, and where it is s

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1.1.1 Processors

1. Briefly explain the functional role of a processor in a computer system.

2. Copy the following table and complete the missing details:

Name	Role
Data bus	
	Carries processor commands to devices and returns sig
Address bus	

3. A processor consists of multiple components, including the arithmetic an control unit and registers.

   a) Circle three operations that the ALU typically perform:

ADD	BRANCH	STORE
MULTIPLY	LOAD	SHIFT

   b) Briefly explain the function of each of the following registers.

      i. Program Counter (PC)
      ii. Accumulator (ACC)
      iii. Current Instruction Register (CIR)

   c) Describe the process of *storing* data to main memory. Identify the re

4. a) Describe in detail each stage of the Fetch-Decode-Execute cycle.

      i. Fetch
      ii. Decode
      iii. Execute

   b) Processor performance is dependent on a number of different factor

      Give two examples of design techniques used to improve processor p explain how they provide this improvement.

5. Explain the difference between a Von Neumann architecture and a Harva For each architecture give an example of an application the architecture i

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1.1.2–3 Types of Processor, Input, Output and

1. Modern computer systems often contain a multicore processor.

   a) Copy and complete the following table stating the resources that are sh processor:

Resource	Shared between Cores (Yes/No)
Arithmetic and Logic Unit (ALU)	
Random-access Memory (RAM)	
Network Card	
Program Counter (PC) re[illegible]	

   b) Gi[illegible]e a[illegible]tage and one disadvantage of rewriting a single-threa ac[illegible]e of multiple processor cores.

2. Consider the following assembly instruction:

ADDSTA Ra, Rb, Rc	Add the value in Ra to Rb and store the result at th

   a) Is the processor with this instruction a CISC or a RISC processor? Expl

   b) Give **two** reasons why RISC processors are often used in portable de

3. When a processor is powered on it immediately loads a boot program fro The boot program instructs the processor to load an operating system fro magnetic hard disk, into RAM (random-access memory).

   a) Explain why the boot program is stored in a ROM rather than in RAM

   b) Instead of being stored using an internal disk, an operating system ca Name two examples of removable media and one advantage and dis each to store an operating system.

4. A school is considering changing from using paper registers to storing all

   a) Name two input devices that could be used to put the data into the c advantage of using each one.

   b) The school is considering using a virtu[illegible] st[illegible]ge system to store the Describe **two** advantages [illegible] a virtual storage system rather tha storage to store r[illegible] data.

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1.2.1 Systems Software

1. Operating systems provide computer systems with a wide range of functi

   a) Circle the three tasks that are performed by an operating system:

COMPILATION	I/O DEVICE COMMUNICATION	INTERRU
PROCESS SCHEDULING	WEB PAGE RENDERING	WEB PA

   b) Briefly explain what a real-time operating syste

   c) Briefly explain what a distributed oper ting system is.

2. When a process is start is a located some memory by the operating s addressed direc by the process; instead a technique called *virtual mem*

   a) E hat virtual memory is.

   b) Explain how the use of virtual memory helps to improve the security

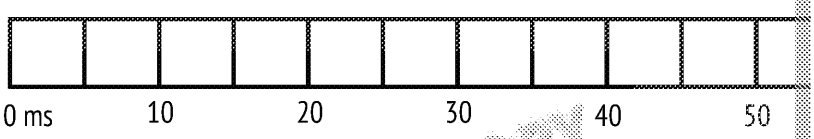
   c) Virtual memory enables paging to a secondary storage device such a State one advantage and one disadvantage of using paging.

3. A system is running three processes. The processes have the IDs A, B and execution time for each process is listed in the table below:

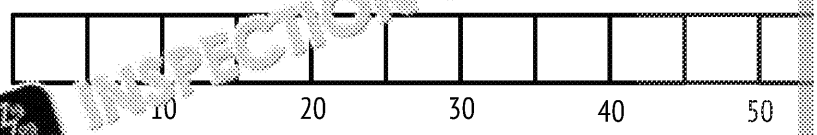
Process ID	Start time	Total execution time
A	10 ms	10 ms
B	0 ms	20 ms
C	5 ms	30 ms

   a) Assume that processes can be scheduled in 5 ms time slots. For each algorithms write the ID of the process that will be running in each tin

      i. First come, first served



      ii. Round robin



   c) Process C is an operating system response to a key press. The operat requires that process C needs to be completed as soon as possible.

      i. Use your answers to questions (a) and (b) to identify whether *ro served* scheduling best meets this requirement.
      ii. Now assume that the start and execution times can change. Wil you gave as an answer to question (i) always be the best? Explai
      iii. Give an example of a scheduling algorithm that can prioritise op such as process C. Explain how this scheduling algorithm works.

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4. Video games designed to run on obsolete game consoles can often be p
using an *emulator*. Emulators are *virtual machines*.

   a) Explain the term *virtual machine*.

   b) Games run in an emulator can execute more slowly than the same ga
   game console. This can happen even when new hardware that is mu
   hardware is used. Explain why this slowdown occurs.

   c) State two other uses for virtual machines.

5. Some computer systems allow processes to put themselves to sleep for a
can use this functionality to add a delay between function calls. For exam
"..." every 60 seconds:

```
0 while true
1     sleep(
2     print("...")
endwhile
```

Explain in detail how interrupts could be used to implement this `sleep(`
Assume that the processor contains a programmable circuit that can raise
period of time has expired. Ensure that your system can cope with scenar
an interrupt earlier than expected.

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1.2.2 Applications Generation

1. a) Briefly explain the difference between system software and applicatio

   b) Copy and complete the following table, stating whether each piece of s software:

Software Name	Type (Application/System)	Software Name
Operating System		Calculator
Word Processor		Sound Card Driver

2. a) A compiler is one type of translator program. Name the other two ty

   b) Explain the difference between the three different types of translato

3. Open-source programs are heavily used throughout the computer indust

   a) Explain the difference between a closed-source program and an ope

   b) Give one example of a closed-source program and one example of a

   c) Describe one advantage and one disadvantage to a company of dist in open-source form.

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1.2.3 Introduction to Programming

1. Procedural programming languages are very popular and are used to cre

   a) Describe what is meant by a procedural programming language.

   b) Variables or routines declared in a procedural program may be acces program but not in another.

      i. Give the term used to describe the part of the program a variab

      ii. Describe two major benefits of restricting the accessibility of var programming language.

2. a) Explain, using examples, the difference be[illegible] a constant and a var

   b) Explain the difference bet[illegible] a procedure and a function.

3. a) Perform th[illegible]ng operations:

      i. [illegible] MOD 4

      ii. 23 DIV 4

   b) Describe, using an example, the concept of concatenation.

4. Consider the following assembly program written for a Little Man compu positive numbers together:

```
          INP
          STA    A
          INP
          STA    B
LOOP      LDA    A
          BRZ    QUIT
          SUB    ONE
          STA    A
          LDA    RESULT
          ADD    B
          STA    RESULT
          BRA    LOOP
QUIT      LDA    RESULT
          OUT
          HLT
ONE       DAT    1
A         DAT
B         DAT
RESUL
T         DAT    0
```

   a) D[illegible] the algorithm that this program implements.

   b) Suppose one of the inputs to this program is 0. Will the program pro Explain your answer.

   c) What are LOOP, QUIT, ONE, A, B and RESULT examples of? Briefly ex identifiers serve in an assembly program.

   d) Modify the assembly program given to produce the result of `A MOD B` Assume that A and B are positive integers. Provide the pseudocode f

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1.3.1 Databases

1. Consider the following entity relationship diagram representing the relati
teachers at a school:

Each student has only one teacher, and there are usually about 30 studen

a) Identify the type of relationship described by the entity relationship d

b) Identify and explain the mistake in the entity relationship diagram gi

c) Each student and teacher attends a single school. Extend the entity r
include *Schools* and appropriate relationships.

