

# Contents

<b>Stem Words</b> .....	3
<b>Unit 1 – Computational Thinking</b> .....	4
<b>Abstraction and Decomposition</b> .....	4
<b>Algorithms</b> .....	4
<b>Code Review</b> .....	21
<b>Errors in Code</b> .....	23
<b>Requirements Analysis</b> .....	23
<b>Sorting and Searching</b> .....	24
<b>Truth and Trace Tables</b> .....	30
<b>Validation and Testing</b> .....	40
<b>Unit 2 - Data</b> .....	42
<b>ASCII &amp; Unicode</b> .....	42
<b>Binary</b> .....	42
<b>Binary Addition and Subtraction</b> .....	49
<b>Compression</b> .....	52
<b>Ciphers</b> .....	56
<b>Graphics and Sound</b> .....	57
<b>Hexadecimal</b> .....	59
<b>Image and Sound Sizes</b> .....	62
<b>Unit 3 - Computers</b> .....	67
<b>Bus and Registers</b> .....	67
<b>CPU Components and Cycles</b> .....	70
<b>Compilers and Interpreters</b> .....	76
<b>Embedded Systems</b> .....	78
<b>High and Low Level Languages</b> .....	81
<b>Open and Closed Source</b> .....	84
<b>Operating Systems</b> .....	85
<b>ROM and RAM</b> .....	87
<b>Software</b> .....	87
<b>Types of Memory</b> .....	89
<b>Unit 4 - Networks</b> .....	93
<b>Components</b> .....	93
<b>Data Speeds</b> .....	94
<b>Internet</b> .....	95

<b>Layouts (Topologies)</b> .....	97
<b>Network Security</b> .....	103
<b>Protocols and Models</b> .....	104
<b>Reasons for a Network</b> .....	109
<b>Server (Client Server and Web Servers)</b> .....	110
<b>Wireless Networks</b> .....	111
<b>Unit 5 – Issues and Impact</b> .....	112
<b>Artificial Intelligence</b> .....	112
<b>Copyright, Patents and Trademarks</b> .....	113
<b>Data Ownership and Rights</b> .....	114
<b>Environmental considerations</b> .....	115
<b>Ethics</b> .....	117
<b>Laws</b> .....	119
<b>Malware</b> .....	119
<b>Virtualisation</b> .....	120

## Stem Words

Paper	Command Word	Mark	Definition
1	Amend	1 to 6 marks	Requires changes or additions to code, or deletions or rearrangement of code.
1	Calculate	2 to 4 marks	Obtain a numerical answer, showing relevant working. If the answer has a unit, this must be included.
1	Complete	2 to 6 marks	Requires the completion of a table/diagram/algorithm (in any notation).
1	Construct	2 to 4 marks	Usually requires creation of an artefact using subject specific symbolic representation, rules and syntax.
1	Convert	2 to 6 marks	Requires changing information from one symbolic representation to another representation. May require amending to provide new functionality/facility.
1	Define	1 to 2 marks	When the meaning of a term is expected but there are different ways of how this can be described.
1	Describe	2 to 4 marks	To give an account of something. Statements in the response need to be developed, as they are often linked, but do not need to include a justification or reason.
1	Discuss	6 marks	Identify the issue/situation/problem/argument that is being assessed within the question. Explore all aspects of an issue/situation/problem/argument. Investigate the issue/situation by reasoning or argument.
1	Draw	2 to 6 marks	Produce a diagram/image either using a ruler or freehand. May require labelling/annotation to express meaning. Used when symbolic representations need to be manipulated.
1	Explain	2 to 4 marks	An explanation requires a justification/exemplification of a point. The answer must contain some element of reasoning/justification, this can include mathematical/logical explanations. The mark scheme will have marking points which are linked.
1	Give/State/Name	1 mark (for each)	All these command words are really synonyms. They all require recall of one or more pieces of information.
1	Identify	1 mark (for each)	Usually requires some key information to be selected from a given stimulus/resource/set of options.
1	Write	1 to 6 marks	Usually requires creation/manipulation of an artefact using a subject-specific notation.
2	Amend	5 to 15 marks	Requires changes or additions to code, or deletions or rearrangement of code.
2	Write	5 to 15 marks	Usually requires creation/manipulation of a program using a high-level programming language.

## Unit 1 – Computational Thinking

### Abstraction and Decomposition

- (a) Programmers use abstraction to model the real world.  
Define the term 'abstraction'. (2)

Question Number	Answer	Additional Guidance	Mark
<b>2(a)</b>	<p>A definition to include:</p> <ul style="list-style-type: none"> <li>The process of removing or hiding unnecessary (1) details so that only the important points remain (1)</li> <li>Programmers can focus only on the important details of a problem (1) because abstraction allows them to ignore (1) any detail that is not relevant.</li> </ul>		<b>2</b>

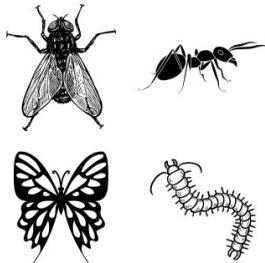
September 2020

- (a) Define the term 'decomposition'. (1)

Question Number	Answer	Additional Guidance	Mark
<b>3(a)</b>	Breaking down a problem/solution/system/algorithm		<b>1</b>

Paper 1 Specimen

- (g) Here are four images of creatures that will be used in a computer game.



Before coding the game, a programmer applies abstraction. One feature of creatures is their colour.

State two other features of the creatures that the programmer could include when creating a general model for a creature. (2)

Question Number	Answer	Additional Guidance	Mark
<b>3(g)</b>	<p>Any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>Number of legs</li> <li>Number of antennae</li> <li>Length / width / size</li> <li>Number of wings</li> <li>Size of head</li> <li>Shape of body</li> <li>Number of eyes</li> <li>Size of mouth</li> <li>Habitat</li> </ul>	<p>Accept any appropriate feature. Award two marks from the same bullet point for the identification of two different features e.g. number of legs (1), legs jointed/unjointed (1)</p>	<b>2</b>

Paper 1 Specimen

### Algorithms

Private Postal People (P-Cubed) is a national delivery service specialising in small letters, large letters, small packages, and medium packages. The company has regional depots across the country. The company runs a fleet of delivery vans. It uses technology to help run the business. It does not deliver internationally. P-Cubed has 2000 employees, some based in the head office, some working in the regional sorting offices and some driving the delivery vans. P-Cubed stores information about its employees on a server.

(a) First name, last name, and start year are items that are stored as variables in an employee record.

State two other items that need to be stored as variables for each employee. (2)

Question Number	Answer	Additional Guidance	Mark
1(a)	<p>Any two from</p> <ul style="list-style-type: none"> <li>• Date of birth (1)</li> <li>• Employee number (1)</li> <li>• Permitted areas (1)</li> <li>• Department (1)</li> <li>• Salary (1)</li> <li>• Address (1)</li> <li>• Job role (1)</li> <li>• Badge number (1)</li> <li>• National Insurance number (1)</li> <li>• Location/depot (1)</li> <li>• Uniform information (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Accept meaningful variable names tied to the scenario, e.g. EmployeeID, DOB, etc.</li> <li>• Do not accept age</li> <li>• Start date is in the question</li> <li>• Accept other examples appropriate to the scenario</li> </ul>	2

17 ay 2018

(b) Employees earn days of holiday based on how long they have worked at P-Cubed.

- For the first two years, employees get 10 days of holiday each year.
- In subsequent years, employees get an additional 0.5 days of holiday for each year worked.
- The employee record has a variable called 'startYear'. Construct a general expression to calculate the total number of days of holiday earned by an employee, for this year, who has worked for P-Cubed for more than two years. (4)

Question Number	Answer	Additional Guidance	Mark
1(b)	<ul style="list-style-type: none"> <li>• Calculation showing length of employment in years (1)</li> <li>• Subtracting 2 for the first two years (1)</li> <li>• Multiplying by 0.5 days per year (1)</li> <li>• Adding in the 10 days basic holiday entitlement (1)</li> </ul> <p>Example:</p> <ul style="list-style-type: none"> <li>• <math>10 + (((\text{currentYear} - \text{startYear}) - 2) \times 0.5)</math></li> </ul>	<ul style="list-style-type: none"> <li>• Units not required</li> <li>• Brackets not required if order of precedence rules are followed (BIDMAS)</li> </ul>	4

17 May 2018

5. P-Cubed uses automatic sorting machines. The sorting machines can only handle items up to 1000 cubic centimetres (cm<sup>3</sup>) in volume. The volume of an item is calculated by this expression: volume = width x height x length Here is the partially completed pseudo-code for an algorithm that calculates the volume of an item.

```

2 FUNCTION calcVolume ( )
3
4 BEGIN FUNCTION
5
6     volume =
7
8     RETURN
9
10 END FUNCTION
11
12 SEND "Enter width" TO DISPLAY
13 RECEIVE itemWidth FROM (INTEGER) KEYBOARD
14 SEND "Enter height" TO DISPLAY
15 RECEIVE itemHeight FROM (INTEGER) KEYBOARD
16 SEND "Enter length" TO DISPLAY
17 RECEIVE itemLength FROM (INTEGER) KEYBOARD
18
19 SET itemVolume TO calcVolume ( )
20
21 SEND "Volume is " & itemVolume TO DISPLAY

```

(a) The function 'calcVolume' represents a generalisation that calculates the volume for any item. Complete the pseudo-code by filling in the boxes. (4)

Question Number	Answer	Additional Guidance	Mark
5(a)	<p>Line 2: inWidth, inHeight, inLength (1) - 3 meaningful variable names, order must match line 19</p> <p>Line 6: inWidth * inHeight * inLength (1) - must match names from line 2, but order of calculation doesn't matter</p> <p>Line 8: volume (1) - only possible response</p> <p>Line 19: itemWidth, itemHeight, itemLength (1) - only possible names because they are used in the main program, any order</p> <p>See next page for an example.</p>	<ul style="list-style-type: none"> <li>Ignore spelling mistakes and syntax as long as logic is discernible</li> </ul>	4

```

2 FUNCTION calcVolume (inWidth, inHeight, inLength)
3
4 BEGIN FUNCTION
5
6     volume = inWidth * inHeight * inLength
7
8     RETURN (volume)
9
10 END FUNCTION
11
12 SEND "Enter width" TO DISPLAY
13 RECEIVE itemWidth FROM (INTEGER) KEYBOARD
14 SEND "Enter height" TO DISPLAY
15 RECEIVE itemHeight FROM (INTEGER) KEYBOARD
16 SEND "Enter length" TO DISPLAY
17 RECEIVE itemLength FROM (INTEGER) KEYBOARD
18
19 SET itemVolume TO calcVolume (itemWidth, itemHeight, itemLength)
20
21 SEND "Volume is " & itemVolume TO DISPLAY

```

17 May 2018

(b) State the reason why 'calcVolume' is a function not a procedure. (1)

Question Number	Answer	Additional Guidance	Mark
5(b)	<p>Any one of:</p> <ul style="list-style-type: none"> <li>A function returns a value (1)</li> <li>Without returning a value, it is not a function (1)</li> <li>A procedure does not return a value (1)</li> </ul>		1

17 May 2018

(c) State the name of a local variable in the pseudo-code. (1)

Question Number	Answer	Additional Guidance	Mark
5(c)	volume	Ignore spelling and extraneous text after a correct response	1

17 May 2018

(d) State two benefits to the programmer of using libraries in a program. (2)

Question Number	Answer	Additional Guidance	Mark
5(d)	<p>Any two from:</p> <ul style="list-style-type: none"> <li>Reduced coding time / code is quicker to write / code can be reused (1)</li> <li>Reduced debugging time / library code is bug-free / reduced testing time (1)</li> <li>Library may have more complex functionality (1) than the programmer has understanding or capability</li> </ul>		2

17 May 2018

(b) Programmers use different types of operators in their programs. Name the type of operator for each example. (3)

<, != .....  
 +, \* .....  
 AND, NOT .....

Question Number	Answer	Additional Guidance	Mark
2(b)	<p>One mark for each in the correct location:</p> <ul style="list-style-type: none"> <li>Relational (1)</li> <li>Arithmetic (1)</li> <li>Boolean/Logical (1)</li> </ul>	<ul style="list-style-type: none"> <li>Ignore spelling</li> </ul>	3

September 2020

Here is some pseudocode.

```

10 SET aNum TO 0
11 SET userNum TO 0
12
13 WHILE userNum = 0 DO
14   SEND "Enter a number:" TO DISPLAY
15   RECEIVE userNum FROM (INTEGER) KEYBOARD
16 END WHILE
17
18 IF userNum < 10 THEN
19   SET aNum TO cubeNum (userNum)
20 ELSE
21   SET aNum TO userNum
22 END IF
23 SEND aNum TO DISPLAY
24
25 FUNCTION cubeNum (aNum)
26 BEGIN FUNCTION
27   SET total TO aNum * aNum * aNum
28   RETURN total
29 END FUNCTION

```

(ii) State the coding technique that Charles could use to make the pseudocode easier to understand. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(ii)</b>	Comment(s) / Annotation(s)	Do not penalise spelling	<b>1</b>

8 June 2016

(iii) State the name of the subprogram shown in the pseudocode. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(iii)</b>	cubeNum	Do not penalise spelling Do not award if other information from function header is provided because the question asks for name only.	<b>1</b>

8 June 2016

(iv) State the range of line numbers that show a selection statement. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(iv)</b>	Any one of: <ul style="list-style-type: none"> <li>• 18 to 22</li> <li>• 18 - 22</li> <li>• 18, 19, 20, 21, 22</li> <li>• 18, 20, 22</li> </ul>	Entire range must be provided Award any discernible notation	<b>1</b>

8 June 2016

(v) State a line number on which the variable aNum is a local variable. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(v)</b>	Any one of: <ul style="list-style-type: none"> <li>• 25</li> <li>• 27</li> </ul>		<b>1</b>

8 June 2016

(vi) State a line number on which the variable aNum is a global variable. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)(vi)</b>	Any one of: <ul style="list-style-type: none"> <li>• 10</li> <li>• 19</li> <li>• 21</li> <li>• 23</li> </ul>		<b>1</b>

8 June 2016

(c) Shaneela is planning to use libraries in the code for the website.

(i) State two reasons for using libraries in code. (2)

Question Number	Answer	Additional Guidance	Mark
3 (c)(i)	Any two of: <ul style="list-style-type: none"> <li>Library code has already been debugged, so it should not have a bug</li> <li>Library code has already been tested, so it should produce the correct results</li> <li>Using libraries can reduce the time needed to develop a solution</li> <li>Library code is usually optimised/faster than own code</li> <li>Library code can be reused many times without having to rewrite the code</li> </ul>	Do not accept just 'saves time'	2

8 June 2016

In Shaneela's program, the days of the week are numbered 1 for Monday, 2 for Tuesday, 3 for Wednesday, 4 for Thursday, 5 for Friday, 6 for Saturday and 7 for Sunday.

She is writing code to determine if a numerical value represents a weekday or weekend day. (ii) Complete the following pseudocode to show the logical operations required to produce the correct output. (4)

```

IF day >= 1  day <= 5 THEN
    SEND "weekday" TO DISPLAY
ENDIF
IF day = 6  day = 7 THEN
    SEND "weekend" TO DISPLAY
ENDIF
IF  (day >= 1  day <= 7) THEN
    SEND "error" TO DISPLAY
ENDIF

```

Question Number	Answer	Additional Guidance	Mark
3(c)(ii)	One mark for each of (in this order only): <ol style="list-style-type: none"> <li>AND</li> <li>OR</li> <li>NOT</li> <li>AND</li> </ol> <pre> ===== 1 Mon, 2 Tues, 3 Wed, 4 Thur, 5 Fri, 6 Sat, 7 Sun  IF day &gt;= 1 AND day &lt;= 5 THEN     SEND "weekday" TO DISPLAY ENDIF IF day = 6 OR day = 7 THEN     SEND "weekend" TO DISPLAY ENDIF IF NOT (day &gt;= 1 AND day &lt;= 7) THEN     SEND "error" TO DISPLAY ENDIF </pre>		4

8 June 2016

(c) Manuel is writing a program to help pupils with their maths revision. Here is some pseudocode for an algorithm that calculates the area of a circle, with radius of 5 units. It uses a subprogram.

```

calcCircleArea ()

PROCEDURE calcCircleArea ()
BEGIN PROCEDURE
    SET area TO Pi * 5 * 5
    SEND area TO DISPLAY
END PROCEDURE

```

Manuel wants to change the pseudocode so that the area of any circle can be calculated using calcCircleArea.

(i) Write the changed pseudocode in the box below. (3)

Question Number	Answer	Additional Guidance	Mark
4(c)(i)	<p>Coding solution (one mark for each item):</p> <ul style="list-style-type: none"> <li>Calling code must provide an input parameter</li> <li>calcCircleArea signature must take an input parameter</li> <li>Input parameter must be used in calculation</li> </ul> <pre> 47 48 calcCircleArea (radiusOfCircle) 49 50 PROCEDURE calcCircleArea (radiusOfCircle) 51 BEGIN PROCEDURE 52     SET area TO Pi * radiusOfCircle * radiusOfCircle 53     SEND area TO DISPLAY 54 END PROCEDURE 55 </pre>	Ignore any reference to data types	3

8 June 2016

(v) Define the term 'iteration'. (1)

Question Number	Answer	Additional Guidance	Mark
3(c)v	Looping over every item in a data structure		1

Paper 1 Specimen

(d) Explain one benefit of using subprograms. (2)

Question Number	Answer	Additional Guidance	Mark
3(d)	<p>An explanation to include <b>two</b> from:</p> <ul style="list-style-type: none"> <li>The subprogram may be used more than once in a program (1) so that writing, debugging, testing will save time (1)</li> <li>The subprogram performs one specific/contained task (1) so it can be moved away from the main program code (1)</li> <li>Subprograms for common tasks can be stored in libraries and reused in other programs (1) so that they don't have to be re-written (1)</li> </ul>		2

Paper 1 Specimen

4. A running club uses a computer to record training data for its members. After each run the total time and the number of laps are stored for each runner.