2. Define each of the following terms:

a) Primary key

b) Secondary key

c) Foreign key

3. Consider the following entity description for a flat-file shop orders databa

Order(OrderNum, CustNum,Title, FirstName, Surname, Address, PostCod
Manufacturer, OrderDate, OrderTime, Dispatched)

a) i. Identify the primary keys

ii. Identify the foreign keys and their location

b) Draw an entity relationship diagram for your database

c) i. Assuming a three-table structure has been used to represent the
this question, what restriction does this place on the database th
day-to-day running of a shop?

ii. Describe a possible solution for this problem.

iii. Draw an Entity Relationship Diagram for your new structure.

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1.3.2 Networks

1. A home user is trying to set up a local area network (LAN) that will be con
They have asked you to help them set it up.

   a) They have a printer with a network port. Suggest an appropriate stat
   assuming a subnet mask of 255.255.255.0.

   b) The network has been set up and the router has successfully obtaine
   ISP. Unfortunately the user isn't able to access any websites. You ask
   of a well-known web server into their browser and the website loads

   What is the name and purpose of the service th s not working cor

2. The Transmission Control Protocol (TC s common low-level networki

   a) TCP uses packets to send data across a link. Explain what a packet is
   informatio et contains.

   b) A s uploading a large amount of data to a server using the TC
   transfer one of the Internet service provider's network switches fails.
   through a different switch; however, several packets are lost.

   Explain how the client and server detect and react to this packet loss

   c) The Hypertext Transfer Protocol (HTTP) is the protocol most commo
   HTTP is commonly implemented on top of TCP/IP.

   Explain the advantages of implementing HTTP as a layer above TCP/I
   standalone protocol.

3. A new company entering the voice over IP (VOIP) telephony market is de
to move voice data between customers. They have two options: a client-s
peer-to-peer model.

   Explain which model you would recommend the company use and why. P
   and disadvantages for both models.

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1.3.3 Web Technologies

1. A software developer is making a personal website that she wants to use s she has worked on and some of the things that interest her. The website c following snippet of HTML listing her favourite things:

```
<p>My favourite website is BBC News.</p>
<p>My favourite TV show is Downton Abbey.</p>
```

   a) Rewrite the first paragraph to replace 'BBC News' with a link to *http:/* The link should still display the text 'BBC News'.

   b) The website author wants to add the heading 'ut Me' above the Recommend an appropriate HTML tag to for this purpose. Expla her to use this tag for the he ... her than using the <p> tag.

   c) The website auth ... cided to refactor her favourite things into writi... th... ng HTML:

```
<li>My favourite website is BBC News.</li>
<li>My favourite TV show is Downton Abbey.</li>
```

      Unfortunately the website is not rendering the way she had intended with the HTML provided and rewrite the list so that it renders correct

   d) At the bottom of the page the author wants to add a form to allow r form should contain two text boxes – one for the comment and one commenting – and a submit button. Write the HTML for the form be

2. Cascading style sheets (CSS) are commonly used to format a web page.

   a) Style information can be added to a HTML file in a few different ways external file.

      i. Write the mark-up required to import a CSS file called style.css i
      ii. Explain the advantages of using an external file to store style inf embedding style information into a static HTML file directly.

   b) Consider the following HTML snippet:

```
<p style="color:red;">Coursework is due on Tuesd
```

      The style has been written directly into the HTML element because th the deadline for the coursework without modifying the style of other

      The author now wants to move this style into an external CSS file and times in each page. Explain one way this co... e achieved while kee Your answer should include the HTML ... S required to implemen

3. JavaScript can be embe... into HTML pages to provide dynamic behav

   a) Ex... wi... JavaScript embedded into web pages is executed.

   b) Co... the following HTML:

```
<p id="name">Michael</p>
```

      Write a line of JavaScript that will change the contents of the paragra

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c) You have been placed in charge of writing a website that requires us
The website currently consists of a simple HTML file containing a for

```
<!DOCTYPE html>
<html lang="en-GB">
<body>
    <form>
        <input id="pswd" type="password" name="p
    </form>
    <script>
        document.getElementById("pswd").onkeydow
    </script>
</body>
</html>
```

The password that the [illegible] should be at least eight characters
checkPassw[illegible] called whenever a new character is added t
im[illegible]en [illegible] the checkPassword function that checks the len
m[illegible] the background colour of the input to be green if the passw
long, and red otherwise.

The contents of the password input can be retrieved using its value p
string can be retrieved using its length property. The background co
modified using its style.backgroundColor property.

4. There are two categories of data compression: lossless and lossy.
   a) Explain the difference between lossless and lossy data compression.
   b) Give an example of a type of data that is suitable for lossy data comp
   Explain why this type of data is suitable for lossy data compression.
   c) It is possible to combine lossless and lossy compression techniques.
   Explain why lossy techniques MUST be applied before lossless techni

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1.4.1 Data Types 1

1. a) Describe the representation of unsigned denary integers in binary fo

   b) Copy and complete the table below for the binary and hexadecimal r denary numbers 0–16:

Denary	Binary	Hexadecimal
0		
↓		
16		

2. Evaluate the following binary expressions. S[illegible] y[illegible] working:
   a) 0111 + 0010
   b) 1011 - 0101

3. a) C[illegible] th[illegible] owing unsigned binary numbers into denary.
      i. [illegible]00110
      ii. 10111001
      iii. 11000101

   b) Convert the following denary numbers into 8-bit unsigned binary.
      i. 78
      ii. 123
      iii. 228

   c) Convert the following 8-bit two's complement binary into denary.
      i. 00101101
      ii. 10100111

   d) Convert the following unsigned binary fractions into denary decimal
      i. 0100.1100
      ii. 1011.1001

4. Convert the following values into each of the formats requested.
   a) 204 (base 10)
      i. Binary:
      ii. Hexadecimal:

   b) 11000111 (base 2)
      i. Denary
      ii. Hexadecimal

   c) E7 (base 16)
      i. Denary
      ii. [illegible]ar[illegible]

   d) Re[illegible]t -19 in binary as an 8-bit signed integer using the following
      i. Sign and magnitude
      ii. Two's complement

   e) Represent $\frac{-3}{16}$ in binary as an 8-bit signed integer with four fractiona
      i. Sign and magnitude
      ii. Two's complement

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1.4.1 Data Types 2

1. ASCII is a widely used standard for encoding characters as binary values.

   a) Knowing that A is character 65 (base 10) in the ASCII table, give the A letters F, M and X.

   b) How many ASCII characters are in the following phrase? You must ex your answer.

   I love OCR Computer Science

   c) How many characters can 7-bit ASCII represent?

2. Unicode is a set of standards for encoding characters as multi-byte binary

   a) Explain the benefit of using Unicode instead of ASCII to encode char

   b) UTF-8 is a popular type of Unicode encoding that uses a variabl e character. For example, the character A is encoded using one by be encoded using two bytes. Explain one advantage and one disadva number of bytes to represent each character.

   c) How many characters can a 16-bit number represent?

3. An IEEE754 floating-point number consists of three component parts: a m a sign bit (S). The following diagram shows how these three parts are co precision floating-point number:

S	E_4	E_3	E_2	E_1	E_0	M_9	M_8	M_7	M_6	M_5	M_4	M

   a) The following equation can be used to calculate the value of a non-z

$$(1-2a)(1+b)2^{c-15}$$

   Write the component each variable in the equation represents: *a*, *b*, c

   b) The number of bits allocated to the exponent and mantissa can be c that is made when the number of bits used to represent the exponen of bits used to represent the mantissa is reduced.

4. Floating-point numbers can be represented as two two's complement int exponent and one representing the mantissa. Use this floating-point form

   a) Convert the following binary floating-point numbers into denary:

   i.

0	1	0	1	0	1	0	1

   Exponent | Mantissa

   ii.

1	1	0	0	1	0	0	0

   Exponent | Mantissa

   b) Convert the following denary numbers into binary floating-point nu a 5-bit mantissa:

   i. 0.75
   ii. -7.5

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c) Find the highest number that can be represented using a 3-bit expo

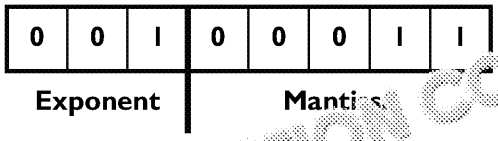
i. In floating-point binary
ii. In denary

d) Find the lowest number that can be represented using a 4-bit expon

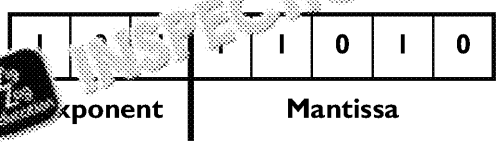
i. In floating-point binary
ii. In denary

e) Normalise the following floating point numbers:

i.

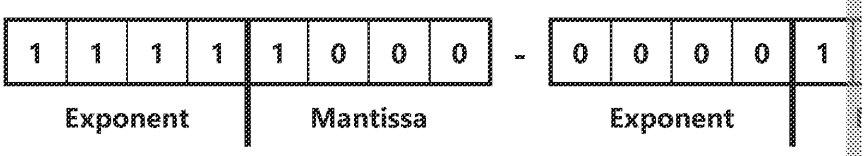


ii.



f) Add the following two numbers and normalise the result. Show your

g) Subtract the number on the right from the number on the left and n
Show your working.



5. Is it possible to represent 0.3 exactly in floating-point binary? Explain you

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1.4.2 Data Structures

1. Arrays are a very popular and commonly used data structure in programm
language of your choice on this question wherever required.

   a) Write the code that would create a one-dimensional array (named 's
   five sports that are played at a school: rugby, football, hockey, netba

   b) In the majority of languages, arrays are said to be 0-based. What doe

   c) Write the code that would output the first and last element.

   d) It has been decided that football will no longer be played and they a
   Write the code that would update the arra[illegible]t is information.

2. Take the following example of a stack that is currently stored in memory.

Memloc	Data	TopOfStack
6		
5		
4		
3	Fish	←
2	Cat	
1	Dog	

   a) Complete the table after the following commands:

   Push 'Mouse', Push 'Rat', Pop

   b) Complete the table after the following further commands:

   Pop, Pop, Push 'Rabbit'

3. Queues are a popular way of representing data within a computer.

   a) Explain the difference between a queue and a stack.

   b) Describe how a circular queue works.

   c) Complete the following table showing the state of the queue at each
   the queue at each state. You must complete the state of the queue a
   NextFree values at each stage.

State 1	State 2	State 3	St
start state	H joins qu[illegible]	[illegible]served from queue	J joi
1 2 3 4 5 C	1 2 3 4 5 A B C	1 2 3 4 5	1 2
FrontPtr = 1 NextFree = 4	FrontPtr = NextFree =	FrontPtr = NextFree =	FrontP NextF

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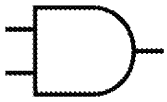
1.4.3 Boolean Algebra

1. a) Explain the function of applying the following logical operators to a

   i. NOT ii. OR

   b) What are the functions of the following logic gates?

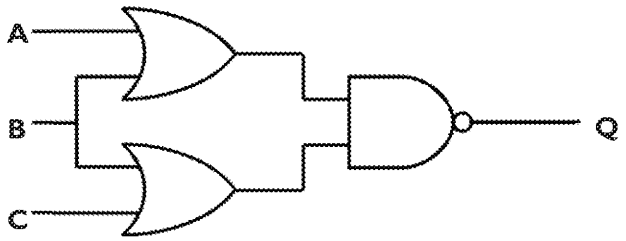
   i.  ii.

2. Copy and complete the following truth table:

A	B	A NAND B	A OR B	A XOR B
FALSE	FALSE			
FALSE	TRUE			
TRUE	FALSE			
TRUE	TRUE			

3. Calculate the results of the following logic expressions:
   a) $0 \vee 1 \vee 1 \vee 0$
   b) $1 \wedge 0$
   c) $(0 \vee 0 \vee 0) \vee (0 \vee (1 \wedge 1))$

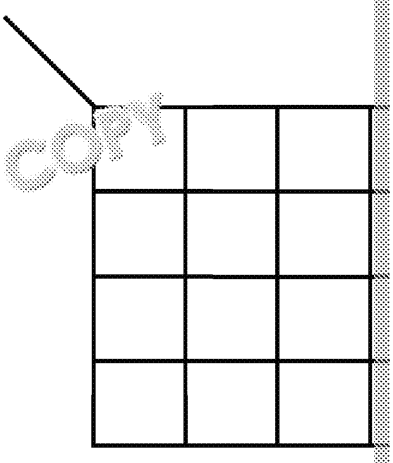
4. Consider the following logic diagram. Write the logic equation for Q.



5. Draw the logic diagram for this expression: $\neg ((A \wedge B) \vee C)$

6. a) Draw a Karnaugh map using the truth table below.

A	B	C	D	Q
0	0	0	0	0
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	1
0	1	0	1	1
0	1	1	0	1
0	1	1	1	1
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1



   b) Use the Karnaugh map to produce a simplified equation for Q.

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1.5.1 Computing-related Legislation

1. The Computer Misuse Act 1990 introduced three new criminal offences.
   a) State the three new criminal offences introduced in the act.
   b) Explain the concept of phishing and give an example of a way a crim gain access to a computer system.

2. The Data Protection Act 1998 sets out the laws that govern the way perso
   a) Explain what is meant by personal data according to the act.
   b) The act contains eight principles that should be followed by organisa data. State three of these princip
   c) Does the UK gover[illegible]nt have to abide by the principles laid out in t
   d) A [illegible]pany wants to collect data about potential custome in[illegible]on such as the person's name, date of birth and contact det and storing it in a database. Does the Data Protection Act forbid this

3. The Copyright, Designs and Patterns Act 1988 sets out some of the laws t content owners.
   a) Give one example of a type of work that can be protected by each of
      i. Patents
      ii. Copyright
      iii. Designs
      iv. Trademarks
   b) In most cases it is illegal for a programmer to copy code that someo her company's code without the owner's permission.
      i. What type of protection applies to computer code?
      ii. The computer code does not contain a notice displaying the nar protected?
   c) Explain the concept of *fair dealing*.
   d) A company is developing a new software product that includes a new company. They are unsure how they should protect their new softwa Discuss the advantages and disadvantages of the protections they co

4. The Regulation of Investigatory Powers Act 200[illegible]e[illegible]s surveillance and and postal communication.
   a) Encrypted communicat[illegible]seless when they are intercepted un Explain the pr[illegible]e act contains to mitigate this problem.
   b) T[illegible]ha[illegible]een widely criticised by privacy campaigners. Explain wh an[illegible]pare the benefits of the act with its effect on civil liberties.