(a) A subprogram is used to calculate each runner's average time per lap.

Write an algorithm to calculate the average time. (2)

Question number	Answer		Mark
4 a)	Correct calculation using variables (1) For example: <ul style="list-style-type: none"> <li>DIVIDE TotalTime by NumberLaps (1)</li> <li>TotalTime/NumberLaps (1)</li> </ul> Use of variable for result (1) For example: <ul style="list-style-type: none"> <li>SET AverageTime (1)</li> <li>STORE AverageTime (1)</li> </ul>	One mark for correct calculation  One mark for correct variable name	2 (1,1)

(ii) Give one reason why programmers use subprograms. (1)

4 b)(ii)	Any <b>one</b> of: <ul style="list-style-type: none"> <li>Can be reused</li> <li>Improves readability of program</li> <li>Easier to debug a small chunk of code rather than a whole program</li> <li>Make it easier to divide the task up between a number of programmers</li> </ul>		1 (1)
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Sample Paper 1

(d) The running club stores details about members in a structured database consisting of the following format:

**Member** (MemberID, Surname, Forename, DateOfBirth, RenewalMonth, EmailAddress)

**Run** (MemberID, DateOfRun, Time)

The club wants to send a reminder email to those members whose membership is due for renewal in September.

(i) Write an SQL query to retrieve the Forename and EmailAddress for the members who should be sent emails. (3)

Algorithms can keep data secure when transmitted over a network. (iv) State the name of this class of algorithm.

4 d)(i)	<pre>SELECT Forename, EmailAddress FROM Member WHERE RenewalMonth = 'September';</pre> 1 mark for correct two fields in SELECT clause  1 mark for FROM clause  1 mark for correct WHERE clause		3 (1,1,1)
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Sample Paper 1

Algorithms can keep data secure when transmitted over a network.

(iv) State the name of this class of algorithm. (1)

Question Number	Answer	Additional Guidance	Mark
1(c)(iv)	Encryption		1

Sample Paper 2

(b) Byron is collecting data to help in his research. He decides to store the life span of a bird as a real number with a decimal point.

(i) Explain how positive real numbers can be stored in floating point binary. (4)

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	Any four of: <ul style="list-style-type: none"> <li>• Uses a mantissa/fractional/significand part</li> <li>• Uses an exponent part</li> <li>• Uses exponent to shift decimal to correct place in mantissa/fraction/significand</li> <li>• Binary digits of 1 on right of decimal (fractional part) represents <math>\frac{1}{2}</math>, <math>\frac{1}{4}</math>, ...</li> <li>• Binary digits of 1 on left of decimal represents 1, 2, 4, 8, ...</li> <li>• Ones on each side of decimal are summed to get a value</li> </ul>		4

Sample Paper 2

Byron wants to save examples of bird songs. (1)

(ii) Complete this sentence.

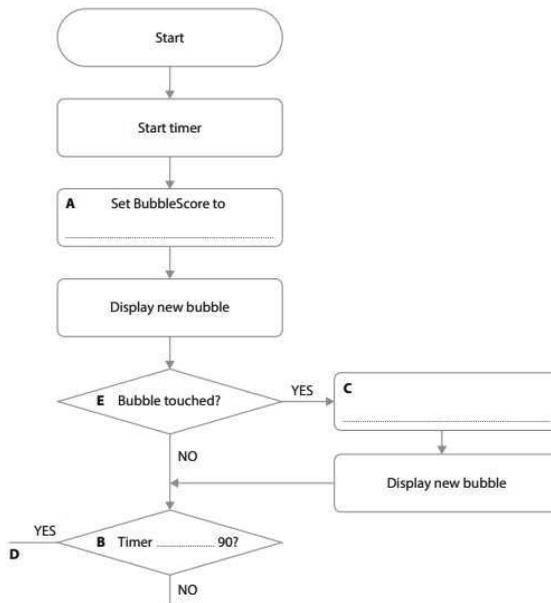
Bird songs are ..... signals, which means they are continuous, with values that constantly change.

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	Analogue		1

Sample Paper 2

2. A game on a touch screen phone displays a bubble. When the player touches the bubble it pops and another bubble appears. The aim of the game is to pop as many bubbles as possible within 90 seconds.

(a) The flow chart for this is given below. It is incomplete.



(i) Complete the process statement in A. (1)

Question number	Answer		Mark
2 a)(i)	0/zero inserted in Box A (SET BubbleScore to 0)	See Flowchart (2a)	1 (1)

Paper 1

(ii) Complete the statement in B. (1)

2 a)(ii)	Any <b>one</b> of (inserted in Box B): <ul style="list-style-type: none"> <li>• &lt;</li> <li>• &lt;=</li> <li>• NOT &gt;=90</li> </ul>	Response must match yes, no connectors given	1 (1)
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Paper 1

(iii) Complete the process statement in C. (2)

2 a)(iii)	Any one of (inserted in Box C): <ul style="list-style-type: none"> <li>• BubbleScore (1) + 1 (1)</li> <li>• increment by 1 (1), BubbleScore (1)</li> <li>• add 1 (1), to BubbleScore (1)</li> </ul>	Do not accept: 'Increment' without value 1 mark for naming variable BubbleScore and 1 for incrementation	2 (1,1)
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Paper 1

(iv) Complete connector D. (1)

2 a)(iv)	Connector D goes between 'Set BubbleScore to 0' and 'Display new bubble' or into 'Display new bubble'	Above or into process box	1 (1)
----------	---	---------------------------	-------

Paper 1

(v) At the end of the game the player's score is displayed.

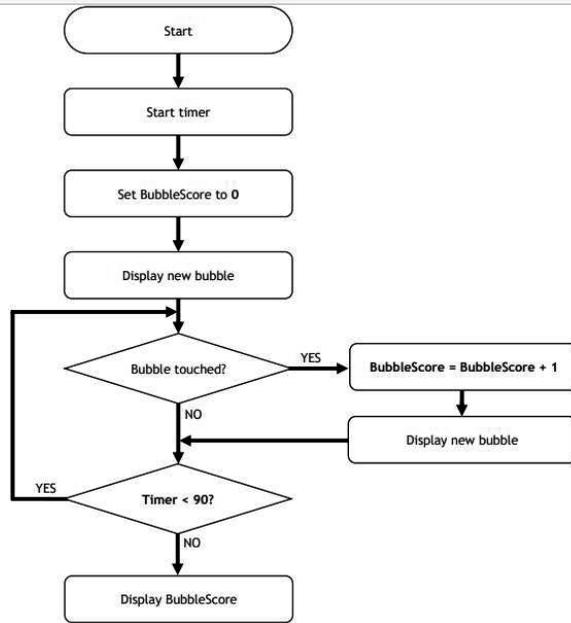
Draw this on the flow chart. (3)

2 a)(v)	Display BubbleScore in a box (1) Connector from timer decision Box B to new process box (1), correct direction shown (arrow)(1)	Stop box not required	3 (1,1,1)
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Paper 1

(vi) Name the programming construct that would be used to implement E. (1)

2 a)(vi)	If/conditional statement		1 (1)
----------	--------------------------	--	-------



(b) BubbleScore is a variable.

(i) Describe what is meant by the term variable. (2)

Question number	Answer	Mark
2 b)(i)	A named (1) storage/memory location (1)	2 (1,1)

Paper 1

The variable BubbleScore stores the number of bubbles popped.

(ii) Explain which data type is most appropriate for the variable BubbleScore. (2)

2 b)(ii)	Integer (1) Any <b>one</b> of: <ul style="list-style-type: none"> <li>• Type integer allows only whole numbers (1)</li> <li>• Integer data type allows calculations (1)</li> </ul>	2 (1,1)
----------	--	---------

Paper 1

This algorithm is designed to display the highest score.

IF HighestScore > BubbleScore THEN

SET HighestScore to BubbleScore

ENDIF DISPLAY HighestScore

(c) Explain why this algorithm would not work as intended. (2)

2 c)	Any <b>one</b> of: Incorrect comparison (1) should be < (1) OR Replaces HighestScore with BubbleScore if BubbleScore is less than HighestScore (1) should be greater than (1)	2 (1,1)
------	---	---------

(d) The array LeaderBoard is used to store the names of the five players with the highest scores.

(i) Explain why an array is a suitable data structure for this purpose. (2)

<b>2 d)(i)</b>	Because all the items in the list have the same data type (1) It is more efficient to access and process data (1)		2 (1,1)
----------------	--	--	---------

Here are some of the contents of the array LeaderBoard.

Ann	Josie	Cahit	Alex	Layla
-----	-------	-------	------	-------

(ii) Give the name of the player stored in LeaderBoard [3] (1)

<b>2 d)(ii)</b>	Alex		1 (1)
-----------------	------	--	-------

The microcontroller monitors the input from the sensor using a subprogram.

Here is a subprogram, in assembly code, for the microcontroller:

Register 0 holds the maximum safe heart rate.

Register 1 holds the address of the current heart rate reading.

```
LDR R3, [R1]
MOV R2, #0
CMP R3, R0
MOVGT R2, #1
```

(ii) Describe how the subprogram processes the heart rate data. (4)

<b>3 b)(ii)</b>	Any <b>four</b> of: <ul style="list-style-type: none"> <li>• Puts the heart rate into register 3 (1)</li> <li>• Sets value/flag/register 2 to 0 (1)</li> <li>• Compares heart rate with maximum safe level (1)</li> <li>• If heart rate too high sets value/flag/register 2 to 1 (1)</li> <li>• Returns a value 0 if heart rate is within safe region or 1 if heart rate is too high (1)</li> </ul>		4 (1,1,1,1)
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4. A running club uses a computer to record training data for its members. After each run the total time and the number of laps are stored for each runner.

(a) A subprogram is used to calculate each runner's average time per lap.

Write an algorithm to calculate the average time. (2)

Question number	Answer		Mark
4 a)	Correct calculation using variables (1) For example: <ul style="list-style-type: none"> <li>DIVIDE TotalTime by NumberLaps (1)</li> <li>TotalTime/NumberLaps (1)</li> </ul> Use of variable for result (1) For example: <ul style="list-style-type: none"> <li>SET AverageTime (1)</li> <li>STORE AverageTime (1)</li> </ul>	One mark for correct calculation  One mark for correct variable name	2 (1,1)

Paper 1

(ii) Give one reason why programmers use subprograms. (1)

4 b)(ii)	Any <b>one</b> of: <ul style="list-style-type: none"> <li>Can be reused</li> <li>Improves readability of program</li> <li>Easier to debug a small chunk of code rather than a whole program</li> <li>Make it easier to divide the task up between a number of programmers</li> </ul>		1 (1)
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Paper 1

Nancy is a member of the running club. Her MemberID is 1234. At her training session on 12 May 2013 she completed a run in 18.4 minutes.

(ii) Write the SQL command to add this information to the database. (2)

4 d)(ii)	INSERT into Run (1234, 2013-05-12, 18.4) 1 mark for INSERT INTO Run 1 mark for correct statement including values		2 (1,1)
----------	---	--	---------

Paper 1

Nick is a member of the running club. His MemberID is 0012. He wants to know the date and time of all his runs.

(iii) Write an SQL query to display his running record in time order. (3)

Question number	Answer		Mark
4 d)(iii)	SELECT DateOfRun, Time FROM Run WHERE MemberId = 0012 ORDER BY Time  1 mark for correct two fields in SELECT clause  1 mark for ORDER BY 1 mark for correct WHERE clause		3 (1,1,1)

Paper 1

Members may log on to the club's website to view details of their training.

(e) Explain the server-side processing that takes place when a member views their training online. (3)

<b>4 e)</b>	Request from club member handled by a script server side (1). Server accepts request and retrieves training data from database (1) Constructs web page to display results of search (1) and sends to client computer (1)		3 (1,1,1)
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Paper 1

5. Rail passengers carry a contactless smartcard to pay for train journeys. The account balance is stored on the card. A processor in the exit barrier calculates the rail fare.

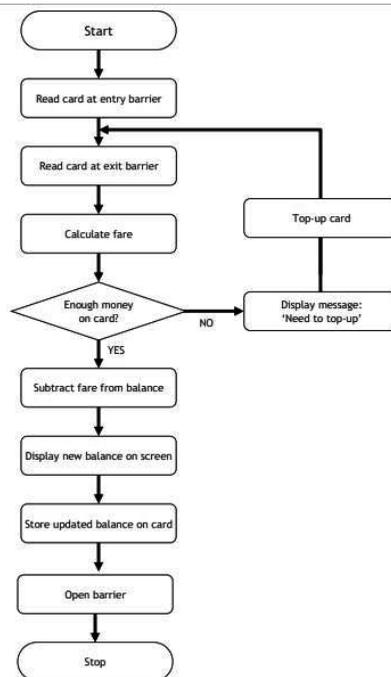
The card is swiped at the start and end of each journey. If there is enough money on the card at the end of the journey, the balance is updated and displayed on the barrier screen, and the exit barrier opens. If not, the message 'Need to top-up' is displayed and the barrier does not open.

(a) Draw a flow chart for this process in the space provided on page 19. (5)

Question number	Answer		Mark
<b>5 a)</b>	See flowchart (5a)  For each of these in logical position: <ul style="list-style-type: none"> <li>• Swipe card and establish fare (1)</li> <li>• Decision for top-up with yes/no labelled (1)</li> <li>• Correct loop for top-up with display message (1)</li> <li>• Subtract fare/update balance (1)</li> <li>• Display balance and complete logical process (1)</li> </ul>		5 (1,1,1,1,1)

Paper 1





Paper 1

Rail fares are based on the distance travelled:

- fewer than 5 miles: £2.50
- 5–12 miles: £3.25
- more than 12 miles: £4.15

A processor in the exit barrier calculates the fare.

A discount of 10% is given for off-peak travel, i.e. after 10 am and before 5 pm on Monday to Friday or any time on Saturday and Sunday.

The ID of the railway station at which a passenger starts their journey is recorded on their card when they swipe in.

The processor in the exit barrier uses a data structure called ListOfStations to look up the distance travelled.

(c) Write an algorithm to calculate the cost of a passenger's journey. It must read in the start of the journey from the card, calculate the fare and apply any discount. The information must then be displayed in a customer-friendly way. (8)

Question number	Answer	Mark
5 c)	<p>Reading in StartStation from card (1)  Choice of suitable data structure for station list (1)  Using a loop to find StartStation in data structure (1) and stopping when station is found (1)  Referencing the items in the data structure correctly (1)  Using an appropriate structure, e.g. nested loop, to calculate fare (1)  Correct expression to calculate the discount, i.e. if time &gt;10:00 AND &lt;17:00 OR day = 'Saturday' OR 'Sunday' (2)  Calculating the discount correctly (1)  Producing a suitable message (1)  Use of meaningful variable names (1)</p> <p>Up to a maximum of 8 marks</p> <p>Example answer:</p> <pre> RECEIVE StartStation from (STRING) CARD READER SET Index TO 0 SET Found TO false WHILE Found = false DO     IF ListOfStations.Station[Index] = StartStation THEN         SET Found TO True     ELSE         SET Index TO Index + 1     END IF END WHILE IF ListOfStations.Distance[Index] &lt; 5 THEN     SET CostOfJourney TO 2.50 ELSE     IF ListOfStations.Distance[Index] &gt;12 THEN         SET CostOfJourney TO 4.15     ELSE         SET CostOfJourney TO 3.25     END IF END IF IF (Time &gt;10.00 AND Time &lt;17.00) OR (Day = Saturday OR Day = Sunday) THEN     SET Cost TO Cost*0.9 END IF SEND ["The cost of your journey is £", CostOfJourney, "Thank you for travelling on our railway."] TO DISPLAY </pre>	<p>8  (1,1,1,1,2,  1,1)</p>

Paper 1

Margaret runs an ice cream kiosk in a seaside town. She makes and sells ice cream. She also sells sweets, hot and cold drinks, and cookies.

1. Margaret has developed her own recipes for different flavours of ice cream. The recipes use only natural ingredients.

Here is Margaret's recipe for strawberry ice cream.

**Margaret's Ice Cream Kiosk**  
**Strawberry ice cream ingredients**

0.8 litres - Full fat milk  
0.9 litres - Cream  
0.3 kilograms - Sugar  
12 Whole eggs  
1.4 kilograms - Strawberries  
15 millilitres - Vanilla

She stores all her recipes on a computer. One variable is needed to hold the amount of fruit and another is needed to hold the number of eggs.

(a) State two additional variables that need to be created to store the recipes for ice cream.

Question Number	Answer	Additional Guidance	Mark
1(a)	<p>Any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>Quantity of milk</li> <li>Quantity of cream</li> <li>Type of milk/cream</li> <li>Quantity/type of sugar</li> <li>Type of ice cream [sorbet, gelato, gluten free, sugar]</li> <li>Flavour</li> </ul>	<ul style="list-style-type: none"> <li>Accept meaningful variable names tied to the scenario, e.g. amtVanilla</li> <li>Mark not awarded for sell-by date</li> </ul>	2

16 May 2019

(b) State the data type needed to store values for the weight of fruit and the number of eggs in a recipe. (2)

- Weight of fruit
- Number of eggs

Question Number	Answer	Additional Guidance	Mark
1(b)	<ul style="list-style-type: none"> <li>Real/float/double</li> <li>Integer</li> </ul>	Accept 'Decimal' for mp1	2

16 May 2019

4 Margaret needs to keep track of how much money she makes. She collects the sales figures on a weekly basis.

(a) The pseudocode of an algorithm is shown.

```
2 w = 0 REPEAT SET w TO w + 1 SEND w TO DISPLAY UNTIL w = 52
```

In some programming languages, if a program is written like this, it could be translated and executed. Discuss the suitability of this code for humans and how it could be improved. (6)

Question Number	Answer	Additional Guidance	Mark
4(a)	<p>Indicative content:</p> <ul style="list-style-type: none"> <li>This pseudo-code is not suitable for humans to read and understand / running all the individual instructions together on a single line makes this pseudo-code difficult for humans to read <b>but</b> algorithm is short and understandable in this form</li> <li>Use of English command words makes it easier to understand for humans</li> <li>To make this pseudo-code easier for humans to read and understand: <ul style="list-style-type: none"> <li>the variable name 'w' could be changed to something more meaningful, such as 'week'</li> <li>comments could be used to explain what the code is doing / using # or // for comments</li> <li>each instruction could be placed on a new line</li> <li>indentation could be used to show the blocking of the constructs / ending words could show blocking of the code</li> <li>additional white space / lines could be used to show blocks of code</li> </ul> </li> </ul>	Rewritten pseudo-code can be used as a supportive example	6

Level	Mark	Descriptor
	0	No rewardable content
<b>Level 1</b>	1-2	Basic, independent points are made showing elements of knowledge and understanding of key concepts/principles of computer science. The discussion will contain basic information with little linkage between points made.
<b>Level 2</b>	3-4	Demonstrates adequate knowledge and understanding of key concepts/principles of computer science. The discussion shows some linkages and lines of reasoning with some structure.
<b>Level 3</b>	5-6	Demonstrates comprehensive knowledge and understanding by selecting relevant knowledge and understanding of key concepts/principles of computer science to support the discussion being presented. The discussion shows a well-developed, sustained line of reasoning which is clear, coherent and logically structured.

16 May 2019

(d) The running club stores details about members in a structured database consisting of the following format:

**Member** (MemberID, Surname, Forename, DateOfBirth, RenewalMonth, EmailAddress)

**Run** (MemberID, DateOfRun, Time)

The club wants to send a reminder email to those members whose membership is due for renewal in September.

(i) Write an SQL query to retrieve the Forename and EmailAddress for the members who should be sent emails. (3)

<b>4 d)(i)</b>	SELECT Forename, EmailAddress FROM Member WHERE RenewalMonth = 'September'; 1 mark for correct two fields in SELECT clause  1 mark for FROM clause  1 mark for correct WHERE clause		3 (1,1,1)
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Paper 1

(b) Margaret wants to send out vouchers to every member of the loyalty scheme. A logical looping construct is needed in the programming code to make this happen. State the most appropriate type of loop and justify your choice. (2)

- Type of Loop
- Justification

Question Number	Answer	Additional Guidance	Mark
<b>7(b)</b>	Type (one from): <ul style="list-style-type: none"> <li>• Count controlled loop (1)</li> <li>• For loop (1)</li> </ul> Justification (one from): <ul style="list-style-type: none"> <li>• The number of loop passes is known in advance (1)</li> <li>• The loop executes for a known number of times (1)</li> <li>• The loop executes for exactly the number of members (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Award marks independently</li> </ul>	<b>2</b>

16 May 2019

## Code Review

5. (d)(ii) The network specialist uses a software tool to carry out a code review. State two checks that are carried out during a code review. (2)

Question Number	Answer	Additional Guidance	Mark
5(d)(ii)	Any two from:  Identify: 1. bad programming practices (1) 2. inefficient code (1) 3. logic errors (1) 4. programming language-specific vulnerabilities (1) 5. security vulnerabilities		2

14 May 2018

6. (c) Best case and worst case for search algorithms can be determined based on the number of comparisons necessary to find the target item. Give the best case and worst case for a binary search algorithm. (2)
- Best case
  - Worst case

Question Number	Answer	Additional Guidance	Mark
6(c)	Best case: The item is the middle/median of the list (1). Worst case: The item is not in the list / located at the point at which the final division could be made (1).	Do not accept last/first item in the list.	2

14 May 2018

- (a) All address codes have the same format. The first two positions are letters, followed by four digits, followed by two letters. "BH1634GQ" and "bh1634gq" are valid codes. Complete the table to show different validation checks and test data caught by the validation check. The first one has been done for you. The letter 'N' represents a number (0-9) and the letter 'L' represents a letter (A-Z or a-z). (4)

Validation check	Test data
Pattern check ("LLNNNNLL")	"4W56AB92"

Question Number	Answer	Additional Guidance	Mark
2 (b)	One mark for each check and one for a linked example of test data that fails the test  Type check (1)      Data (1) Length check (1)    Data (1) Presence check (1)   Code is blank (1) Lookup check (1)    Explanation of data not in pre-existing lists (1)	<ul style="list-style-type: none"> <li>• Data must follow test</li> <li>• Quotes not required</li> <li>• Data must fail the indicated test and not several tests</li> <li>• Do not interpret blank cell as an answer to presence check</li> </ul>	4

17 May 2018

- (c) A code review is an important stage in software development. State the purpose of a code review. (1)

Question Number	Answer	Additional Guidance	Mark
6(c)	Any one from: <ul style="list-style-type: none"> <li>• To check for bad programming practices</li> <li>• To check for vulnerabilities in the programming language</li> <li>• To check efficiency of code</li> </ul>	Do not accept: 'Checking for errors' if not qualified with 'not picked up in testing'.	1

13 May 2019

## Errors in Code

(a) Describe one difference between a syntax error and a logic error. (2)

Question Number	Answer	Additional Guidance	Mark
2(d)	<p>A description to include:</p> <ul style="list-style-type: none"> <li>A syntax error is caused by using the grammar/form/words of the programming language incorrectly (1), whereas a logic error is caused by an error in the design of the algorithm (1)</li> <li>A syntax error causes the program not to interpret/compile/translate, whereas a logic error produces an incorrect/wrong result (1)</li> </ul>		2

September 2020

5 Errors are revealed when program code is translated and executed.

(a) Here is an error that a programmer received when writing and testing some code.



Explain this type of error.

(2)

Question Number	Answer	Additional Guidance	Mark
5(a)	<p>An explanation that makes reference to the following point:</p> <ul style="list-style-type: none"> <li>This is a runtime error (1)</li> </ul> <p>Plus <b>one</b> from:</p> <ul style="list-style-type: none"> <li>Because it occurs when the computer tries to execute the code (1)</li> <li>Because the (translated) code cannot be executed (1)</li> <li>Because it crashes/stops (1) (the computer when attempting to execute)</li> <li>Occur intermittently, depending on the data that is encountered (1)</li> <li>Can be caused when a user inputs data of the wrong type (1)</li> </ul>		2

16 May 2019

## Requirements Analysis

4 (a) When developing a computer system, requirements are investigated.

State one requirement that must be investigated. (1)

Question Number	Answer	Additional Guidance	Mark
4(a)	<p>Any <b>one</b> from:</p> <p>Inputs (type of keyboard, sensor)  Outputs (type of printer, etc)  Processing (Calculations, loops, selections)  Initialisation</p>		1

11 May 2020

(f) The identifier `plants` is used for an array of values.

`len(plants) // 2` is used to find the index position of the middle item in `plants`

Explain one reason why integer division, rather than division, is used to do this. (2)

Question Number	Answer	Additional Guidance	Mark
3(f)	An explanation to include <b>two</b> from: An integer is returned with // (1) because <ul style="list-style-type: none"> <li>len(plants) could be an odd number (1)</li> <li>the value for position has to be an integer / not a decimal (1)</li> </ul> e.g. If the length of the array is an odd number, normal division will return a real number (1) (which is not acceptable because) index values are integers (1)		2

Paper 1 Specimen

### Sorting and Searching

(c) A bubble sort is carried out on this list.

5	2	4	1	9	3	7
---	---	---	---	---	---	---

(i) State the number of comparisons that will be made on the first pass. (1)

Question Number	Answer	Additional Guidance	Mark
6(c)i	6		1

11 May 2020

(ii) State the number of swaps that will be made on the first pass. (1)

Question Number	Answer	Additional Guidance	Mark
6(c)ii	5		1

11 May 2020

(iii) State the number of passes that will be made. (1)

Question Number	Answer	Additional Guidance	Mark
6(c)iii	4		1

11 May 2020

(iv) State the condition that will cause the algorithm to end. (1)

Question Number	Answer	Additional Guidance	Mark
6(c)iv	No swaps will have been performed.	Do not accept: The list is sorted.	1

11 May 2020

(d) A sorted data set contains millions of items.

State why a binary search algorithm would be preferable to a linear search algorithm for use with this data set. (1)

Question Number	Answer	Additional Guidance	Mark
<b>6(d)</b>	Any <b>one</b> of: <ul style="list-style-type: none"> <li>Faster</li> <li>More efficient</li> <li>Uses fewer comparisons</li> </ul>		<b>1</b>

11 May 2020

(e) A merge sort is carried out on this list.

9 4 3 5 5 1 7

(i) State the number of splits required to complete the sort. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(e)i</b>	Six/6		<b>1</b>

September 2020

(ii) Here is the list after being split.

Complete the diagram to show the merging steps.

9 4 3 5 5 1 7

1 3 4 5 5 7 9

Question Number	Answer	Additional Guidance	Mark										
<b>2(e)ii</b>	The list has already been split into 7 individual lists. The response here should only show the missing merges.  One mark for each correct merge: <table border="1" style="margin-left: 20px;"> <tr> <td>4 9</td> <td>3 5</td> <td>1 5</td> <td>7</td> <td>(1)</td> </tr> <tr> <td>3 4 5 9</td> <td>1 5 7</td> <td></td> <td></td> <td>(1)</td> </tr> </table>	4 9	3 5	1 5	7	(1)	3 4 5 9	1 5 7			(1)		<b>2</b>
4 9	3 5	1 5	7	(1)									
3 4 5 9	1 5 7			(1)									

September 2020

(iii) Explain the effect on efficiency of using a merge sort algorithm instead of a bubble sort algorithm on the original list. (2)

9 4 3 5 5 1 7

Question Number	Answer	Additional Guidance	Mark
<b>2(e)iii</b>	An explanation to include: <ul style="list-style-type: none"> <li>• The merge sort will use more memory (1) because it makes copies of the list (1).</li> <li>• The bubble sort will use less memory (1) because it is an in-place (1) sort.</li> <li>• The merge sort will take more time to write and debug (1), because it is a much more complex (1) algorithm.</li> <li>• The bubble sort will probably take less time to write (1) because it is a simple/well-known (1) algorithm.</li> </ul>		<b>2</b>

September 2020

Manuel is writing a binary search routine to search for an individual pupil in a list of all pupil numbers. Here is the list of pupil numbers.

837, 1529, 1683, 2245, 3901, 3921, 4524

(ii) Complete the table showing the pupil numbers visited and the associated sublists when using a binary search to locate the pupil number 1683. (5)

Pupil number visited	Sublist

Question Number	Answer	Additional Guidance	Mark								
<b>4(c)(ii)</b>	One mark for each correct cell <table border="1" style="margin-top: 5px;"> <thead> <tr> <th>Pupil Number Visited</th> <th>Sub-list</th> </tr> </thead> <tbody> <tr> <td>2245</td> <td>837, 1529, 1683</td> </tr> <tr> <td>1529</td> <td>1683</td> </tr> <tr> <td>1683</td> <td></td> </tr> </tbody> </table>	Pupil Number Visited	Sub-list	2245	837, 1529, 1683	1529	1683	1683			<b>5</b>
Pupil Number Visited	Sub-list										
2245	837, 1529, 1683										
1529	1683										
1683											

8 June 2016

(e) State why a binary search algorithm will not be appropriate for use with this sequence of numbers. (1)

55	33	2	47	90	105	44	3
----	----	---	----	----	-----	----	---

Question Number	Answer	Additional Guidance	Mark
<b>5(e)</b>	It is not sorted		<b>1</b>

13 May 2019

(d) Staff use a stock control system to check stock availability. The system uses a binary search algorithm.

Here is an ordered list of shoe codes. The target value is 2.

Give the sequence of values visited to find the target value using a binary search. (3)

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
---	---	---	---	---	---	---	---	---	----	----	----	----	----	----	----	----

<b>2(d)</b>	Marks awarded for applying a 'divide and conquer' process. 9 (1) 4 or 5, 3 (1) 2 (1)	<ul style="list-style-type: none"> <li>Do not award last point alone.</li> </ul>	<b>3</b>
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2017 Paper 1 Specimen

(e) Here is some data used to represent an image. Each pixel is encoded as a character.

AADACCEFABAAEFCFGBDGE

Explain why a run-length encoding algorithm may not be appropriate for encoding this image. (2)

Question Number	Answer	Additional Guidance	Mark
<b>4(e)</b>	This sequence has very few repeated patterns (1), therefore using a RLE will not lead to a significant reduction in the file size / not compress the image very much. (1)		<b>2</b>

2017 Paper 1 Specimen

(b) State the worst case for a linear search algorithm. (1)

Question Number	Answer	Additional Guidance	Mark
<b>3(b)</b>	The target item is not in the list / is at end of the list		<b>1</b>

Paper 1 Specimen

(c) A bubble sort is carried out on this list to put it in ascending order.

8 3 2 4 0 3 9

The value '8' starts in position 0.

(i) State the number of passes required to complete the sort. (1)

Question Number	Answer	Additional Guidance	Mark
<b>3(c)i</b>	5		<b>1</b>

Paper 1 Specimen

(ii) State the number of swaps made on the final pass.

Question Number	Answer	Additional Guidance	Mark
<b>3(c)ii</b>	0		<b>1</b>

Paper 1 Specimen

(iii) State the component of an algorithm used to store whether a swap has been made during a pass.

(1)

Question Number	Answer	Additional Guidance	Mark
3(c)iii	Variable	Accept words that describe a use of variable in this case, e.g. flag	1

Paper 1 Specimen

(iv) State the position of the item that will be compared with the value in position 0. (1)

Question Number	Answer	Additional Guidance	Mark
3(c)iv	1		1

Paper 1 Specimen

(b) BubbleScore is a variable.

(i) Describe what is meant by the term variable. (2)

Question number	Answer	Mark
2 b)(i)	A named (1) storage/memory location (1)	2 (1,1)

Sample Paper 1

The variable BubbleScore stores the number of bubbles popped.

(ii) Explain which data type is most appropriate for the variable BubbleScore. (2)

Any <b>one</b> of:		
<ul style="list-style-type: none"> <li>Type integer allows only whole numbers (1)</li> <li>Integer data type allows calculations (1)</li> </ul>		

Sample Paper 1

This algorithm is designed to display the highest score.

IF HighestScore > BubbleScore THEN

    SET HighestScore to BubbleScore

ENDIF DISPLAY HighestScore

(c) Explain why this algorithm would not work as intended. (2)

2 c)	Any <b>one</b> of: Incorrect comparison (1) should be < (1) OR Replaces HighestScore with BubbleScore if BubbleScore is less than HighestScore (1) should be greater than (1)	2 (1,1)
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Sample Paper 1

(d) The array LeaderBoard is used to store the names of the five players with the highest scores. (2)

(i) Explain why an array is a suitable data structure for this purpose.

<b>2 d)(i)</b>	Because all the items in the list have the same data type (1) It is more efficient to access and process data (1)		2 (1,1)
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Sample Paper 1

Here are some of the contents of the array LeaderBoard. (1)

Ann	Josie	Cahit	Alex	Layla
-----	-------	-------	------	-------

Sample Paper 1

(ii) Give the name of the player stored in LeaderBoard [3].

<b>2 d)(ii)</b>	Alex		1 (1)
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Sample Paper 1

(c) A runner completes four laps of the track. A bubble sort algorithm is used to sort the lap times into ascending order.

Complete the table to show Pass 1 and Pass 2 of the bubble sort. (2)

Lap time (seconds)	Pass 1	Pass 2	Pass 3
48			40
40			42
47			47
42			48

Sample Paper 1

Question number	Answer	Mark																																								
<b>4 c)</b>	Correct bubble sort Pass 1 (1), Pass 2 (1):  <table border="1"> <thead> <tr> <th>Time</th> <th>Pass 1</th> <th>Pass 2</th> <th>Pass 3</th> </tr> </thead> <tbody> <tr> <td>48</td> <td>40</td> <td>40</td> <td>40</td> </tr> <tr> <td>40</td> <td>47</td> <td>42</td> <td>42</td> </tr> <tr> <td>47</td> <td>42</td> <td>47</td> <td>47</td> </tr> <tr> <td>42</td> <td>48</td> <td>48</td> <td>48</td> </tr> </tbody> </table> <p>or</p> <table border="1"> <thead> <tr> <th>Time</th> <th>Pass 1</th> <th>Pass 2</th> <th>Pass 3</th> </tr> </thead> <tbody> <tr> <td>48</td> <td>40</td> <td>40</td> <td>40</td> </tr> <tr> <td>40</td> <td>48</td> <td>42</td> <td>42</td> </tr> <tr> <td>47</td> <td>42</td> <td>48</td> <td>47</td> </tr> <tr> <td>42</td> <td>47</td> <td>47</td> <td>48</td> </tr> </tbody> </table>	Time	Pass 1	Pass 2	Pass 3	48	40	40	40	40	47	42	42	47	42	47	47	42	48	48	48	Time	Pass 1	Pass 2	Pass 3	48	40	40	40	40	48	42	42	47	42	48	47	42	47	47	48	2 (1,1)
Time	Pass 1	Pass 2	Pass 3																																							
48	40	40	40																																							
40	47	42	42																																							
47	42	47	47																																							
42	48	48	48																																							
Time	Pass 1	Pass 2	Pass 3																																							
48	40	40	40																																							
40	48	42	42																																							
47	42	48	47																																							
42	47	47	48																																							

Sample Paper 1

(c) A runner completes four laps of the track. A bubble sort algorithm is used to sort the lap times into ascending order.