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1.5.2 Moral and Ethical Issues

1. a) Peer-to-peer networks are frequently used to share large files on the

   i. Explain what a peer-to-peer network is.
   ii. Give two reasons why peer-to-peer networks are more popular
   networks for distributing pirated videos.

   b) Explain what Digital Rights Management (DRM) is.

   c) Give four ways DRM might restrict the way a video file can be used.

2. Give two advantages and two disadvantages of ... robots for work i

3. There has been a huge push in ... years into the development of com
software by companies ... Google, Facebook and Apple.

   If a hu... s... two pictures, they will be able to identify if the same
   an acc... f 97.53% on average. Facebook has developed an algorithm

   Discuss the uses of this technology and any ethical issues surrounding its
   You may wish to consider what the technology would be used for, privacy
   information and the impact of wearable technology.

4. 'According to a well written and thorough article in the ***Virginia Journal***
we've been saying for over three years has been determined to be true: W

   In September 2004, this statement was written by Marius Milner. Marius w
   NetStumbler, which is a tool used to map Wi-Fi networks using a Wi-Fi ca
   known as 'WarDriving'.

   Marius Milner also worked for Google and his code for gathering this info
   the street-view cars which were used to gather data on mapping network
   from open networks as street-view information was being gathered.

   Discuss the ethics and legality of WarDriving. You may wish to consider h
   WarDriving yourself – what information could be gathered, what the end
   such information, what happens to the information later, and where it is s

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1.1.1 Processors

1. A processor is the chip/circuit in a computer that decodes and executes instr

2. *1 mark for each answer in **bold**:*

Name	Role
Data bus	**Carries binary data to and from devices.**
Control bus	Carries processor commands to devices and returns signals
Address bus	**Carries the address/location of data that needs to be sent retrieve data from.**

3. a) 1 mark for circling ADD, MULTIPLY and SHIFT.

   b) *2 marks for a correct description, 1 mark if the description is less specific b*
      i. Program Counter (PC): Stores the memory address of the next instr
      ...er ... instruction and can be overwritten to branch.
      ii. Accumulator (ACC): Stores the results of arithmetic and logic opera
      ...perations.
      iii. Current Instruction Register (CIR): Instructions are loaded into this r
      while the instruction is decoded and executed.

   c) *1 mark for each correct step and 1 mark for each correct register name. Th in any order:*
      Load the target memory address into the MAR (memory address registe
      Load the data to store into the MDR (memory data register).

4. a) i. Fetch:
      Load the next instruction from the memory location given by the pr
      into the current instruction register (CIR) (1 mark). Increment the co
      ii. Decode
      The processor separates the instruction in the CIR into the function
      immediate values (1 mark) and registers to operate on or store resu
      iii. Execute (up to 3 marks from the following)
      The instruction and its associated data are dispatched to the appro
      ALU or LOAD/STORE unit) (1 mark). If the operation is a branch the
      operation is a load or a store then the MAR is updated with the me
      either read from or written to (1 mark). Arithmetic and logic instruc
      alternative destination register (1 mark). If the operation is a HLT in
      are loaded (1 mark).

   b) *1 mark for identifying a technique and 1 mark for a correct explanation:*
      - Clock speed: Increasing the clock speed reduces the time the pr
        each operation.
      - Cache size: Increasing size of the cache reduces the chance that
        need to travel all the way to the main memory, reducing the ave
        an operation.
      - Vector instructions (also known as SIMD): Operations take place
        than needing to be executed one after another.
      - Multiple cores: Increasing the number of cores means that m
        simultaneously rather than needing to be executed one after

5. *Give 2 marks for correctly identifying the difference between the two architectu reasonable application of each.*

   Von Neumann: Instructions are stored in the same memory address space as
   purpose computers.
   Harvard: Instructions are stored in a separate memory address space to the d
   embedded applications.

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1.1.2–3 Types of Processor, Input, Output and Stora

1. a) *1 mark for each two correct answers:*

Resource	Shared between Cores (Y
ALU (arithmetic and logic unit)	No
RAM (random-access memory)	Yes
Network card	Yes
PC (program counter) register	No

b) *2 marks for each advantage and disadvantage, o identification and*

Advantages:

- Performance: Can do multiple tasks in parallel.
- Responsiveness: Tasks don't necessarily have to wait for other tas
- Clearer code: Tasks that are unrelated can be written in separate fi areas rather than needing to be multiplexed into a single code

Disadvantages:

- Difficult: Writing and maintaining multi-threaded code is generall single-threaded code.
- Bugs: Rewriting the code may introduce bugs.
- Less clear code: Tasks that need to be split to balance the load on elegant.

2. a) The processor is a CISC processor (1 mark). The instruction performs mo

b) *1 mark for a reason and 1 mark for a correct explanation:*

- Low power: RISC processors require less complex circuitry and so
- Custom chips: RISC processors are simpler and, therefore, cheape less chip space. Therefore, they are easier/cheaper to combine wit single chip (known as a system-on-chip or SoC).
- Software availability: RISC processors are more common than CIS and, therefore, more mobile-centric software is available.
- Simpler assembly: Code written in RISC assembly uses a smaller n be easier to write and understand. This can be important if a mob to heavily hand-optimise parts of the software to improve perfor

3. a) 2 marks: RAM loses its data when it loses power; therefore, a ROM is use remains available after power has been lost.

1 mark: RAM can be overwritten so the boot pro might be lost. By to accidentally wipe the boot program.

b) *1 mark per advantage and di va ge. Only one advantage and disadv*

- Flash me tick, SD card, etc.):
- dv can save operating system state, maximum capacity
- advantages: high cost relative to optical media, might be slow
- Optical disk (CD, DVD, Blu-Ray):
- Advantages: cheap, can save state if rewriteable
- Disadvantages: easily damaged, can degrade, slow, require optica
- External hard disk (HDD, SSD):
- Advantages: cheap per GB relative to flash memory, fast, can save
- Disadvantages: minimum cost is high, possibly fragile if HDD used

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4. a) *2 marks each for two of the following:*
   - Mouse (to select classes, and then pupils who are absent) – cheap
   - Keyboard – cheap and shortcut commands can be used
   - Optical Mark Reader – very quick and access to computer not nee
   - Bar Code Reader – easy to use and could later be used (by pupils) from printed sheet by teacher
   - Electronic Whiteboard – often installed in modern classrooms and see the class
   - RFID – can be used wirelessly for convenience
   - Smart Card – can contain a relatively large amount of information other alternatives so can be used for various functions
   - Biometrics – much more secure than other methods as only a part enter data into the computer

   b) *1 mark for a correct advantage and 1 mark for a good explanation for two*
   - Appears as a single storage device: users don't have to manage m
   - Cheap: [illegible] hardware can be used to implement storage s
   - [illegible]erf[illegible]ce as expensive dedicated network storage devices
   - [illegible]pandable: adding extra servers can expand storage capacity; vir limits a single piece of hardware such as a NAS has
   - High availability: virtual storage can be designed with redundancy ensure maximum uptime

1.2.1 Systems Software

1. a) 1 mark for circling I/O DEVICE COMMUNICATION, PROCESS SCHEDULIN

   b) A real-time operating system provides processes with guarantees about will be scheduled to run. This means that processes can be designed to within a certain time frame. Real-time operating systems are typically op rather than throughput as a standard operating system is.

   c) A distributed operating system combines multiple computers connected virtual system.

2. a) Virtual memory is a mapping, usually implemented with hardware suppo management unit), from a processes address space to a physical addres that processes do not use physical memory addresses directly.

   b) Since each process can only see the address space it has been allocated are not in its address space. Therefore, it cannot overwrite or read memo system or other processes.

   c) *1 mark for one of the following advantages:*
   - Allows system to keep functioning ev[illegible] it runs out of main mem
   - Infrequently used da[illegible] moved from main memory to ma data and cach[illegible]

   1 m[illegible]for [illegible]e following disadvantages:
   - [illegible]stem performance may be reduced if data contained in second
   - Memory may be moved to secondary storage unnecessarily.
   - Memory access times become more variable (important in system performance/responsiveness is required).

3. a) *Full marks for the correct answer. 1 mark if the processes are scheduled in times are incorrect.*

   i. First come, first served

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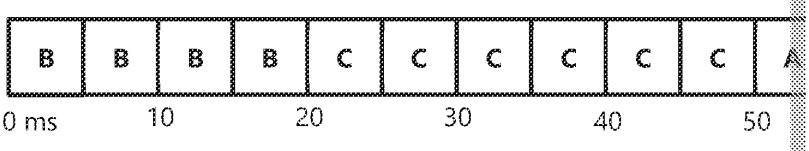


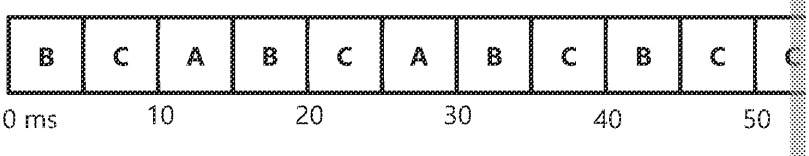
B	B	B	B	C	C	C	C	C	C	A

0 ms 10 20 30 40 50

ii. Round robin

B	C	A	B	C	A	B	C	B	C	C

0 ms 10 20 30 40 50



c) i. First come, first served (C ends after 50 ms rather than 60 ms).

ii. No (1 mark), if A and B were longer-running processes and started b have to wait until the long-running processes completed before get round-robin approach, [illegible] get processor time earlier, and so c in a first come, first served system (2 marks).

iii. Multi-level feedback queues could be used (1 mark). In this schedul placed in a higher priority queue than A or B. The scheduler pref higher priority queues so C would be run in preference to A or B un

4. a) A virtual machine is a piece of software that executes instructions design machine itself or for a hardware platform that the virtual machine is emu

b) *1 mark each for up to two of the following:*

- Executing an instruction in software incurs overhead (the cost of m place for example) that executing an instruction in hardware does
- Hardware may contain specialised circuits to perform certain oper
- The instruction set of the machine being emulated may not be a g machine the emulator is run on, so the virtual machine may have t map the instructions to the real underlying hardware.

c) *1 mark for each of:*

- Interpreting an intermediate instruction set generated by a compil
- Running one or more operating systems within another.

5. *1 mark for each of the following steps. Full marks should also be given if an alt*

- Provide an interrupt service routine (ISR) that will add the process back scheduler.
- Register the ISR so that it will be called when the given time period has
- Remove the process from the operating system's scheduler.
- Yield the process to stop executing.
- When the process resumes, check to see if the given time period has el repeat the process subtracting the time elapsed from the delay require

1.2.2 Applications Generation

1. a) 1 mark each for correct descriptions of system software and application s A application software is used for a specific task. System software controls ma[illegible]s the system and provides a platform for applications.

b) *1 mark for each two correct answers.*

Software Name	Type (Application or System)
Operating System	System
Word Processor	Application
Calculator	Application
Sound Card Driver	System

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2. a) Assembler, interpreter

b) *2 marks for each correct description:*
Compilers convert code written in a high-level language into an executa
Assemblers convert code written in a low-level assembly language into a
machine code.
Interpreters execute code directly without necessarily first converting int

3. a) Closed-source programs are programs where the source code is kept se
code for open-source programs is made available to the recipient and th
redistribute it (1 mark).

b) *1 mark for a correct example of each. Examples:*
Open-source: Linux, Open/LibreOffice, GCC, Mozilla Firefox, Chromiu
Closed-source: Windows, Office, Internet Explorer, Safari, PowerDVD,

c) *Up to 2 marks each for one advantage and one disadvantage, with good*

Advantages:

- Community involvement and support: members of the software d
develop and support the software.
- Maintaining community relations: open-sourcing software can he
relations with the community and encourage similar ventures by
- Increased adoption: the software might be adopted more widely a
commercial activities such as advertising, hardware sales and prop

Disadvantages:

- Exposure of proprietary information: the software might expose in
would rather keep secret.
- Difficult to sell open-source software: it can be more difficult to m
than proprietary software.

1.2.3 Introduction to Programming

1. a) Procedural programming languages are imperative (consist of a sequen
executed one after the other) (1 mark) and have subroutines/procedures
isolate and group a particular sequence of statements to provide some

b) i. Scope
ii. *1 mark for each of the following points up to a maximum of 2 marks*
- Makes it more difficult to accidentally change the value of a v
program can see.
- Reduces the possibility of procedures having side effects tha
understand and work with the code.
- Allows access to variables to be restricted to the executing th
accessed by any thread (or possibly in an unsafe manner).

2. a) *2 marks for describing the concept, plus an additional mark for giving e*
Variables are declared to store data that may change while the program
For example, the product number of an item on an e-commerce website
Constants are used where data that is used in a computer program is pr
For example, assigning Pi (π) the value of 3.145 (3dp).

b) A procedure is a routine called by the program which performs a set of
A function is a routine called within an expression which returns a result

3. a) i. 23 MOD 4 = 3
ii. 23 DIV 4 = 5

b) Concatenation is used to join two strings together where the combined
Example (1 mark), 'OCR' + 'Computer Science'; returns 'OCR Computer S

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4. a) The program adds B to the result (1 mark) A times (1 mark).

   b) It will produce the correct answer (1 mark). If A is 0, the loop will not exe
   and if B is 0, then 0 will be added to the result A times, again resulting in

   c) Labels (1 mark). They allow instructions to be addressed without hardco
   might change as the program is edited (1 mark).

   d) Pseudocode:

```
RESULT = A
while (B - RESULT) < 0
    RESULT = RESULT - B
endwhile
```

   Assembly Program:

```
          INP
          STA     [illegible]
          SUB     ONE
          STA     B
LOOP      LDA     B
          SUB     RESULT
          BRP     QUIT
          LDA     RESULT
          SUB     B
          STA     RESULT
          BRA     LOOP
QUIT      LDA     RESULT
          OUT
          HLT
ONE       DAT     1
B         DAT
RESULT    DAT
```

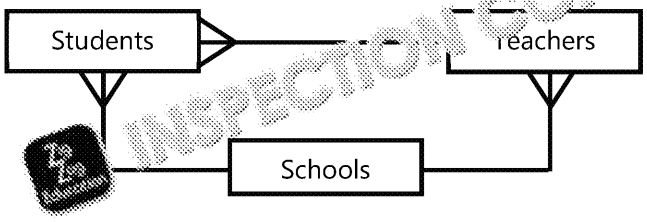
   Max 3 marks for a correct pseudocode algorithm (does not have to mat
   Max 4 marks for fully correct assembly program (reduce accordingly if th

1.3.1 Databases

1. a) One-to-many

   b) The relationship between students and teachers is the wrong way round
   students to one teacher.

   c)



2. a) A primary key is an attribute which uniquely defines a tuple/row.

   b) A secondary key is an attribute which uniquely defines a tuple/row but t
   the primary key.

   c) A foreign key is an attribute that is found in multiple tables. It must be th
   tables.