Complete the table to show Pass 1 and Pass 2 of the bubble sort. (2)

Lap time (seconds)	Pass 1	Pass 2	Pass 3
48			40
40			42
47			47
42			48

Question number	Answer	Mark																																								
4 c)	Correct bubble sort Pass 1 (1), Pass 2 (1):	2 (1,1)																																								
	<table border="1"> <thead> <tr> <th>Time</th> <th>Pass 1</th> <th>Pass 2</th> <th>Pass 3</th> </tr> </thead> <tbody> <tr> <td>48</td> <td>40</td> <td>40</td> <td>40</td> </tr> <tr> <td>40</td> <td>47</td> <td>42</td> <td>42</td> </tr> <tr> <td>47</td> <td>42</td> <td>47</td> <td>47</td> </tr> <tr> <td>42</td> <td>48</td> <td>48</td> <td>48</td> </tr> </tbody> </table> <p>or</p> <table border="1"> <thead> <tr> <th>Time</th> <th>Pass 1</th> <th>Pass 2</th> <th>Pass 3</th> </tr> </thead> <tbody> <tr> <td>48</td> <td>40</td> <td>40</td> <td>40</td> </tr> <tr> <td>40</td> <td>48</td> <td>42</td> <td>42</td> </tr> <tr> <td>47</td> <td>42</td> <td>48</td> <td>47</td> </tr> <tr> <td>42</td> <td>47</td> <td>47</td> <td>48</td> </tr> </tbody> </table>	Time	Pass 1	Pass 2	Pass 3	48	40	40	40	40	47	42	42	47	42	47	47	42	48	48	48	Time	Pass 1	Pass 2	Pass 3	48	40	40	40	40	48	42	42	47	42	48	47	42	47	47	48	
Time	Pass 1	Pass 2	Pass 3																																							
48	40	40	40																																							
40	47	42	42																																							
47	42	47	47																																							
42	48	48	48																																							
Time	Pass 1	Pass 2	Pass 3																																							
48	40	40	40																																							
40	48	42	42																																							
47	42	48	47																																							
42	47	47	48																																							

Paper 1

### Truth and Trace Tables

- (c) A player earns a badge for every 100 questions they answer correctly, providing this includes at least 10 hard questions or 30 medium questions. This can be expressed as  $(NQ \geq 100)$  and  $(HQ \geq 10 \text{ or } MQ \geq 30)$ . Complete the truth table. (6)

$NQ \geq 100$	$HQ \geq 10$	$MQ \geq 30$	$HQ \text{ or } MQ$	$NQ \text{ and } (HQ \text{ or } MQ)$
0	0	0	0	
0	1	0		0
0	0	1	1	
0	1	1	1	0
1	0	0		0
1	1	0	1	
1	0	1	1	
1	1	1	1	1

(Total for Question 1 = 13 marks)

Question Number	Answer	Additional Guidance	Mark																		
1(c)	One mark for each correct cell. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>HQ or MQ</th> <th>NQ and (HQ or MQ)</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td></tr> <tr><td>1</td><td>0</td></tr> <tr><td>1</td><td>0</td></tr> <tr><td>0</td><td>0</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td></tr> </tbody> </table>	HQ or MQ	NQ and (HQ or MQ)	0	0	1	0	1	0	1	0	0	0	1	1	1	1	1	1	Award alternative representations of 0 and 1: 0 = OFF / FALSE / NO 1 = ON / TRUE / YES	6
HQ or MQ	NQ and (HQ or MQ)																				
0	0																				
1	0																				
1	0																				
1	0																				
0	0																				
1	1																				
1	1																				
1	1																				

14 May 2018

2 P-Cubed sorts items by their address codes. This is pseudo-code for an algorithm that forwards items to regional depots.

```

2 IF (code[0] >= "A" AND code[0] <= "I") THEN
3   SEND "Midlands depot" TO DISPLAY
4 ELSE
5   IF (code[0] >= "J" AND code[0] <= "R") THEN
6     SEND "South depot" TO DISPLAY
7   ELSE
8     IF (code[0] >= "S" AND code[0] <= "Z") THEN
9       SEND "North depot" TO DISPLAY
10    ELSE
11      SEND "Unknown code" TO DISPLAY
12    END IF
13  END IF
14 END IF

```

(b) Complete the table to show the output of the algorithm for the given inputs. (3)

Code	Output displayed
QB7698RI	
VA2288ZA	
4W56AB92	

Question Number	Answer	Additional Guidance	Mark
2 (a)	In this exact order: <ul style="list-style-type: none"> <li>• South depot / South (1)</li> <li>• North depot / North (1)</li> <li>• Unknown code / Unknown (1)</li> </ul>	Ignore spelling Ignore extraneous text after a correct response	3

17 May 2018

(b) Complete this truth table.

A	B	NOT (A OR B)
1	1	
0		0
		1
1	0	

Question Number	Answer	Additional Guidance	Mark									
4(b)	1 mark for each correct row. <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>A</th> <th>B</th> <th>NOT (A OR B)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> </tr> </tbody> </table>	A	B	NOT (A OR B)	1	1	0	0	1	0		4
A	B	NOT (A OR B)										
1	1	0										
0	1	0										

		0	0	1		
		1	0	0		

11 May 2020

(b) Here is an algorithm.

```

1  myNumber = 0
2
3  myNumber = int (input ("Enter a whole number between 1 and 100:"))
4
5  if (myNumber < 1):
6      print ("Too low")
7  elif (myNumber > 100):
8      print ("Too high")
9  elif (myNumber % 10 == 0):
10     print ("Nice round number")
11  elif (myNumber == 100):
12     print ("That's the biggest number")
13  else:
14     print ("Good choice")

```

Complete the table to show the output for the given input. (4)

Input	Output
200	
33	
100	
0	

Question Number	Answer	Additional Guidance	Mark										
<b>2(c)</b>	One for each correct cell.  <table border="1"> <thead> <tr> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>200</td> <td>Too high (1)</td> </tr> <tr> <td>33</td> <td>Good choice (1)</td> </tr> <tr> <td>100</td> <td>Nice round number (1)</td> </tr> <tr> <td>0</td> <td>Too low (1)</td> </tr> </tbody> </table>	Input	Output	200	Too high (1)	33	Good choice (1)	100	Nice round number (1)	0	Too low (1)	<ul style="list-style-type: none"> <li>Ignore spelling</li> </ul>	<b>4</b>
Input	Output												
200	Too high (1)												
33	Good choice (1)												
100	Nice round number (1)												
0	Too low (1)												

September 2020

Manuel is working on logic for an exclusive OR operator, often known as XOR. This logical operator can be implemented using AND, OR, and NOT.

(iii) Complete this truth table to show Q. (3)

A	B	R = A OR B	S = NOT (A AND B)	Q = R AND S
0	0			
0	1			
1	0			
1	1			

Question Number	Answer	Additional Guidance	Mark																									
<b>4 (c)(iii)</b>	One mark for each correct column  <table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>R = A OR B</th> <th>S=NOT(A AND B)</th> <th>Q=R AND S</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>1</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>0</td> <td>0</td> </tr> </tbody> </table>	A	B	R = A OR B	S=NOT(A AND B)	Q=R AND S	0	0	0	1	0	0	1	1	1	1	1	0	1	1	1	1	1	1	0	0		<b>3</b>
A	B	R = A OR B	S=NOT(A AND B)	Q=R AND S																								
0	0	0	1	0																								
0	1	1	1	1																								
1	0	1	1	1																								
1	1	1	0	0																								

8 June 2016

(g) Construct a truth table for a NOT operator that is used to reverse the state of a single light. Use any familiar notation.

Question Number	Answer	Additional Guidance	Mark						
<b>1(g)</b>	<ul style="list-style-type: none"> <li>Table or any other suitable notation</li> </ul> <table border="1"> <thead> <tr> <th>Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> </tr> </tbody> </table> <ul style="list-style-type: none"> <li>NOT (0) == 1</li> <li>NOT (1) == 0</li> </ul>	Input	Output	0	1	1	0		<b>1</b>
Input	Output								
0	1								
1	0								

3 June 2015

(h) Refer to the robot diagram. Assume R is the red light, B is the blue light, and S is the speaker switch.

(i) Complete the table to show the Boolean expression  $Q = (\text{NOT } R) \text{ AND } B$ . (3)

R	B	NOT R	Q
0	0		
0	1		
1	0		
1	1		

Question Number	Answer	Additional Guidance	Mark										
1(h)(i)	<ul style="list-style-type: none"> <li>NOT R column correct = 1 mark</li> <li>First 2 rows correct of Q = 1 mark</li> <li>Last 2 rows of Q = 1 mark</li> </ul> <table border="1"> <thead> <tr> <th>NOT R</th> <th>Q</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0</td> </tr> <tr> <td>1</td> <td>1</td> </tr> <tr> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>0</td> </tr> </tbody> </table>	NOT R	Q	1	0	1	1	0	0	0	0		3
NOT R	Q												
1	0												
1	1												
0	0												
0	0												

3 June 2015

(ii) Construct a Boolean expression to determine if either light is on at the same time as the speaker switch is on. (1)

Question Number	Answer	Additional Guidance	Mark
1(h)(ii)	<ul style="list-style-type: none"> <li><math>Q = (R \text{ OR } B) \text{ AND } S</math></li> <li>Alternative correct solutions should be awarded e.g.                             <ul style="list-style-type: none"> <li>(R AND S) OR (B AND S)</li> <li>R AND S OR B AND S – works by order of precedence</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Q = not required</li> <li>Accept correct transpositions</li> <li>Order of precedence is (); NOT; AND; OR</li> </ul>	1

3 June 2015

(h) Audio interviews with the club's coach are converted to a digital format.

(i) State the aspect of the analogue signal that must be sampled and stored as binary data during the analogue to digital conversion. (1)

Question Number	Answer	Additional Guidance	Mark
3(h)(i)	Amplitude		1

3 June 2015

(ii) State how increasing the sampling frequency affects the digital representation of the original audio. (1)

Question Number	Answer	Additional Guidance	Mark
3(h)(ii)	Any one of the following – 1 mark <ul style="list-style-type: none"> <li>(The more samples,) the smoother the digital representation of the original audio.</li> <li>(Higher sampling rates) result in less distortion of the original audio</li> <li>This makes the resulting digital representation more accurately match the original audio.</li> </ul>	<ul style="list-style-type: none"> <li>Do not award "better", "better quality", or similar</li> </ul>	1

(i) The club has a simple black and white logo. The image is compressed using a lossless, run-length encoding (RLE) algorithm.

Question Number	Answer	Additional Guidance	Mark
3(i)	<p>Must have idea of <b>runs</b> (1) being compressed to <b>a single item + a count</b> of that item (1)</p> <p>Example:</p> <p>Simple mono-chrome icon will have long sequences of bits of same colour (1)</p> <p>Sequences/runs of identical data are translated/stored as a single data value and a count (1)</p>		2

Explain how a run-length encoding algorithm works. (2)

(c) Complete the trace table to find an error in the algorithm. (2)

b	f	i	anArray[i]	c
75	FALSE	0		-1

Question Number	Answer	Additional Guidance	Mark																																																																	
5(c)	<ul style="list-style-type: none"> <li>1 mark = 0-5 sequence under column i</li> <li>1 mark = 78, 83, 72, 80, 83 sequence under column anArray[i]</li> </ul> <table border="1"> <thead> <tr> <th>b</th> <th>f</th> <th>i</th> <th>anArray[i]</th> <th>c</th> </tr> </thead> <tbody> <tr> <td>75</td> <td>FALSE</td> <td>0</td> <td></td> <td>-1</td> </tr> <tr> <td></td> <td></td> <td></td> <td>78</td> <td></td> </tr> <tr> <td></td> <td></td> <td>1</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>83</td> <td></td> </tr> <tr> <td></td> <td></td> <td>2</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>72</td> <td></td> </tr> <tr> <td></td> <td></td> <td>3</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>80</td> <td></td> </tr> <tr> <td></td> <td></td> <td>4</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>83</td> <td></td> </tr> <tr> <td></td> <td></td> <td>5</td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>	b	f	i	anArray[i]	c	75	FALSE	0		-1				78				1						83				2						72				3						80				4						83				5									2
b	f	i	anArray[i]	c																																																																
75	FALSE	0		-1																																																																
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		1																																																																		
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		3																																																																		
			80																																																																	
		4																																																																		
			83																																																																	
		5																																																																		

3 June 2015

(d) There is a bug in line 9. Write a line of code that will fix this bug. (1)

Question Number	Answer	Additional Guidance	Mark
5(d)	<ul style="list-style-type: none"> <li>Examples: <ul style="list-style-type: none"> <li>WHILE ((NOT f) AND (i &lt; LENGTH (anArray))) DO</li> <li>WHILE (NOT f) AND (i &lt; 5) DO</li> <li>WHILE (f = FALSE) AND (i &lt; 5) DO</li> <li>WHILE (NOT f) AND i &lt; 5 DO</li> <li>WHILE NOT f AND i &lt; 5 DO</li> <li>WHILE (i &lt; LENGTH (anArray)) DO</li> </ul> </li> </ul>	<ul style="list-style-type: none"> <li>Any sensible pseudocode is awardable</li> <li>Brackets not required</li> <li>Accept &lt;= in place of &lt;</li> </ul>	1

3 June 2015

(e) State the purpose of the algorithm. (1)

Question Number	Answer	Additional Guidance	Mark
5(e)	<p>Any one of:</p> <ul style="list-style-type: none"> <li>Finding the <b>location</b> of a target number in an array</li> <li>Finding the <b>position</b> of a number in an array</li> </ul>	<ul style="list-style-type: none"> <li>"Finding a number in an array" is not awardable.</li> <li>The idea of location is important because of the <b>return</b> statement value</li> </ul>	1

3 June 2015

(f) Truth tables are used to show how digital output relates to input. Complete the truth table for the AND and OR statements. (1)

AND			OR		
Input		Output	Input		Output
0	0	0	0	0	0
0	1		0	1	
1	0		1	0	1
1	1	1	1	1	

Question Number	Answer	Additional Guidance	Mark																																				
1(f)	<p>All correct as they appear in the table (1)</p> <table border="1"> <thead> <tr> <th colspan="3">AND</th> <th colspan="3">OR</th> </tr> <tr> <th colspan="2">Input</th> <th>Output</th> <th colspan="2">Input</th> <th>Output</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> <td>0</td> </tr> <tr> <td>0</td> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>1</td> </tr> <tr> <td>1</td> <td>0</td> <td>0</td> <td>1</td> <td>0</td> <td>1</td> </tr> <tr> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> <td>1</td> </tr> </tbody> </table>	AND			OR			Input		Output	Input		Output	0	0	0	0	0	0	0	1	0	0	1	1	1	0	0	1	0	1	1	1	1	1	1	1		1
AND			OR																																				
Input		Output	Input		Output																																		
0	0	0	0	0	0																																		
0	1	0	0	1	1																																		
1	0	0	1	0	1																																		
1	1	1	1	1	1																																		

2017 Paper 1 Specimen

(e) Complete this truth table. (3)

A	B	C	(A AND B)	(NOT C)	(A AND B) OR (NOT C)
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

A	B	C	(A AND B)	(NOT C)	(A AND B) OR (NOT C)
0	0	0	0	1	1
0	0	1	0	0	0
0	1	0	0	1	1
0	1	1	0	0	0
1	0	0	0	1	1
1	0	1	0	0	0
1	1	0	1	1	1
1	1	1	1	0	1

Paper 1 Specimen

(d) The baby alarm system monitors heart rate, temperature and movement. These are Boolean variables that are set to 0 when the values are within safe limits and 1 when they are outside safe limits.

The microcontroller monitors the readings and sounds an alarm if any two of the readings are outside safe limits.

(i) Give the logic statement the microcontroller uses to determine if the alarm should be sounded. (2)

<b>3 d)(i)</b>	Alarm = (Heart Rate AND Temperature) OR (Heart Rate AND Movement) OR (Temperature AND Movement)		2 (2/1)
	With one minor error in the logic award a maximum of 1 mark, providing answer demonstrates at least one correct use of logical OR and logical AND between pairs.		

Sample Paper 1

(ii) Complete the truth table for this logic statement. (2)

INPUTS			OUTPUT
Heart Rate	Temperature	Movement	Alarm

Question number	Answer	Mark
3 d)(ii)	<b>INPUTS</b>	<b>OUTPUT</b>
	<b>HeartRate    Temp    Movement    Alarm</b>	
	0            0            0            0	
	0            0            1            0	
	0            1            0            0	
	0            1            1            1	
	1            0            0            0	
	1            0            1            1	
	1            1            0            1	
	1            1            1            1	
	Award a maximum of 1 mark if input values for three sensors are not all correct but Alarm values are correct for stated inputs.	2 (2/1)

Sample Paper 1

The table shows the binary values stored in two registers, R4 and R5. (1)

Register	Binary value
R4	0100 1001
R5	0010 1010

(iii) The microcontroller's processor executes the command ADD R6, R4, R5.

State the binary value that would be stored in register R6 when this command is executed.

<b>3 b)(iii)</b>	0111 0011 (1)	1 (1)
------------------	---------------	-------

Paper 1

(ii) Complete the truth table for this logic statement. (2)

INPUTS			OUTPUT
Heart Rate	Temperature	Movement	Alarm

Question number	Answer	Mark																																								
3 d)(ii)	<table border="1"> <thead> <tr> <th colspan="3">INPUTS</th> <th>OUTPUT</th> </tr> <tr> <th>HeartRate</th> <th>Temp</th> <th>Movement</th> <th>Alarm</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table>	INPUTS			OUTPUT	HeartRate	Temp	Movement	Alarm	0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	1	1	0	0	0	1	0	1	1	1	1	0	1	1	1	1	1	2 (2/1)
	INPUTS			OUTPUT																																						
	HeartRate	Temp	Movement	Alarm																																						
	0	0	0	0																																						
	0	0	1	0																																						
	0	1	0	0																																						
	0	1	1	1																																						
	1	0	0	0																																						
	1	0	1	1																																						
	1	1	0	1																																						
1	1	1	1																																							
Award a maximum of 1 mark if input values for three sensors are not all correct but Alarm values are correct for stated inputs.																																										

Paper 1

### Validation and Testing

The form validates telephone numbers to make sure they are fit for processing. An example of correctly entered data is 01745920043.

All telephone numbers begin with a 0.

(c) State two different validation checks that could be used to validate the telephone numbers. Provide one example of test data for each type of check to show the error is caught. (4)

Type of Check	Test Data

Question Number	Answer	Additional Guidance	Mark
4(c)	<p>Any four of:</p> <ul style="list-style-type: none"> <li>• Phone can be located if reported stolen</li> <li>• Parents can track where their children are</li> <li>• Convicted law breakers can be tracked</li> <li>• Dementia patients can be located if they wander from home</li> <li>• Employees could track movement of employees, like delivery drivers</li> <li>• Emergency services can find you, even if you can't talk on the phone</li> <li>• Movements tied to other systems such as transport to be used as input to traffic control algorithms</li> <li>• Can be offered services/information relevant to location</li> <li>• Data may be collected and stored</li> <li>• Use of information may be seen as an invasion of privacy</li> <li>• Is it ethical to track vulnerable people (children, dementia)?</li> <li>• Is it ethical to track law breakers (sex offenders, parolees)?</li> <li>• Who should be allowed access to the collected position data?</li> <li>• Could law enforcement be granted automatic access or should they need a court order?</li> <li>• Employees, with a mobile phone, would still be tracked even when they weren't working for the company (evenings, holidays)</li> </ul>	<p>Any other appropriate advantage is awardable.</p> <p>Any other appropriate concern alluding to ethics or privacy.</p>	4

Sample Paper 2

(iii) The user enters the value for tax rate on line 35. Tax is a percentage, for example, 0.03 is 3% tax. The entered value needs to be validated.

Construct two validation tests. Test data for Test 1 is provided.

Give an example of invalid test data for Test 2. (3)

Question Number	Answer	Additional Guidance	Mark												
6(b)(iii)	<p>One mark for each correct validation test (1) maximum of 2. One mark for each appropriate corresponding test data (1) maximum of 1.</p> <p>The mark for test data identified must be linked with the associated data validation test.</p> <p>Note: inTax must be between 0 and 1. For example, 0.03 is 3% tax. Example</p> <table border="1"> <thead> <tr> <th>Validation test</th> <th>Test data</th> </tr> </thead> <tbody> <tr> <td>rateTax &gt;= 0</td> <td>-0.03</td> </tr> <tr> <td>rateTax &lt;= 1</td> <td>0.12</td> </tr> <tr> <td>Presence check</td> <td>"" / null / empty string</td> </tr> <tr> <td>Type check</td> <td>ABC</td> </tr> <tr> <td>Range check &gt;= 0 AND &lt;= 1 / 1.00</td> <td>1.55</td> </tr> </tbody> </table>	Validation test	Test data	rateTax >= 0	-0.03	rateTax <= 1	0.12	Presence check	"" / null / empty string	Type check	ABC	Range check >= 0 AND <= 1 / 1.00	1.55	<ul style="list-style-type: none"> <li>• Do not penalise syntax</li> <li>• Accept appropriate alternative values for the test data</li> </ul>	3
Validation test	Test data														
rateTax >= 0	-0.03														
rateTax <= 1	0.12														
Presence check	"" / null / empty string														
Type check	ABC														
Range check >= 0 AND <= 1 / 1.00	1.55														

16 May 2019

## Unit 2 - Data

### ASCII & Unicode

(b) Computer science uses different types of data representation.

The ASCII code for the character “K” is 75 in denary.

(i) State the ASCII code for “N” in denary. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(b) (i)</b>	78		<b>1</b>

Sample Paper 2

(h) Here is a sequence of text.

The quick brown fox jumps over the lazy dog 素早い茶色  
の狐が怠惰な犬を飛び越えます

Explain why 7-bit ASCII could not be used to represent this text. (2)

Question Number	Answer	Additional Guidance	Mark
<b>3(h)</b>	<p>An explanation to include:</p> <p>ASCII only represents English characters / Kana/hiragana cannot be represented in ASCII (1) because there are not enough bits (1)</p> <p>With just 7 bits, only 128 unique codes (1) can be generated, which is not enough (1) to represent all the characters used in the written languages of the world</p> <p>The text has foreign characters (1) and there are not enough bits (1) in ASCII to represent them</p>		<b>2</b>

September 2020

(d) The ASCII code for the character ‘R’ is 82 in denary.

Derive the ASCII code for the character ‘D’ in 8-bit binary. (2)

Question Number	Answer	Additional Guidance	Mark
<b>1(d)</b>	<p>One from :</p> <ul style="list-style-type: none"> <li>• 68</li> <li>• 82 – 14</li> <li>• R – D</li> <li>• 18 – 4</li> </ul> <p>Plus</p> <ul style="list-style-type: none"> <li>• 0100 0100</li> </ul>	Final conversion must be expressed in 8 bits.	<b>2</b>

13 May 2019

(e) Explain why the car park system encrypts the data it stores. (2)

Question Number	Answer data	Additional Guidance	Mark
<b>1(e)</b>	To prevent unauthorised reading/use/analysis/understanding (1) of sensitive/payment/personal/customer data (1)	Do not accept unauthorised <b>access</b> for first mark.	<b>2</b>

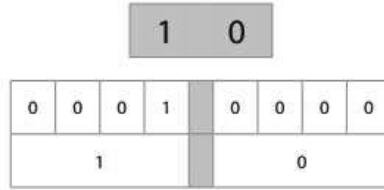
13 May 2019

### Binary

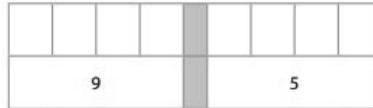
3. An alarm system sensor embedded in a baby’s clothing is used to measure its heart rate. (a) A digital display shows the baby’s heart rate in beats per minute (bpm).

Each digit in the display is represented as a 4-bit binary code.

For example:



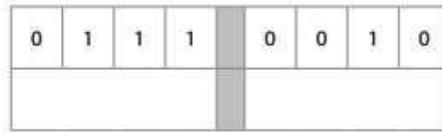
(i) Complete the table to show how a heart rate of 95 bpm is represented. (1)



Question number	Answer	Mark
<b>3 a)(i)</b>	1001 0101	1 (1)

Paper 1

(ii) Complete the table to show what heart rate is being displayed. (1)



<b>3 a)(ii)</b>	72	1 (1)
-----------------	----	-------

Paper 1

(iii) The binary number 0110 1110 is stored in a memory location. State the hexadecimal representation of this binary number. (1)

<b>3 c)(iii)</b>	6E	1 (1)
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Paper 1

(d) The baby alarm system monitors heart rate, temperature and movement. These are Boolean variables that are set to 0 when the values are within safe limits and 1 when they are outside safe limits.

The microcontroller monitors the readings and sounds an alarm if any two of the readings are outside safe limits.

(i) Give the logic statement the microcontroller uses to determine if the alarm should be sounded. (2)

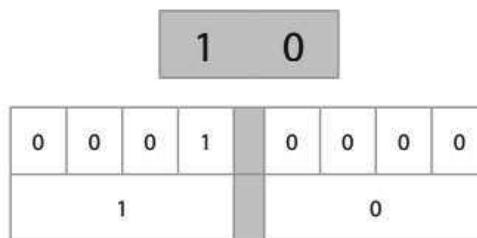
<b>3 d)(i)</b>	Alarm = (Heart Rate AND Temperature) OR (Heart Rate AND Movement) OR (Temperature AND Movement)  With one minor error in the logic award a maximum of <b>1</b> mark, providing answer demonstrates at least one correct use of logical OR and logical AND between pairs.		2 (2/1)
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Paper 1

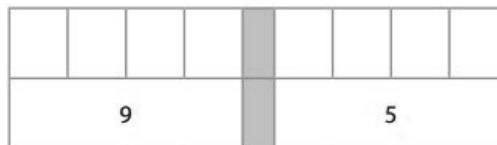
3. An alarm system sensor embedded in a baby's clothing is used to measure its heart rate. (a) A digital display shows the baby's heart rate in beats per minute (bpm).

Each digit in the display is represented as a 4-bit binary code.

For example:



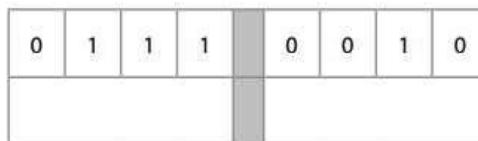
(i) Complete the table to show how a heart rate of 95 bpm is represented. (1)



Question number	Answer	Mark
<b>3 a)(i)</b>	1001 0101	1 (1)

Sample Paper 1

(ii) Complete the table to show what heart rate is being displayed. (1)



<b>3 a)(ii)</b>	72	1 (1)
-----------------	----	-------

Sample Paper 1

1. Computer scientists use numbers and mathematics in many areas, such as data representation, data transmission, and algorithms.

(a) (i) State the number of bits in a byte. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(i)</b>	8		<b>1</b>

Sample Paper 2

(ii) Write an expression to calculate how many different numbers can be represented by an 8-bit binary number. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(ii)</b>	$2^8$ $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$ $2^4 \times 2^4$	Do not award the single number 256; the question asks for an expression.	<b>1</b>

Sample Paper 2

(iii) State the number of bytes in these units. (2)

- Kilobyte
- Megabyte

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(iii)</b>	1024, $2^{10}$ 1024 x 1024, $1024^2$ , 1048576, $2^{20}$		<b>2</b>

Sample Paper 2

(iv) Write an expression to calculate the number of bytes in a gigabyte. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(iv)</b>	$\frac{1024 \text{ bytes}}{KB} \times \frac{1024 \text{ KB}}{MB} \times \frac{1024 \text{ MB}}{GB}$ $1024 \times 1024 \times 1024$ $1024^3$ $2^{10} \times 2^{10} \times 2^{10}$ $2^{30}$ $(2^{10})^3$ Other correct mathematical expressions should be awarded		<b>1</b>

Sample Paper 2

Computers use sequences of binary digits to represent data.

(v) State one other item that computers use binary to represent. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(v)</b>	Instructions		<b>1</b>

Sample Paper 2

4. Binary strings can be used to represent numbers, text, and images.

(a) Identify the binary system used to represent text. (1)

- A IMAP
- B URL
- C ASCII
- D RLE

Question Number	Answer	Additional Guidance	Mark
4(a)	C - ASCII (1)		1

2017 Paper 1 Specimen

(c) Charles is preparing to write program code.

(i) Complete the table to show the place value of the 1s to the right of the decimal in this binary real number. (3)

Place value	4	2	1	.					
	0	1	0	.	1	1	0	0	0

Convert this binary real number to denary.

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	First box = $\frac{1}{2}$ or equivalent expression for 1 mark / 0.5 Second box = $\frac{1}{4}$ or equivalent expression for 1 mark / 0.25 Conversion = $2\frac{3}{4}$ or equivalent expression for 1 mark / 2.75		3

8 June 2016

(ii) State the number of bits in a nibble. (1)

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	4		1

8 June 2016

(iv) Write an arithmetic expression to show that 256 different numbers can be represented in 8 bits. (1)

Question Number	Answer	Additional Guidance	Mark
1(c)(iv)	Any one of: <ul style="list-style-type: none"> <li>• <math>2^n</math> and <math>n=8</math></li> <li>• <math>2^8</math></li> <li>• <math>2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2</math></li> <li>• <math>2^4 \times 2^4</math></li> <li>• <math>2^2 \times 2^2 \times 2^2 \times 2^2</math></li> <li>• Any other appropriate formula giving a result of 256</li> </ul>		1

8 June 2016

2. A car has many embedded systems.

(a) An embedded system processes binary numbers.

(i) The speed limit for some roads is 60 miles per hour. Convert the denary number 60 to 8-bit binary. (2)

Question Number	Answer	Additional Guidance	Mark
2(a)(i)	One mark for each correct nibble (4-bits) in the correct position. <ul style="list-style-type: none"> <li>• 0011 1100</li> </ul>	<ul style="list-style-type: none"> <li>• Leading 0s required</li> </ul>	2

14 May 2018

(ii) The car displays speed limits in denary. Convert the 8-bit binary number 0010 0011 to denary. (2)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	One mark for each correct digit in the right position. <ul style="list-style-type: none"><li>• 35</li></ul>		2

14 May 2018

(d) Identify the number of bits in a nibble. (1)

- A 2
- B 4
- C 8
- D 16

Question Number	Answer	Additional Guidance	Mark
3(d)	B – 4		1

11 May 2020

7. A computer operates as a binary digital device.

(a) Explain why binary is used to represent computer data. (2)

Question Number	Answer	Additional Guidance	Mark
7(a)	An explanation to include <b>two</b> from:  Binary can represent two states (1) because computer circuits use transistors, which can either be on or off (1)		2

11 May 2020

1. (b) (ii) A bit can have two different states. State how many bits are needed to represent the 26 capital letters A to Z. Give a reason for your answer. (2)

- Number of bits
- Reason

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	5-bits are needed. (1)  And one from: <ul style="list-style-type: none"><li>• Because 4-bits / <math>2^4</math> only represents 16 values (1)</li><li>• Because 5-bits / <math>2^5</math> represent up to 32 values (1)</li></ul>		2

14 May 2018

(a) Complete the table. (2)

Base	Number of values per digit
Binary	
	16

Question Number	Answer	Additional Guidance	Mark						
<b>3(a)</b>	One mark for each correct cell <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Base</th> <th>Number of values per digit</th> </tr> </thead> <tbody> <tr> <td>Binary</td> <td>2</td> </tr> <tr> <td>Hexadecimal</td> <td>16</td> </tr> </tbody> </table>	Base	Number of values per digit	Binary	2	Hexadecimal	16	<ul style="list-style-type: none"> <li>Ignore spelling</li> </ul>	<b>2</b>
Base	Number of values per digit								
Binary	2								
Hexadecimal	16								

September 2020

(b) Identify the reason why data capacity should be expressed in gibibytes rather than gigabytes. (1)

A Gibibytes are consistent with the units used for data transmission

B Gibibytes represent binary multiples

C More data can be represented in gibibytes

D Processors have to carry out fewer operations when using gibibytes

Question Number	Answer	Additional Guidance	Mark
<b>3(b)</b>	B Gibibytes represent binary multiples  <i>A is not correct because Gigabits are consistent with the units used for data transmission</i> <i>C is not correct because more data cannot be represented in gibibytes</i> <i>D is not correct because processors do not have to carry out fewer operations when using gibibytes</i>		<b>1</b>

September 2020

(c) Convert the denary number 82 to 8-bit binary. (2)

Question Number	Answer	Additional Guidance	Mark
<b>3(c)</b>	1 mark for each nibble 0101 0010		<b>2</b>

September 2020

1. A car park uses a number plate recognition system.

(a) Identify the reason why unsigned integers should be used to record the number of cars entering and leaving the car park, rather than signed integers. (1)

A Unsigned integers are more accurate

B Unsigned integers cannot have overflow errors

C Unsigned integers store more positive values

D Unsigned integers do not use a parity bit

Question Number	Answer	Additional Guidance	Mark
1(a)	<p>C Unsigned integers store more positive values</p> <p><b>The only correct answer is C</b></p> <p>A is not correct because unsigned integers are not more accurate</p> <p>B is not correct because overflow errors can still occur with unsigned integers</p> <p>D is not correct because the use of a parity bit is not relevant to the scenario.</p>		1

13 May 2019

(b) The system uses a hard disc to store images of car number plates. One kilobyte is 1024 bytes. Construct an expression that calculates how many bytes there are in four terabytes of disc storage. You do not need to carry out the calculation. (2)

Question Number	Answer	Additional Guidance	Mark
1(b)	<p>Award <b>one</b> mark for sight of either <math>1024^4</math> <b>OR</b> <math>\times 4</math></p> <p>Award <b>both</b> marks for a correct expression including <math>1024^4</math> <b>AND</b> <math>\times 4</math> (with nothing else) e.g. <math>1024^4 \times 4</math></p> <p>Accept for <math>1024^4</math> any equivalent showing understanding that 1 terabyte is <math>2^{40}</math> bytes e.g.</p> <ul style="list-style-type: none"> <li><math>1024 \times 1024 \times 1024 \times 1024</math> (bytes)</li> <li><math>2^{10} \times 2^{10} \times 2^{10} \times 2^{10}</math> (bytes)</li> <li>1,099,511,627,776 (bytes)</li> </ul> <p>Award <b>both</b> marks for 4,398,046,511,104 (bytes).</p>	Equivalent expressions are awarded.	2

13 May 2019

### Binary Addition and Subtraction

(f) (i) Add these two 8-bit binary integers and write the result in the last row of this table.

0	1	0	1	0	1	1	0
0	0	1	0	1	0	1	1

Question Number	Answer	Additional Guidance	Mark								
1(f)(i)	<table border="1"> <tbody> <tr> <td>1</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td><td>1</td> </tr> </tbody> </table>	1	0	0	0	0	0	0	1		1
1	0	0	0	0	0	0	1				

3 June 2015

(b) Explain the concept of overflow in relation to binary addition. (2)

Question Number	Answer	Additional Guidance	Mark
4(b)	<p>An explanation that makes reference to the following point:</p> <p>Overflow is the result of a binary addition where the sum exceeds the word length of the CPU / computer / maximum number of bits the CPU can process at one time / available storage space. (1)</p> <p>Plus one from:</p> <p>The computer ignores the overflow digit. (1) This could cause errors in further calculations. (1)</p>		2

2017 Paper 1 Specimen

Another 8-bit addition generates an overflow error.