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3. a) i. *All primary keys must be present to get the mark and must match th*
Don't penalise twice for mistakes in part a.

OrderNum, CustNum, StockNum

ii. *Both foreign keys must be present to get the mark and must match t*
Don't penalise twice for mistakes in part a.

CustNum and StockNum in the Orders table

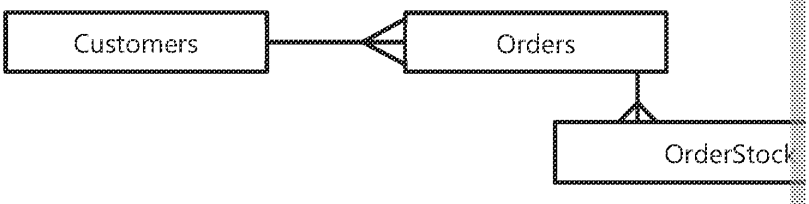
b) *1 mark for all tables being present*

1 mark for the correct ordering and connections between them
1 mark for identifying the 1-many relationships
Tables may differ from below but must match [illegible] answer for part a.

c) i. *[illegible] problem and 1 mark for the knock-on effect*
[illegible]rder can only have one item of stock assigned to it.
So if a customer wants to buy more than one thing, several entries
to be created.

ii. *1 mark for identifying a fourth table could be created*
1 mark for further explanation
Create a fourth table that can store multiple entries of StockNum fo

iii. *1 mark for link between Orders and Stock being broken*
1 mark for new table added with sensible name
1 mark for correct 1-many relationship between Orders and new tab
1 mark for correct 1-many relationship between Stock and new table



1.3.2 Networks

1. a) Any IP address in the range 192.168.1.2–192.168.1.254 such as 192.168.1
b) DNS (domain name service) (1 mark). DNS is responsible for translating
addresses (1 mark).

2. a) A packet consists of data and a header ([illegible]). The header contains inf
the packet, the destination of the [illegible], the sequence number of the si
checksum of the packet for example (2 marks for at least two).

b) Every time [illegible] receives a packet it sends an acknowledgement to
re[illegible] (1 mark). If the client does not receive the acknowledgement w
(1 [illegible]) then it resends the packet (1 mark). The sequence number is en
be received out of order (1 mark). So the client would simply resend the
acknowledged.

c) *1 mark for an advantage and 1 mark for a good description.*
- Allows HTTP to operate over TCP/IP networks: no special hardwa
- Can take advantage of TCP/IP features such as error handling: so
- Simplicity: reduces the complexity of the HTTP standard.
- Reliability: TCP/IP implementations may already be very reliable.
- Flexibility: HTTP could use other transport systems as required.

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3. *2 marks for each advantage/disadvantage up to a maximum of 6 marks.*

Advantages of peer-to-peer:

- Cheaper – no need to buy bandwidth / expensive servers
- Can be faster – transmission does not need to travel to a server and or
- Privacy – the transmission is not sent to a server

Advantages of client-server:

- Less complex client code (important if, for example, the client is implem
- Server can be upgraded to fix security problems – client is controlled b as frequently
- Servers can provide more features

1.3.3 Web Technologies

1. a) *1 mark for using <a> [illegible] an[illegible] mark for using it correctly.*

```
<p>M[illegible] fa[illegible] website is <a href="http://www.bbc.co
N[illegible]</p>
```

b) She should use the h1 (or, less likely, h2–6) tag (1 mark). It is important t styled appropriately by a web browser (1 mark) / interpreted properly by reader (1 mark).

c) Each item should be contained in <li> tags, with an <ul> tag around the

```
<ul>
    <li>My favourite website is BBC News.</li>
    <li>My favourite TV show is Downton Abbey.</li>
</ul>
```

d) *1 mark for each of the following elements: form, text input, submit input,*

```
<form>
    <label>Name</label>
    <input type="text">
    <label>Comment</label>
    <input type="text">
    <input type="submit">
</form>
```

2. a) i. *1 mark for using a link tag, 1 mark for any other correct element up*

```
<link rel="stylesheet" type="text/css" href="styl
```

ii. *1 mark per advantage up to a maximum of 2 marks.*

- Can be used in multiple HTML files
- Can be cached by a browser
- Can be swapped out to give the site dif[illegible]ent looks

b) *1 mark for identifying that a class is requ[illegible]ed. 1 [illegible]ark for adding the class selector and 1 mark for the cor[illegible]t [illegible]syntax.*

The author should [illegible] a class. Example code:

HT[illegible]

```
<p [illegible]s="deadline">...</p>
```

CSS:

```
.deadline {
    .color: red;
}
```

3. a) JavaScript is executed by the web browser on the client's computer.

b)

```
document.getElementByID("name").innerHTML = "Emily";
```

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c) *5 marks for a correct function that fulfils the specification. Accept minor e*

```
function checkPassword() {
    var pswd = document.getElementById("pswd");
    if (pswd.value.length < 8) {
        pswd.style.backgroundColor = "red";
    } else {
        pswd.style.backgroundColor = "green";
    }
}
```

4. a) Lossless compression is reversible: the original data can be recreated exa
Lossy compression is not reversible: some data is lost (e.g. the quality m

b) Examples: Music, Video, Pictures
Reason: Humans can still understand/enj[illegible]e result when certain inform

c) Lossless compression techniques [illegible]e all the information in the comp
order for the original file to be recreated (1 mark). Lossy compression wo
information, [illegible] the original file being recreated (1 mark). Lossles
an[illegible]to [illegible]compressed files as the lossy compressed file will be rec

1.4.1 Data Types 1

1. a) Denary numbers are each represented by a pattern of bits which are incr
example, 0000, 0001, 0010, 0011.

b) *1 mark for five correct answers and 2 marks for a complete set of correct a*

Denary	Binary	Hexadecimal
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F
16	10000	10

2. a)
```
  0111
+ 0010
  1001
```

b)
```
- 0001
  0110
```

3. a) i. 102
ii. 185
iii. 197

b) i. 01001110
ii. 01111011
iii. 11100100

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c) i. 45
ii. -89

d) i. 4.75
ii. 11.5625

4. a) i. 11001100
ii. CC

b) i. 199
ii. C7

c) i. 231
ii. 11100111

d) i. 10010011
ii. 11101101

e) i. 1000.0011
ii. 11.