(ii) State what is meant by the term overflow error. (1)

Question Number	Answer	Additional Guidance	Mark
1(f)(ii)	<ul style="list-style-type: none"> <li>The result of the calculation cannot fit into the size of the location assigned to hold it</li> <li>Two 8-bit numbers added together resulted in a number that could not be stored in 8 bits</li> <li>The addition resulted in a number <math>\geq 1\ 0000\ 0000</math> binary (note the overflow out of the destination field)</li> <li>The result is <math>&gt;255</math></li> <li>The result needs 9-bits to store it</li> </ul>	Do not accept - the number is too big - without further explanation	1

3 June 2015

(iii) State what happens if the overflow error is ignored and the result is used in other calculations. (1)

Question Number	Answer	Additional Guidance	Mark
1(f)(iii)	<ul style="list-style-type: none"> <li>Introduces errors in subsequent calculations</li> <li>Compounds errors in subsequent calculations; snowballs</li> <li>Signed numbers may change sign</li> <li>Any indication that arithmetic performed on inaccurate calculated numbers results in subsequent inaccurate results</li> </ul>	<ul style="list-style-type: none"> <li>Ignore examples</li> </ul>	1

3 June 2015

(iii) The embedded system adds numbers in binary. Complete the table to show the result of  $0010\ 0011 + 0100\ 1010$  (2)

0	0	1	0	0	0	1	1
0	1	0	0	1	0	1	0

Question Number	Answer	Additional Guidance	Mark
2(a)(iii)	<p>One mark for each correct nibble (4-bits) in the correct position.</p> <ul style="list-style-type: none"> <li>0110 1101</li> </ul>	<ul style="list-style-type: none"> <li>Leading 0s required</li> </ul>	2

14 May 2018

(b) 8-bit two's complement is used to represent the denary numbers -8 and -1. Complete the table to show the binary addition on these two negative numbers. (2)

-8								
-1								
Result								

Question Number	Answer	Additional Guidance	Mark
7(b)	1 1 1 1 1 0 0 0		2
	1 1 1 1 1 1 1 1		
	1 1 1 1 0 1 1 1		
Award <b>one</b> mark for first two rows being correct. Award <b>both</b> marks if last row is correct			

11 May 2020

(c) Explain why it is not possible to apply two's complement to the 8-bit unsigned integer 1111 1101. (2)

Question Number	Answer	Additional Guidance	Mark
7(c)	An explanation such as: A two's complement of an 8-bit number can only represent positive integers up to 127 (1) because the rest of the bit combinations (with the most significant bit as '1') represent negative integers (1)		2

11 May 2020

(g) Complete the table to show the result of the 8-bit binary addition. (2)

0	1	0	0	0	0	0	1
0	1	1	0	0	1	1	0

Question Number	Answer	Additional Guidance	Mark
3(g)	One mark for each nibble  1010 0111		2

September 2020

(c) Binary numbers are used to represent data in programs.

(i) Complete the table by adding these two positive 8-bit binary integers. (1)

0	1	1	1	0	0	1	0
0	0	1	0	0	0	1	1

Question Number	Answer	Additional Guidance	Mark
<b>1(c)(i)</b>	1001 0101		<b>1</b>

8 June 2016

5. Computers carry out mathematical operations.

(a) Give the result of applying a logical shift left by 2 to the 8-bit binary pattern 00110110. (1)

Question Number	Answer	Additional Guidance	Mark
<b>5(a)</b>	1101 1000		<b>1</b>

13 May 2019

### Compression

A lossless, run length encoding (RLE) algorithm is used to compress the images.

This table shows some of the data for an image.

r	r	r	r	b	b	r	y	y	y
---	---	---	---	---	---	---	---	---	---

(ii) Apply RLE to the data and give the result. (2)

<b>1 b)(ii)</b>	Any <b>one</b> of: <ul style="list-style-type: none"> <li>• R4B2R1Y3</li> <li>• R4B2RY3</li> <li>• 4R2BR3Y</li> <li>• 4R2B1R3Y</li> </ul> With one incorrect character or digit award a maximum of <b>1</b> mark.		<b>2 (2/1)</b>
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Paper 1

A lossy compression algorithm could be applied to the image data.

One feature of lossy compression is that it reduces the file size.

(c) Give two other features of lossy compression. (2)

<b>1 c)</b>	Any <b>two</b> of: <ul style="list-style-type: none"> <li>• Not all pixels are recorded</li> <li>• Quality/detail reduced</li> <li>• Only suitable when images have lots of the same pixels</li> <li>• Cannot reproduce original using the lossy data</li> </ul>		<b>2 (1,1)</b>
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Paper 1

(d) (i) State one characteristic of a lossy compression algorithm. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(d)(i)</b>	Any one of the following: <ul style="list-style-type: none"> <li>Data is permanently lost (during the compression process)</li> <li>Resolution is lost in images, (usually where it will not be noticed by the human eye)</li> <li>Signal is degraded in audio files, (usually not noticeable to the human ear)</li> </ul>	Accept answers that indicate a loss of quality	<b>1</b>

8 June 2016

The photographer sends a message which is encrypted using a Caesar cipher algorithm.

(d) (i) Outline how a Caesar cipher algorithm works. (2)

<b>1 d)(i)</b>	Each character is shifted in the alphabet (1) by a fixed number of positions (1)		<b>2 (1,1)</b>
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Sample Paper 1

(ii) Part of the encrypted text is PEA. Complete the table to show the original text. (2)

Encrypted text	P	E	A
Original text	L		

<b>1 d)(ii)</b>	E - A (1), A - W (1) LAW		<b>2 (1,1)</b>
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Sample Paper 1

(g) A company is designing promotional products for a band. Products include CDs, toys, greeting cards and digital downloads. All the products use sound. (6)

Discuss the choice of lossless or lossy compression for sound in these products.

Your answer should consider:

- the types of product
- lossless compression
- lossy compression.

Question Number	Indicative content
<b>4(g)</b>	<ul style="list-style-type: none"> <li>Compression reduces data used to represent the original sound</li> <li>Both types require encoding and decoding</li> <li>Lossy compression reduces the accuracy of the representation (Lossless - Reverse)</li> <li>Lossy compression increases the reduction in file size. (Lossless - Reverse)</li> <li>Lossy better for online transmission of sound, e.g. streaming technologies as it takes less time to download / can facilitate access by users with low-speed connections.</li> <li>Lossy better for cases where limited storage available, e.g. embedded systems (toys/cards)</li> <li>Lossless better for physical media (CDs), since it supports high quality audio.</li> <li>Lossy audio removes data representing frequencies that humans cannot hear (or are masked) so they cannot tell the difference</li> <li>Lossy compression can be variable so that different amounts of compression can be offered depending on a user's bandwidth.</li> </ul>

Paper 1 Specimen

(b) The photographer downloads images from a website. The images are compressed.

(i) Give one reason why images are compressed. (1)

<b>1 b)(i)</b>	Any <b>one</b> of: <ul style="list-style-type: none"> <li>• To reduce download time/increase transfer speed</li> <li>• To reduce amount of storage space required</li> </ul>		<b>1 (1)</b>
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Sample Paper 1

A lossless, run length encoding (RLE) algorithm is used to compress the images.

This table shows some of the data for an image.

r	r	r	r	b	b	r	y	y	y
---	---	---	---	---	---	---	---	---	---

(ii) Apply RLE to the data and give the result. (2)

<b>1 b)(ii)</b>	Any <b>one</b> of: <ul style="list-style-type: none"> <li>• R4B2R1Y3</li> <li>• R4B2RY3</li> <li>• 4R2BR3Y</li> <li>• 4R2B1R3Y</li> </ul> With one incorrect character or digit award a maximum of <b>1</b> mark.		<b>2 (2/1)</b>
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Sample Paper 1

A lossy compression algorithm could be applied to the image data.

One feature of lossy compression is that it reduces the file size.

(c) Give two other features of lossy compression. (2)

<b>1 c)</b>	Any <b>two</b> of: <ul style="list-style-type: none"> <li>• Not all pixels are recorded</li> <li>• Quality/detail reduced</li> <li>• Only suitable when images have lots of the same pixels</li> <li>• Cannot reproduce original using the lossy data</li> </ul>		<b>2 (1,1)</b>
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Sample Paper 1

2. (b) Each audiobook is compressed before it is released.

(i) A lossy compression algorithm reduces the size of a file by removing data. Explain why data loss is acceptable when using lossy compression. (2)

Question Number	Answer	Additional Guidance	Mark
3(b)(i)	Most people do not notice (1)  And one from: ...because: <ul style="list-style-type: none"> <li>• People have a limited hearing range (1)</li> <li>OR</li> <li>• Sounds (frequencies/amplitudes) can be masked by other sounds (1)</li> <li>OR</li> <li>• People's brains will 'fill in the blanks'</li> </ul>	Max 1 mark without first statement.	2

14 May 2018

(iii) Describe the process needed to convert the bird song to a format that can be stored on a computer. (3)

Question Number	Answer	Additional Guidance	Mark
4(b)(iii)	Any three of: <ul style="list-style-type: none"> <li>• The height/amplitude of the signal is measured.</li> <li>• The sampling/measuring takes place at given times/intervals.</li> <li>• The sampled value is saved.</li> <li>• This sampling and saving continues along the whole signal.</li> <li>• The more frequent the samples, the more true the digital representation is to the original analogue signal.</li> <li>• The sampled values are a stepped representation of the original analogue curve.</li> </ul>		3

Sample Paper 2

Byron wants to save images of the birds for publishing on the web.

(iv) Complete this sentence. (1)

JPEG is a ..... image compression algorithm, which results in a much-reduced file size but also the deletion of data.

Question Number	Answer	Additional Guidance	Mark
4(b)(iv)	Lossy		1

Sample Paper 2

(e) The game uses black and white as well as colour images.

Explain the effects of using a run-length encoding (RLE) algorithm on the black and white images used in the game. (3)

Question Number	Answer data	Additional Guidance	Mark
1(e)	An explanation such as: The file size is reduced (1) because repeated values (1) are assigned a number (that represents the count of the repeats) (1) OR File size is only reduced (1) if there are lots of run lengths of repeated values (1). In some instances, the 'compressed' file size is actually larger than the original. (1) OR Compressing a black and white image will produce a smaller file size (1) than producing a coloured image because only a single bit needed (1) to indicate the presence/absence of colour (1). OR There will be no loss of quality (1) because RLE is a lossless compression algorithm (1) meaning the exact bit pattern is represented (1)		3

11 May 2020

(e) Identify the type of software used to compress files. (1)

- A Backup
- B Utility
- C Security
- D Network

Question Number	Answer	Additional Guidance	Mark
3(e)	B – Utility		1

11 May 2020

(d) A musician wants to store hundreds of audio files to cloud storage. She wants to compress the files before she stores them. Compare using a lossless compression algorithm with using a lossy compression algorithm for this purpose. (6)

Question Number	Answer	Additional Guidance	Mark
7(d)	<p>Indicative content:</p> <p>(Digital) audio quality is represented using binary. A number of bits (referred to as bit-depth) are used to 'describe' each sample. A lossy algorithm will reduce the bit-depth. However, it will improve the experience of users who want to stream/download the published files. It will not use frequency/amplitude masking (as is the case with lossless compression algorithms). Lossless algorithms are more complex so will take longer to run. The quality of the audio file is reduced when using a lossy algorithm and may not be as acceptable to a listener as one that has been compressed using a lossless algorithm. Depending on the level of compression, listeners may not be able to distinguish between the original and compressed file. Lossless algorithms will allow the musician to work on files at a later date at their original quality/sample rate/resolution. Files that have been compressed using a lossless algorithm will take longer to upload and require more storage/cost (and reverse).</p>		6

11 May 2020

### Ciphers

(ii) Complete the table using a Caesar cipher to encrypt and decrypt the text. (2)

Plain text	Shift	Cipher text
digit	+3	
	-2	z g l y p w

Question Number	Answer	Additional Guidance	Mark									
1(b)(ii)	<table border="1"> <thead> <tr> <th>Plain Text</th> <th>Shift</th> <th>Cipher Text</th> </tr> </thead> <tbody> <tr> <td>digit</td> <td>+3</td> <td>g l j l w</td> </tr> <tr> <td>binary</td> <td>-2</td> <td>z g l y p w</td> </tr> </tbody> </table>	Plain Text	Shift	Cipher Text	digit	+3	g l j l w	binary	-2	z g l y p w		2
Plain Text	Shift	Cipher Text										
digit	+3	g l j l w										
binary	-2	z g l y p w										

8 June 2016

(ii) Complete the table using a Caesar Cipher algorithm. (2)

Plain Text	Shift	Cipher Text
brakes	+4	
clutch		a j s r a f

Question Number	Answer	Additional Guidance	Mark
2(c)(ii)	One mark for each correct cell, in the correct place. <ul style="list-style-type: none"> <li>• f v e o i w (1)</li> <li>• -2 (1)</li> </ul>		2

14 May 2018

(ii) Part of the encrypted text is PEA.

Complete the table to show the original text. (2)

Encrypted text	P	E	A
Original text	L		

<b>1 d)(ii)</b>	E – A (1), A – W (1) LAW		2 (1,1)
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Paper 1

(iii) Explain **one** special condition a Caesar Cipher algorithm must handle. (2)

Question Number	Answer	Additional Guidance	Mark
2(c)(iii)	When the start/end of the alphabet is reached (1) the algorithm must roll over (1)		2

14 May 2018

The photographer sends a message which is encrypted using a Caesar cipher algorithm.

(d) (i) Outline how a Caesar cipher algorithm works. (2)

<b>1 d)(i)</b>	Each character is shifted in the alphabet (1) by a fixed number of positions (1)		2 (1,1)
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## Graphics and Sound

(e) The photographer uses a scanner and computer to convert printed photographs into bitmap images.

Describe how binary digits are used to represent bitmap images. (2)

<b>1 (e)</b>	Any <b>two</b> of: <ul style="list-style-type: none"> <li>• Images stored in (an array of) pixels</li> <li>• Number of pixels determines the quality of the image</li> <li>• The number of bits in each pixel determines how many colours/shades</li> <li>• Can be encoded to reduce the file size</li> </ul>		2 (1,1)
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Paper 1

(f) The photographer takes up to 2000 photographs per week. Each photograph requires 5 MB of storage on the camera's memory card.

(i) Select the camera memory card with the smallest capacity that can store 2000 photographs.

Indicate your answer by putting a cross in the box. (1)

Capacity (GB)		
<b>A</b>	4	<input type="checkbox"/>
<b>B</b>	8	<input type="checkbox"/>
<b>C</b>	16	<input type="checkbox"/>
<b>D</b>	32	<input type="checkbox"/>

<b>1 f)(i)</b>	16		1 (1)
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Paper 1

(ii) At the end of each week, the photographer transfers the photographs from the camera's memory card to his computer's hard drive.

Explain how to calculate the time it will take to transfer 2000 photographs. (2)

<b>1 f)(ii)</b>	Number of bits = $5 \times 2000 \times 1024 \times 1024$ (1) Time = Number of bits/transfer rate OR Time = Number of bits/bps (1)		2 (1,1)
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Paper 1

(b) The photographer downloads images from a website. The images are compressed.

(i) Give one reason why images are compressed. (1)

<b>1 b)(i)</b>	Any <b>one</b> of: <ul style="list-style-type: none"> <li>• To reduce download time/increase transfer speed</li> <li>• To reduce amount of storage space required</li> </ul>		1 (1)
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Paper 1

(e) The photographer uses a scanner and computer to convert printed photographs into bitmap images. (2)

Describe how binary digits are used to represent bitmap images.

<b>1 (e)</b>	Any <b>two</b> of: <ul style="list-style-type: none"> <li>• Images stored in (an array of) pixels</li> <li>• Number of pixels determines the quality of the image</li> <li>• The number of bits in each pixel determines how many colours/shades</li> <li>• Can be encoded to reduce the file size</li> </ul>		<b>2 (1,1)</b>
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Sample Paper 1

(c) State what is meant by the term 'image resolution'. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(c)</b>	<b>One</b> from: The number of pixels per cm <sup>2</sup> /in <sup>2</sup> (1) The number of pixels on the vertical axis x the number of pixels on the horizontal axis (1) The amount of detail that can be seen (1)	Do not accept: 'Number of pixels' on its own	<b>1</b>

11 May 2020

(d) Computers use binary to represent colour.

Compare the use of 8 bits and 24 bits to represent colour. (3)

<b>1(d)</b>	A comparison to include:  Effect on colour depth (1) <ul style="list-style-type: none"> <li>• More colours can be represented (with 24 bits)</li> </ul> Effect on accuracy of representation (1) <ul style="list-style-type: none"> <li>• So the image looks more realistic</li> </ul> Effect on transmission speed/storage/memory (1) <ul style="list-style-type: none"> <li>• But takes longer to transmit / creates larger file sizes / uses more memory</li> </ul>		<b>3</b>
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11 May 2020

### Hexadecimal

(iii) The binary number 0110 1110 is stored in a memory location.

State the hexadecimal representation of this binary number. (1)

<b>3 c)(iii)</b>	6E		<b>1 (1)</b>
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Sample Paper 1

The ASCII code for the question mark character "?" in hexadecimal is 3F.

(ii) Convert the hexadecimal number 3F to 8-bit binary. (2)

Question Number	Answer	Additional Guidance	Mark
<b>1(b) (ii)</b>	Answer must be given to 8-bits One mark for each correct 4-bits (nibble) 0011 1111 3 = 0011 F = 1111		<b>2</b>

Sample Paper 2

(iii) State why hexadecimal representations are used. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(b)(iii)</b>	As a shorthand for binary Easier for humans to read than binary Shorter visual representation than binary	Do not award any indication of memory usage, such as "takes less memory" Do not accept "easier" or "better" without expansion.	<b>1</b>

Sample Paper 2

One way of checking for errors during data transmission is by using a parity bit.

A 7-bit binary code is being transmitted with even parity. The original 7 bits are 1010100.

(ii) State the correct parity bit. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(c)(ii)</b>	1		<b>1</b>

Sample Paper 2

(d) Convert the hexadecimal number 2A to 8-bit binary. (2)

Question Number	Answer	Additional Guidance	Mark
<b>4(d)</b>	1 mark for each nibble 0010 1010		<b>2</b>

Paper 1 Specimen

(iii) Convert the hexadecimal number C4 to 8-bit binary. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(c)(iii)</b>	1 1 0 0 0 1 0 0	Ignore spacing Must be 8-bits	<b>1</b>

8 June 2016

(d) Explain why hexadecimal notation is preferred to binary notation when specifying screen colours.

(2)

Question Number	Answer	Additional Guidance	Mark
<b>3(d)</b>	Shorthand form that is easier for humans to read (1) and is likely to reduce errors when specifying colours / reduces potential for mixing up the 0s and 1s.(1)		<b>2</b>

2017 Paper 1 Specimen

(c) (i) Convert the binary number 00111101 to hexadecimal. (2)

Question Number	Answer	Additional Guidance	Mark
<b>5(c)(i)</b>	3D	Award one mark for each nibble in the correct location	<b>2</b>

13 May 2019

(ii) Explain why hexadecimal notation is used. (2)

Question Number	Answer	Additional Guidance	Mark
5(c)(ii)	Hexadecimal is used as a short-hand for binary / uses fewer digits/characters (1) so <b>humans</b> make fewer mistakes / find it easier to read/understand/remember/manipulate (1).	Do not accept answers suggesting fewer digits save storage/memory	2

13 May 2019

(ii) Convert the 8-bit binary 01101110 to hexadecimal. (1)

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	6 E	Ignore case	1

8 June 2016

(b) One of the colours used in an image is 'cadet blue'. 'Cadet blue' in binary is 0101 1111 1001 1110 1010 0000 Convert 0101 1111 1001 1110 1010 0000 to hexadecimal. (3)

Question Number	Answer	Additional Guidance	Mark
1(b)	One mark for each pair of digits in the correct location. • 5F 9E A0		3

14 May 2018

1. A computer game designer is creating a new game.

(a) Colours in the game are represented in hexadecimal. Convert the binary numbers in this table to hexadecimal. (3)

	Hexadecimal
1101 1110	
1010 1111	
1100 0100	

Question Number	Answer	Additional Guidance	Mark
1(a)	One mark for each pair of digits in the correct location. DE AF C4		3

11 May 2020

(b) Convert the hexadecimal number 12 to binary and the result from binary to denary. (2)

- Binary
- Denary

Question Number	Answer	Additional Guidance	Mark
1(b)	<b>Binary:</b> One mark for 0001 0010. <b>Denary:</b> One mark for 18		2

11 May 2020

(e) Convert the binary number 0100 1010 to hexadecimal. (2)

Question Number	Answer	Additional Guidance	Mark
3(e)	1 mark for each digit in the correct location: 4A		2

Image and Sound Sizes

(c) Construct an expression to show how many seconds it will take to transmit 20 MB of data using a network transmission speed of 2 Mbps

1 KB = 1024 bytes. You do not have to do the calculation. (4)

4(c)	<p>Total number of bits to transfer:  <b>1 mark for</b> <math>20 \times 1024^2</math>  <b>1 mark for</b> <math>\times 8</math></p> <p>Speed in bits per second:  <b>1 mark for</b> <math>2 \times 1000000</math></p> <p>Numerator/Denominator:  <b>1 mark for</b></p> <p style="text-align: center;"><i>bits to transfer</i>  <hr style="width: 50%; margin: auto;"/>  <i>bits per second</i></p> <p>e.g:</p> <p style="text-align: center;"><b><math>\frac{20 \times 1024 \times 1024 \times 8}{2 \times 1000000}</math></b></p>	Any equivalent expression to be awarded	<b>4</b>
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13 May 2019

(e) Images can be represented as bitmaps.

(i) Define the term 'pixel'. (1)

Question Number	Answer	Additional Guidance	Mark
<b>4(e)i</b>	The smallest single point of colour in an image / picture element / the smallest element of a bit-mapped image		<b>1</b>

Paper 1 Specimen

(ii) Describe one way that changing the number of bits allocated to the colour depth determines how an image is represented. (2)

Question Number	Answer	Additional Guidance	Mark
<b>4(e)ii</b>	<p>A description to include <b>two</b> from:</p> <p>Increasing the number of bits used for each pixel (1) allows more colours to be represented in each pixel (1)</p> <p>OR</p> <p>increasing the number of bits allows more pixels to be used (1) providing a greater level of resolution (1)</p> <p>OR</p> <p>Decreasing the number of bits used for each pixel (1) allows fewer colours to be represented in each pixel (1)</p> <p>OR</p> <p>Decreasing the number of bits allows fewer pixels to be used (1) providing a reduced level of resolution (1)</p>		<b>2</b>

Paper 1 Specimen

(f) Analogue sound must be converted into a digital representation.

(i) State the name for the height of a sound wave. (1)

Question Number	Answer	Additional Guidance	Mark
<b>4(f)i</b>	Amplitude		<b>1</b>

Paper 1 Specimen

(ii) State one benefit and one drawback of increasing the bit depth of audio. (2)

- Benefit
- Drawback

Question Number	Answer	Additional Guidance	Mark
4(f)ii	One mark for the benefit: <ul style="list-style-type: none"> <li>• Increases the accuracy of the representation (1)</li> </ul> One mark for a drawback from: <ul style="list-style-type: none"> <li>• Increases the amount of storage required (1)</li> <li>• Increases the time it takes to download the audio file (1)</li> </ul>	Do not accept increases the quality	2

Paper 1 Specimen

1. An online quiz asks students questions about computer science topics.
- (a) Images are used in some of the questions.
- (i) An image is 300 pixels high and 200 pixels wide. Construct an expression to calculate how many pixels are needed to represent this image. (1)

Question Number	Answer	Additional Guidance	Mark
1(a)(i)	One from: <ul style="list-style-type: none"> <li>• <math>300 \times 200</math> (1)</li> <li>• <math>200 \times 300</math> (1)</li> <li>• <math>60000</math> (1)</li> </ul>	Award mark if result is incorrect but expression is correct. E.g. $300 \times 200 = 500$	1

14 May 2018

- (ii) An image file uses 24-bit colour depth. Describe how 24-bits are used to represent the colour in the file. (3)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	Any three from: <ul style="list-style-type: none"> <li>• All colours are combinations of RGB (1)</li> <li>• Each of R, G, B is 8 bits / 8 bits are allocated to the three primary colours, red, green, blue (1)</li> <li>• 3 colours <math>\times</math> 8 bits each = 24 bits (1)</li> <li>• <math>2^{24}</math> colours can be represented (1)</li> <li>• 24-bits are used to represent the colour of each pixel (1)</li> </ul>		3

14 May 2018

6. A computer stores images online.
- (a) An image uses 8-bit colour and is 64 pixels wide.

It uses 1MB of storage. Construct an expression to calculate the height of the image in pixels. 1 KB = 1024 bytes You do not have to do the calculation. (2)

Question Number	Answer	Additional Guidance	Mark
6(a)	Award <b>one</b> mark for either: Sight of: $1024 \times 1024$ OR Sight of: divided by 64  Award <b>both</b> marks for correct expression, e.g.: $\frac{1024 \times 1024}{64}$	Accept any other equivalent mathematical expression.	2

13 May 2019

3. (c) The organisation calculates how long it takes to transmit the audiobook over the internet.
- 1 Mbps = 10002 bps  
 1 MB = 10242 bytes  
 The network transmission speed is 54 Mbps.  
 An audiobook file is 81 MB in size.

Construct an expression to show how many seconds it will take to transmit the audiobook file.  
Show your unit conversions. You do not have to do the calculations. (5)

Question Number	Answer	Additional Guidance	Mark
3(c)	<p>Total number of bits to transfer:</p> <p>1 mark for <math>81 \times 1024^2</math> 1 mark for <math>\times 8</math></p> <p>Speed in bits per second:</p> <p>1 mark for <math>54 \times 1000^2</math></p> <p>Time = number of bits / bits per second:  <math display="block">\frac{81 \times 1024 \times 1024 \times 8}{54 \times 1000 \times 1000}</math> </p> <p>1 mark = number of bits in numerator 1 mark = number of bits per second in denominator</p>	<ul style="list-style-type: none"> <li>No units required</li> <li>Any equivalent expression to be awarded</li> </ul>	5

14 May 2018

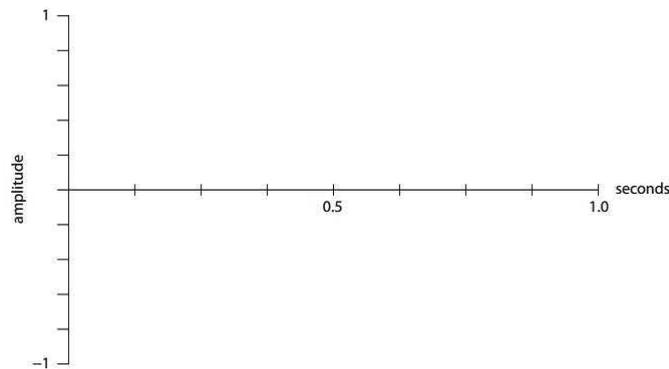
(d) A sound is recorded with these settings:

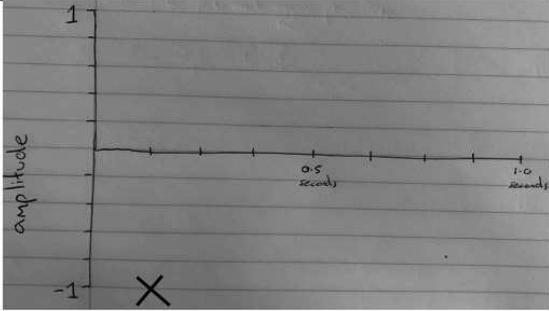
- sample rate: 24 kHz
- bit depth: 4-bit.

Two's complement is used to represent sample values.

The 3000th sample of the sound is represented in binary as 1111

(i) Draw an  $\times$  on the graph to plot the value of the 3000th sample. (2)



Question Number	Answer	Additional Guidance	Mark
3(d)i	 <p>Correct X position (1) Correct Y position (1)</p>		2

September 2020

(ii) State the reason why decreasing the sample interval improves the digital representation of a sound wave. (1)

Question Number	Answer	Additional Guidance	Mark
3(d)ii	There will be more samples in each second (1)		1

September 2020

(f) A 5-colour bitmap image uses 6-bit colour depth.

The image is 96 pixels wide and 128 pixels high.

(i) Complete the expression to show the minimum file size for the image in KiB.

You do not have to do the calculation. (3)

$$\frac{96 \times 128 \times \boxed{\phantom{000}}}{\boxed{\phantom{000}} \times \boxed{\phantom{000}}}$$

Question Number	Answer	Additional Guidance	Mark
3(f)i	<p>Award 1 mark for each number in the correct location for a maximum of 3:</p> <ul style="list-style-type: none"> <li>• 6 in numerator (1)</li> <li>• 1024 in either box in denominator (1)</li> <li>• 8 in either box in denominator (1)</li> </ul> <p>Example of expression that gains full marks:</p> $\frac{96 \times 128 \times 6}{1024 \times 8}$		3

September 2020

(ii) The file size can be optimised by changing the colour depth.

Give the minimum number of bits that can store 5 colours. (1)

Question Number	Answer	Additional Guidance	Mark
3(f)ii	<p>3 bits</p> <p>Explanation: because you need to count up to 5. 3 bits counts up to 8, but 2 bits only counts to 3, which is not enough.</p>		1

September 2020

(iii) Write an arithmetic expression to show the time needed to transmit a 10 KB file at 10 Mbps. (2)

Question Number	Answer	Additional Guidance	Mark
<b>2(c)(iii)</b>	<p>One mark for:</p> <ul style="list-style-type: none"> <li>• Numerator (top) calculation</li> <li>• Denominator (bottom) calculation</li> </ul> <p>Any of the following:</p> $\frac{\left(\frac{10\text{Kilobytes}}{1}\right)\left(\frac{1024\text{bytes}}{\text{Kilobytes}}\right)\left(\frac{8\text{ bits}}{\text{byte}}\right)}{\left(\frac{10\text{Megabits}}{\text{Seconds}}\right)\left(\frac{1000\text{Kilobits}}{\text{Megabits}}\right)\left(\frac{1000\text{ bits}}{\text{Kilobits}}\right)}$ $\frac{10 \times 1024 \times 8}{10 \times 1000 \times 1000}$ $\frac{81920}{10000000}$ $\frac{8192}{1000000}$ <p>Any other correct calculation where the unit conversions are discernible.</p>		<b>2</b>

8 June 2016

## Unit 3 - Computers

### Bus and Registers

(b) Assembly code is used to program a microcontroller.

Here is part of an assembly code instruction set showing the commands and a description of each command. (2)

Command	Description
ADD Rd, Rn, Rm	Adds the contents of Register m to the contents of Register n and stores the result in Register d
CMP Rn, Rm	Compares the value in Register m with the value in Register n and updates the result status flags according to the result
LDR Rd, [Rm]	Loads the contents of the memory address stored in Register m into Register d
MOV Rd, #<value>	Moves <value> into Register d
MOVGT Rd, #<value>	Moves <value> into Register d if result status flags indicate that the 'greater than' condition is true

(i) The assembly code makes use of registers.

Describe the role of registers in a processor. (2)

<b>3 b)(i)</b>	Provides small amount of storage (in the processor)(1) holds an instruction/memory address/data value (1)	2 (1,1)
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Paper 1

(c) The processor has a 32-bit address bus.

(i) State the function of the address bus. (1)

<b>3 c)(i)</b>	Specifies a memory address/uniquely identifies a memory location (1)	1 (1)
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Paper 1

(ii) Describe how the size of the address bus affects the maximum amount of memory available to the microcontroller's processor. (2)

<b>3 c)(ii)</b>	The more lines/wires/bits the address bus has (1) the more memory locations can be uniquely identified (1)	A valid example that demonstrates understanding is acceptable, e.g. 8-bit address bus generates 256 different addresses, a 16-bit address book generates 65,536 different addresses	2 (1,1)
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Paper 1

(d) Describe the role of the control unit, the data bus and the address bus when fetching an instruction from memory. (4)

Question Number	Answer	Additional Guidance	Mark
5(d)	A description to include <b>four</b> from: The control unit increments the program counter (1) <b>The control unit sends</b> a signal (1) along the control bus (1) ...to the memory/MAR (to tell it to send) (1) ...(the address of) the memory location (holding the instruction) (1) ...which is loaded <b>onto the address bus</b> (1) ...(and carried to RAM to tell it to) load the <b>instruction/</b> contents of the memory location <b>onto the data bus</b> (1) ...along which it is <b>carried</b> to the MDR/MBR. (1)		4

13 May 2019

(e) Here is a representation of the contents of main memory.

Memory

Memory location	Value
0000	1100
0011	1000
0100	1111
0101	0111

Draw a flowchart to show the process required to read the contents of memory location 0100 into the CPU. (6)

You must include in your response:

- the buses used
- the contents of each bus.

Question Number	Answer	Additional Guidance	Mark
5(e)	<pre>           graph TD             START[START] --&gt; A[0100 added to address bus]             A --&gt; B["(Read) signal sent down control bus"]             B --&gt; C[1111 placed on data bus]             C --&gt; STOP[STOP]           </pre>	2 marks for each box between START and STOP.  Award 4 marks max if the order is incorrect.	6

September 2020

The microprocessor inside a computing device is made up of several individual components. These components work together to implement the fetch-decode-execute cycle in the device.

(d) Identify one component and its function in the fetch-decode-execute cycle. (2)

- Component
- Function

Question Number	Answer	Additional Guidance	Mark
<b>2(d)</b>	<p>One mark for name and one mark for use (must match)</p> <ul style="list-style-type: none"> <li>• Control Unit (CU) <ul style="list-style-type: none"> <li>◦ Sends signals to other components to coordinate the cycle</li> </ul> </li> <li>• Arithmetic / Logic Unit (ALU) <ul style="list-style-type: none"> <li>◦ Performs arithmetic (+, -, /, *, etc.) and logic (AND, NOT, OR, etc.)</li> </ul> </li> <li>• Registers <ul style="list-style-type: none"> <li>◦ Very fast storage locations which hold instructions, data, or memory addresses.</li> </ul> </li> <li>• Cache (Not expected) <ul style="list-style-type: none"> <li>◦ Sits between components in the microprocessor to make up for the difference in physical speed of the components</li> </ul> </li> <li>• Address Bus <ul style="list-style-type: none"> <li>◦ Holds the address of physical memory or the address of an input/output device that is to be read from/written to</li> </ul> </li> <li>• Data Bus <ul style="list-style-type: none"> <li>◦ If an instruction needs data, the data is loaded onto the data bus before being read by the CPU</li> <li>◦ All data/instructions moved here to go to or from Memory</li> </ul> </li> <li>• Clock <ul style="list-style-type: none"> <li>◦ Provides the timing for the cycle</li> </ul> </li> </ul> <p>Other correct uses should be awarded.</p>	<ul style="list-style-type: none"> <li>• "Bus" or "Buses" alone is not awarded; must include qualifier.</li> <li>• Allow "arithmetic" or "logic" unit</li> </ul>	<b>2</b>

3 June 2015

(c) The processor has a 32-bit address bus.

(i) State the function of the address bus. (1)

<b>3 c(i)</b>	Specifies a memory address/uniquely identifies a memory location (1)		1 (1)
---------------	--	--	-------

Sample Paper 1

(ii) Describe how the size of the address bus affects the maximum amount of memory available to the microcontroller's processor. (2)

<b>3 c(ii)</b>	The more lines/wires/bits the address bus has (1) the more memory locations can be uniquely identified (1)	A valid example that demonstrates understanding is acceptable, e.g. 8-bit address bus generates 256 different addresses, a 16-bit address book generates 65,536 different addresses	2 (1,1)
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Sample Paper 1

CPU Components and Cycles

(c) The workstations used at the hotel are old and are starting to run slowly when searching the files.