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1.4.1 Data Types 2

1. a) i. F: 70
ii. M: 77
iii. X: 88

b) *1 mark for the correct answer and 1 mark for the explanation mentioning* 28 – 4 spaces, 1!, and 23 letters. You may accept 29 if the student mentio end of the line in the explanation.

c) 128

2. a) Unicode can represent a much larger number of characters than ASCII.

b) *1 mark for an advantage and 1 mark for a disadvantage:*

Advantages:
- Common characters can use fewer bytes
- Can be made backwards compatible with ASCII

Disadvantages:
- More difficult to process
- If a string does not use many one-byte characters then the encodi

c) $2^{16} = 65{,}536$

3. a) a: sign
b: mantissa
c: exponent

b) In g umber of exponent bits increases the range of the numb pr of the number (1 mark)

4. a) i. $-11 * 2^2 = -44$
ii. $8 * 2^{-2} = 2$

b) i. 0.75

1	0	0	0	1	1	0	0
Exponent			Mantissa				

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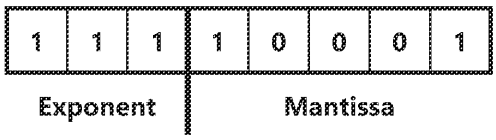
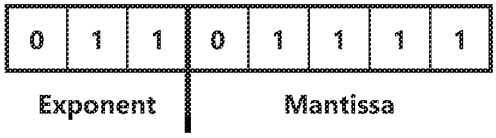
ii. –7.5



c) i.

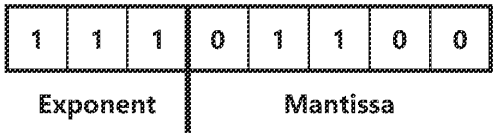


ii. $15 * 2^3 = 120$

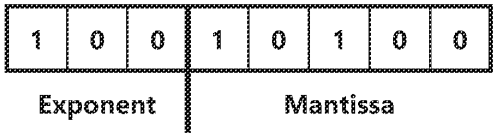
d) i.

ii. $2^7 = -1024$

e) i.



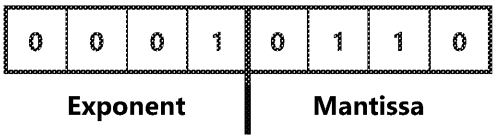
ii.



f) Equalise the exponents:
00000100 = 00010010

Add the mantissas:
0100 + 0010 = 0110

Answer:

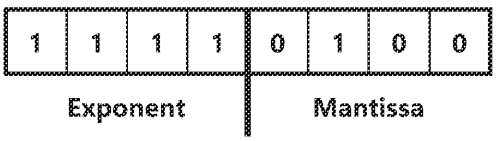


g) Equalise the exponents:
11111000 = 00001100

Subtract the mantissa
1[illegible]0010

Normalise the result:
00000010 = 11110100

Answer:



5. No (1 mark). 0.3 is not representable as a fraction with a denominator that is

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1.4.2 Data Structures

1. a) *1 mark for the correct declaration of an array string and 1 mark for the sp*

```
C:
const char *sports[] = {"rugby", "football", "hockey"

VB:
Dim sports() As String = {"rugby", "football", "hocke
"cricket"}

JS:
var sports = ["rugby", "football", "hockey", "ne
```

b) The first element of the array has the index 0 wh[illegible]eans the last elem
of number of elements –1.

c)
```
C:
printf("%s\n", sports[0]);
printf("%s\n", sports[4]);

VB:
co[illegible].writeline(sports(0))
console.writeline(sports(4)) OR console.writeline(spo

JavaScript:
console.log(sports[0]);
console.log(sports[4]); OR console.log(sports[sports.
```

d) `C/JavaScript: sports[1] = "gymnastics";`
`VB: sports(1) = "gymnastics"`

2. a) Accept 1 mark each for Mouse and Rat being added in the correct order
being at MemLoc 4.

Memloc	Data	TopOfStack
6		
5	Rat	
4	Mouse	←
3	Fish	
2	Cat	
1	Dog	

b) Accept 1 mark for the TopOfStack being in MemLoc 3 and 1 mark for th
Rabbit. (Don't penalise for a mistake in part a if their answers suit their r

Memloc	Data	TopOfStack
6		
5	Rat	
4	[illegible]se	
3	Rabbit	←
[illegible]	Cat	
1	Dog	

3. a) A queue is a first-in, first-out (FIFO) data structure (1 mark) whereas a st
data structure (1 mark). This means that items are retrieved from a queu
inserted, whereas items are retrieved from a stack in the reverse of the o

b) A circular queue consists of a fixed length array with pointers to the star
of the queue. The pointers wrap around to 0 when they reach the end o

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c) *1 mark for the state of the queue and 1 mark for the pointer values being*

State 1	State 2	State 3	S
Start state	H joins queue	Item served from queue	J join
1 2 3 4 5 A B C	1 2 3 4 5 A B C H	1 2 3 4 5 A B C H	1 2 A B
FrontPtr = 1 NextFree = 4	FrontPtr = 1 NextFree = 5	FrontPtr = 2 NextFree = 5	Fro Nex

1.4.3 Boolean Algebra

1. a) i. NOT – This give[illegible]negation (or opposite response)
   ii. OR – Th[illegible] whether either of the two conditions is true includin
   b) i.
   ii. XOR

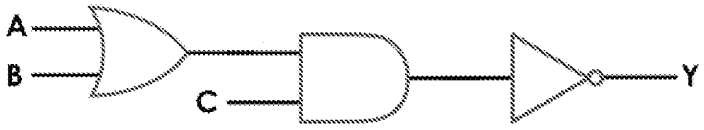
2. *1 mark for each correct column.*

A	B	A NAND B	A OR B	A XOR B
FALSE	FALSE	TRUE	FALSE	FALSE
FALSE	TRUE	TRUE	TRUE	TRUE
TRUE	FALSE	TRUE	TRUE	TRUE
TRUE	TRUE	FALSE	TRUE	FALSE

3. a) 1 b) 0 c) 1

4. $Q = \neg((A \vee B) \wedge (B \vee C))$

5. *1 mark for each correctly placed symbol:*



6. a)

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

b) $Q = (\neg A \wedge B) \vee (A \wedge D)$

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1.5.1 Computing-related Legislation

1. a) *1 mark for each correct criminal offence*
Accessing computer material without authorisation.
Modifying computer material without authorisation.
Accessing computer material without authorisation in order to commit a

b) Phishing is the act of masquerading as a trusted institution or person (e.g into providing personal information (1 mark). Phishing can be used to ge and passwords in order to get access to a computer system (1 mark).

2. a) *Up to 2 marks from the following:*

Personal data is data related to a living individual (1 mark) who can be id
- from the data (1 mark)
- from the data and other informati n t e data controller has, or is of the data controller (1 ma

b) *1 mark each for up to three of the following (may be reworded and simpli*

- ers data shall be processed fairly and lawfully and, in particul
  - (a) at least one of the conditions in Schedule 2 is met, and
  - (b) in the case of sensitive personal data, at least one of the co
- Personal data shall be obtained only for one or more specified an be further processed in any manner incompatible with that purpo
- Personal data shall be adequate, relevant and not excessive in rela for which they are processed.
- Personal data shall be accurate and, where necessary, kept up to d
- Personal data processed for any purpose or purposes shall not be for that purpose or those purposes.
- Personal data shall be processed in accordance with the rights of d
- Appropriate technical and organisational measures shall be taken ag processing of personal data and against accidental loss or destructio
- Personal data shall not be transferred to a country or territory out unless that country or territory ensures an adequate level of prote of data subjects in relation to the processing of personal data.

c) Yes, unless there is an exception for a particular purpose.

d) Yes, it is forbidden (1 mark). In order to store identifiable data about an individual in question must give their consent (2 marks).

3. a) One example required for each.
i. Inventions
ii. Literature, art, music, code, film or any other copyrightable work
iii. Product appearance, configuration, decoration or shape
iv. Names, logos and phrases

b) i. Copyright
ii. Yes, copyright is automati

c) Fair dealing is the l duction of part of a copyrighted work (1 m research/r n news reporting (1 mark).

d) *1 r each point up to a maximum of four.*

They could use copyright or patents (1 mark). Copyright means that no code / program (1 mark); however, it does not automatically stop someo algorithm and rewriting the code from scratch (1 mark). Patents might a algorithm (1 mark) although technically algorithms are not directly pate also force them to make their algorithm public (1 mark). Patents also expire much more quickly than copyright (1 mark).

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4. a) The act allows the authorities to demand that a person either hand over the file. It is a criminal offence not to comply.

b) This is a banded question:

Level	Description
3	Provides a clear, structured and well-reasoned response. Identifies points and provides examples related to the act.
2	Provides a clear, structured and well-reasoned response. Identifies
1	Provides one or two points related to the act.

Example benefits of the act:

- Provides a legal framework for covert surveillance and clarifies the institutions.
- Allows police to intercept communications relating to terrorism and
- Allows secret services to intercept communications for national se

Example effects on civil liberties:

- Allows installation of equipment at ISPs enabling mass surveillance
- Open to many different parts of government (including local coun such a broad mandate for surveillance.
- Broad range of reasons that surveillance can be used.
- Limited oversight.
- No way to achieve redress.

1.5.2 Moral and Ethical Issues

1. a) i. A group of computers connected together with equal status that ca data.

ii. Any two of the following:

- Difficult to shut down (need to shut down all the peers rather
- Lower cost as upload bandwidth is shared
- Harder to trace the original source of the files
- Faster as upload bandwidth is equal to the combined upload

b) DRM uses hardware or software and encryption to restrict the usage of a

c) *1 mark for each of the following (up to a maximum of 4):*

DRM might prevent a video file being:

- viewed on multiple computers
- copied to different computers
- viewed more than a set number of times
- played using anything other than a particular proprietary program
- played on portable devices
- played in an unsanctioned country

2. *1 mark for each of two advantages and two disadvantages:*

Advantages

- Robots can work in places that humans can't
- Robots can perform tedious tasks continuously and at speed
- Robots are cheaper to run than a labour force
- Robots are consistent in the quality of finished products

Disadvantages

- Robots are very expensive to set up
- Robots are unable to work well in changing environments
- Robots can be difficult to maintain without the relevant expertise

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3.

Level	Description
4	A line of reasoning has been followed to produce a coherent, relevant, s logically structured response. The response covers all four areas indicat guidance below and in at least three of these areas there is sufficient de the student has a good level of understanding of the technologies requ of understanding would be indicated by expanded points showing both arguments in each section. Answer uses an excellent range of technical vocabulary and there are no few spelling or grammar mistakes in the answer.
3	A line of reasoning has been followed to produce a coherent, relevant, s logically structured response but the response may only cover three of t in the guidance below, with two or three substantiated points being mad Answer uses a good range of technical vocabulary but there are more t or grammar mistakes in the answer.
2	A limited attempt has been made to follow a line of reasoning by cover topic areas in the guidance below. Overall, at least four valid points which can relate to any of the topic areas in the guidance. Answer uses some technical vocabulary and there are several spelling o mistakes in the answer.
1	A few relevant points have been made but there is no evidence that a li has been followed. The points may only relate to one or two of the four guidance or may be made in a superficial way with little substantiation. Answer contains very little if any technical vocabulary and the spelling / g

Indicative content –

What the technology would be used for

Facial unlock of devices

Security (e.g. the bouncer who knows you in a crowd of people before you ge

Targeted advertising – Tesco announced plans for screens that identify your g checkout and target you with specific advertising.

The more companies such as Facebook and Google know about you, the bett advertising, etc. Facial recognition allows them to create a kind of diary of you pictures on the Internet to create a personal history.

TVs are being made that can measure your engagement with a program/adv companies directly.

Benefits include targeted adverts that you may actually find relevant and sign

Privacy concerns

When is the data being collected?

Always-on technologies

Do the brands have the right to know anything and everything about their cu have such information?

Who can this data then be shared with? (SceneTap is a company in America w It allows users to identify real-time information on gender ratios and average wish to be where to go on a night out. The company have since filed a pa identified people with their social networking profiles. This would then be use status, intelligence, education and income' – is this information then going to

Most information that is currently data mined by companies is anonymous – designed to be exactly the opposite.

Plans for use in public places means people don't get the choice to 'opt in' – is it

Who holds the information?

Who has given permission for the data to be taken in the first place?

Who can the data be passed/sold to?

What country is the data stored in? Implications of the Data Protection Act.

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The impact of wearable technology
Google Glass and other such technologies herald an age where someone cou
identify you on the street without ever meeting you.
As soon as Google Glass was announced, an app called NameTag was create
you are able to start a conversation with a stranger; it would take a picture an
Internet to find out who it is. Google Glass said they wouldn't use facial recog
matter of time before someone else does – would Google then change their

The specific use of Google Glass is not required – even though the project is discon
to call upon and has only been discontinued so that Google can develop the next

4.

Level	Description
4	A line of reasoning has been followed to produce a coherent, relevant, s logically structured response. The response covers all four areas indicate guidance below and at least three of these areas there is sufficient de the student has a good level of understanding of the technologies requ [illegible] understanding would be indicated by expanded points showing both [illegible] ments in each section.
3	A line of reasoning has been followed to produce a coherent, relevant, subst logically structured response but the response may only cover three of the a the guidance below, with two or three substantiated points being made per
2	A limited attempt has been made to follow a line of reasoning by coveri the topic areas in the guidance below. Overall, at least four valid points made which can relate to any of the topic areas in the guidance.
1	A few relevant points have been made but there is no evidence that a lin has been followed. The points may only relate to one or two of the four a guidance or may be made in a superficial way with little substantiation.

Indicative content –

How easy it is nowadays to do WarDriving yourself?
The ability to map nearby Wi-Fi networks using GPS data is now a common f
many able to complete the task without a 3rd party app.
When using these inbuilt apps, who has control over that data thought?
Where is it going and why is it being used?

What information could be gathered?
At the most basic level a map would be created with an overlay of Wi-Fi cove
indication of the security level of each network so that open/public networks
As Google did during the Street View project though, other data can also be
then connected to and any information on the network that could be accesse
to the Google servers.
Google argued any information stored on an individual was only ever very m
the car driving past the house/building

What may the end [illegible] gathering such information?
The ma[illegible] WarDriving is to identify open networks for the conve
where [illegible] go to get Wi-Fi access if required (e.g. in a café).
WarDriv[illegible] can be broken down into three groups:

- 'They innocently wish to gain free wireless access in their neighbourhoo
- 'They have commercial motivations and hope to sell security services.'
- 'They have dishonest motives and hope to surreptitiously access netwo spam, or acquire illegal data.'

What happens to the information later, where is it stored?
Who has given permission for the data to be taken in the first place?
Who can the data be passed/sold to?
What country is the data stored in? Implications of the Data Protection Act.

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