The hotel is considering two specifications for replacement workstations.

Specification 1: 3 GHz, 64-bit CPU, with 4MB cache and 8 GB RAM.

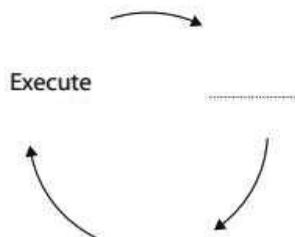
Specification 2: 4 GHz, 64-bit CPU, with 4MB cache and 4 GB RAM. Compare the performance likely to be provided by the two specifications. (6)

Question Number	Answer	Additional Guidance	Mark
6(c)	<p>Indicative content:</p> <ul style="list-style-type: none"> <li>• Specification 2 has a higher clock speed and therefore will be able to deal with a greater number of instructions / cycles per second with the effect that processing will be faster than for Specification 1.</li> <li>• Because of the higher clock speed the CPU in Specification 2 will use more energy and create more heat than the CPU in Specification 1.</li> <li>• The CPU cache memories and the bandwidths are the same.</li> <li>• Specification 1 has more RAM / a larger memory and will therefore be able to handle more programs and operations at the same time. The larger memory will reduce the extent of swapping with virtual memory / secondary storage which will go some way to offset the benefit provided by the greater clock speed of Specification 2.</li> </ul>		6

2017 Paper 1 Specimen

2. Computers (a) The CPU carries out a process.

(i) Complete the diagram.



Question Number	Answer	Additional Guidance	Mark
2(a)i			2

Paper 1 Specimen

(ii) Identify the hardware component that carries instructions from memory to the CPU. (1)

A Binary shift

B Control unit

C Data bus

D Register

Question Number	Answer	Additional Guidance	Mark
<b>2(a)ii</b>	C Data bus  <i>A is not correct because binary shift is not a hardware component. B is not correct because the control unit does not carry instructions from memory to the CPU D is not correct because registers do not carry instructions from memory to the CPU</i>		<b>1</b>

Paper 1 Specimen

(iii) State the component of the CPU that carries out additions and comparisons. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(a)iii</b>	Arithmetic logic unit / ALU		<b>1</b>

Paper 1 Specimen

(iv) State the reason why a higher clock speed is desirable. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(a)iv</b>	More instructions can be carried out each second		<b>1</b>

Paper 1 Specimen

(v) State the name of a bus that is unidirectional. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(a)v</b>	Address (bus)		<b>1</b>

Paper 1 Specimen

(c) Identify the component of the CPU that holds the current program instruction. (1)

A Control unit (CU)

B Register

C Arithmetic logic unit (ALU)

D Data bus

Question Number	Answer	Additional Guidance	Mark
<b>1(c)</b>	<b>B</b> - Register (1)		<b>1</b>

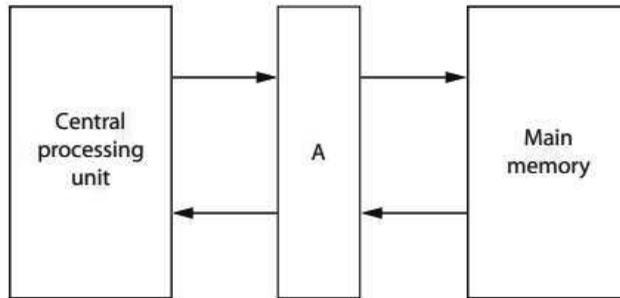
2017 Paper 1 Specimen

(d) Describe the concept of a stored program. (2)

Question Number	Answer	Additional Guidance	Mark
1(d)	<p>Any <b>two</b> of:</p> <p>A program must be resident in memory in order to be executed. (1)</p> <p>Machine code instructions are fetched from memory one at a time, decoded and executed in the processor. (1)</p> <p>The idea of storing programs and data in the same memory unit / of treating programs as just one form of data. (1)</p> <p>Enables a single control unit to manage program control / the fetch-decode-execute sequence. (1)</p>		2

2017 Paper 1 Specimen

(b) Describe the function of the component labelled A. (2)



Question Number	Answer	Additional Guidance	Mark
5(b)	<p>A description to include <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• (Cache) Stores regularly accessed instructions/data</li> <li>• Reduces the need to access instructions/data from main memory</li> <li>• Makes up for the difference in speed of the CPU and main memory</li> </ul>		2

13 May 2019

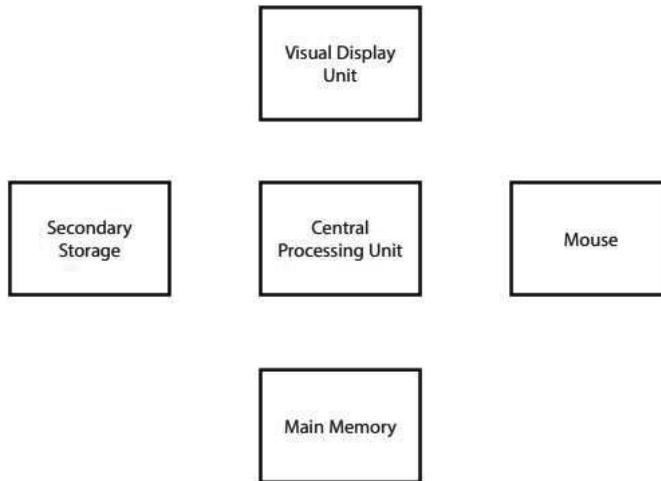
(b) Identify the hardware component that holds a program that is currently being executed. (1)

- A ALU
- B RAM
- C Hard drive
- D Control unit

Question Number	Answer	Additional Guidance	Mark
4(b)	<p>B – RAM</p> <p><b>The only correct answer is B</b></p> <p><i>A is not correct because the ALU does not hold a program</i></p> <p><i>C is not correct because a hard drive does not hold a currently executing program</i></p> <p><i>D is not correct because the control unit does not hold a program</i></p>		1

13 May 2019

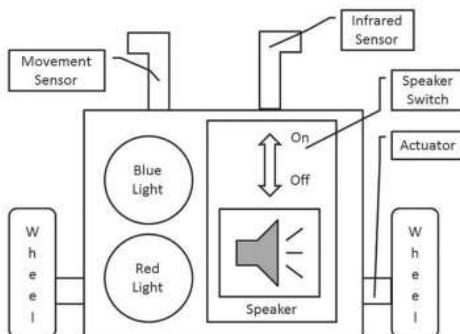
(c) Complete the diagram by adding six arrows to indicate the input and output relationships between the devices. (3)



Question Number	Answer	Additional Guidance	Mark
2(c)	<p>1 or 2 correct = 1 mark            3 or 4 correct = 2 marks            5 or 6 correct = 3 marks</p> <p><b>If there are more than 6 arrows, 2 marks Max.</b></p> <p><b>If unsure, please send it to review</b></p>	<ul style="list-style-type: none"> <li>Lines without direction cannot be awarded.</li> </ul>	3

3 June 2015

1. This is a block diagram of a robot.



(a) Put a cross to identify whether each of these is an input, process, output, or none. (3)

	Input	Process	Output	None
Actuator	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Infrared Sensor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Wheel	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Calculate Distance	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Programming Language	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Movement Sensor	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question Number	Answer	Additional Guidance	Mark																																			
<b>1(a)</b>	<p>1 or 2 correct = 1 mark                      3 or 4 correct = 2 marks                      5 or 6 correct = 3 marks</p> <table border="1"> <thead> <tr> <th></th> <th>Input</th> <th>Process</th> <th>Output</th> <th>Neither</th> </tr> </thead> <tbody> <tr> <td>Actuator</td> <td></td> <td></td> <td>x</td> <td></td> </tr> <tr> <td>Infrared Sensor</td> <td>x</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Wheel</td> <td></td> <td></td> <td></td> <td>x</td> </tr> <tr> <td>Calculate Distance</td> <td></td> <td>x</td> <td></td> <td></td> </tr> <tr> <td>Programming Language</td> <td></td> <td></td> <td></td> <td>x</td> </tr> <tr> <td>Movement Sensor</td> <td>x</td> <td></td> <td></td> <td></td> </tr> </tbody> </table>		Input	Process	Output	Neither	Actuator			x		Infrared Sensor	x				Wheel				x	Calculate Distance		x			Programming Language				x	Movement Sensor	x					<b>3</b>
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Wheel				x																																		
Calculate Distance		x																																				
Programming Language				x																																		
Movement Sensor	x																																					

3 June 2015

(b) The robot stores information as binary sequences. State two types of information that binary sequences can represent in the fetchdecode-execute cycle. (2)

Question Number	Answer	Additional Guidance	Mark
<b>1(b)</b>	<ul style="list-style-type: none"> <li>Data (1)</li> <li>Instructions (1)</li> </ul>		<b>2</b>

3 June 2015

4. Manuel is interested in understanding the relationship between hardware and software.

(a) Describe what is meant by the term 'stored program concept'.(2)

Question Number	Answer	Additional Guidance	Mark
<b>4(a)</b>	<p>Any two of:</p> <ul style="list-style-type: none"> <li>Both the instructions and data for a program are stored in main memory</li> <li>Instructions and data are stored in binary code</li> <li>Instructions and data are fetched, decoded, and executed in a sequence by the CPU</li> </ul>		<b>2</b>

8 June 2016

(b) Computing machines can take many forms and can be based on various models.

(i) Describe what is meant by the term 'virtual machine'. (2)

Question Number	Answer	Additional Guidance	Mark
4(b)(i)	One mark for: <ul style="list-style-type: none"> <li>Software (layer)</li> </ul> One mark for any of: <ul style="list-style-type: none"> <li>Allows the operating system on one physical computer to <b>simulate another computer</b>, usually of a different operating system.</li> <li>Allows a <b>guest operating system</b> to reside on a machine</li> <li>Allows a <b>program written for one machine to run on another without changes (Java Virtual Machine)</b>.</li> <li>Any other appropriate and correct response.</li> </ul>	An example (JVM or Linux on Windows) is not enough for marks	2

8 June 2016

(iii) John von Neumann proposed the concept of a stored program.

State the two items he proposed to store in main memory. (2)

Question Number	Answer	Additional Guidance	Mark
4(a)(iii)	<ul style="list-style-type: none"> <li>Data (1)</li> <li>Instructions (1)</li> </ul>		2

14 May 2018

(c) Describe how the CPU and main memory work together. (4)

Question Number	Answer	Additional Guidance	Mark
5(c)	Response identifies any <b>four</b> from: <ul style="list-style-type: none"> <li>data and instructions are stored in main memory (1)</li> <li>data and instructions are fetched by the CPU (1)</li> <li>on the pulse of a clock (1) (as 'required'/ notified / assigned by the program counter)</li> <li>correctly identify role of address bus (1)</li> <li>correctly identify role of data bus (1)</li> <li>instructions decoded by the CU (1)</li> <li>instructions executed (with data, as appropriate) by the ALU (1)</li> </ul> Data and instructions are fetched from main memory (1), from addresses requested by the CPU (1) on the address bus (1). (Data and instructions are <b>sent</b> ) using the data bus (1). (Data and instructions are then) decoded and executed in the CPU (1). Results of operations are <b>sent back</b> to the memory (1) on the data bus (1).	Response must cover both main memory and CPU  Accept CPU for bullets 6 and 7	4

11 May 2020

(iv) Identify the part of the CPU that sends signals to the other components. (1)

A Arithmetic logic unit

B Control unit

C Register

D Bus

Question Number	Answer	Additional Guidance	Mark
4(a)(iv)	B - Control unit (1)		1

14 May 2018

(b) State two components of the CPU. (2)

Question Number	Answer	Additional Guidance	Mark
5(b)	Any <b>two</b> from: <ul style="list-style-type: none"> <li>• Registers</li> <li>• Clock</li> <li>• CU</li> <li>• ALU</li> </ul>		<b>2</b>

11 May 2020

5 (a) Identify one component common to all computers. (1)

- A Disk drive
- B Graphics card
- C Processor
- D Screen

Question Number	Answer	Additional Guidance	Mark
5(a)	C - Processor		<b>1</b>

11 May 2020

### Compilers and Interpreters

(d) Hara and Nara decide to have a customised software application made for them. Compilers and interpreters translate source code to machine code.

Complete the table to show characteristics of interpreters and compilers. (4)

	Interpreter	Compiler
Translates one source line at a time and executes it	<input type="checkbox"/>	<input type="checkbox"/>
The resulting executable file can be run without the need for additional software	<input type="checkbox"/>	<input type="checkbox"/>
Translates the entire file of source at one time to create a module	<input type="checkbox"/>	<input type="checkbox"/>
Needs a special environment in which to run the source code	<input type="checkbox"/>	<input type="checkbox"/>

Question Number	Answer	Additional Guidance	Mark															
2(d)	<table border="1" style="width: 100%;"> <thead> <tr> <th></th> <th>Interpreter</th> <th>Compiler</th> </tr> </thead> <tbody> <tr> <td>Translates one source line at a time and executes it</td> <td style="text-align: center;">X</td> <td></td> </tr> <tr> <td>The resulting executable file can be run without the need for additional software</td> <td></td> <td style="text-align: center;">X</td> </tr> <tr> <td>Translates the entire file of source at one time to create a module</td> <td></td> <td style="text-align: center;">X</td> </tr> <tr> <td>Needs a special environment in which to run the source code</td> <td style="text-align: center;">X</td> <td></td> </tr> </tbody> </table>		Interpreter	Compiler	Translates one source line at a time and executes it	X		The resulting executable file can be run without the need for additional software		X	Translates the entire file of source at one time to create a module		X	Needs a special environment in which to run the source code	X			<b>4</b>
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Translates the entire file of source at one time to create a module		X																
Needs a special environment in which to run the source code	X																	

Sample Paper 2

(d) Some program code requires translation.

Define the term 'translation'. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(d)</b>	Converting (human readable) code to binary/machine code		<b>1</b>

Paper 1 Specimen

(e) Describe two ways a compiler differs from an interpreter. (4)

Question Number	Answer	Additional Guidance	Mark
<b>2(e)</b>	<p><b>Two</b> linked descriptions from:</p> <ul style="list-style-type: none"> <li>A compiler carries out translation once prior to execution (1) whereas an interpreter carries out translation every time the program executes (1)</li> <li>A compiler produces a stand-alone executable file (1) whereas an interpreter is required each time the code is run (1)</li> <li>A compiler reports errors after translation is complete (1) whereas an interpreter reports errors as they occur (1)</li> </ul>	Both items in the question must be addressed in each response	<b>4</b>

Paper 1 Specimen

5. Forhad is new to programming. He wants to develop an app for his online music business.

(a) Forhad's source code will need to be translated.

(i) Identify the purpose of program translation. (1)

Question Number	Answer	Additional Guidance	Mark
<b>5(a)(i)</b>	To change high-level code into machine code. (1)		<b>1</b>

2017 Paper 1 Specimen

(ii) Identify a method of translation Forhad could use during development of the app. (1)

Question Number	Answer	Additional Guidance	Mark
<b>5(a)(ii)</b>	Compilation / Use a compiler / Interpretation / Use an interpreter. (1)		<b>1</b>

2017 Paper 1 Specimen

(b) Forhad has decided to develop the app using a high-level programming language.

Give two reasons for this decision. (4)

Question Number	Answer	Additional Guidance	Mark
<b>5(b)</b>	<p>An explanation that makes reference to <b>two</b> of the following points:</p> <p>Non specialist (1) - can be developed without knowledge of hardware / architecture. (1)</p> <p>Accessible (1) - straightforward to read as closer to natural language. (1)</p> <p>Availability of library functions (1) – both built in and available from third parties / usually tested and well proven. (1)</p> <p>Portability (1) - the app will be portable because the source could be translated to run on various types of computer. (1)</p>		<b>4</b>

2017 Paper 1 Specimen

Programmers write software that controls hardware and interacts with users. Some of this software ensures that networks function properly.

(a) Compilers and interpreters translate source code written in programming languages. State four other features of a compiler. (4)

Question Number	Answer	Additional Guidance	Mark
6(a)	Any four from: <ol style="list-style-type: none"> <li>1. A single executable file is produced (1)</li> <li>2. The executable program is portable between machines (1)</li> <li>3. The program source code is not available (1)</li> <li>4. Code can be optimised/made more efficient (1)</li> <li>5. Entire source code file is converted at once (1)</li> <li>6. No special environment is needed to execute the code (1)</li> <li>7. It creates object/machine code (1)</li> <li>8. Error report is provided at the end of the compilation (1)</li> </ol>		4

14 May 2018

(d) Compare the use of a compiler with the use of an interpreter to translate code. (6)

Question Number	Answer	Additional Guidance	Mark																
5(d)	Indicative content: Both translate source code written in high level programming languages into machine code. <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="width: 50%;">Compiler</th> <th style="width: 50%;">Interpreter</th> </tr> </thead> <tbody> <tr> <td>Produces a single executable file that is portable between machines</td> <td>Source code needs special environment to run</td> </tr> <tr> <td>Needs to be compiled for a particular architecture</td> <td>Can run on any architecture that has the translator/interpreter</td> </tr> <tr> <td>Entire source code file is translated at once</td> <td>Code is translated line by line</td> </tr> <tr> <td>Provides error report at the end of the compilation</td> <td>Errors more obvious in sequence</td> </tr> <tr> <td>The program source code is not available (so helps protect IP)</td> <td>Source code is available</td> </tr> <tr> <td>Only has to be translated once (affecting the speed of execution)</td> <td>Has to be translated each time therefore (affecting the speed of execution)</td> </tr> <tr> <td>Requires two files to be maintained (one for execution and for editing purposes)</td> <td>Requires only one file to be maintained</td> </tr> </tbody> </table>	Compiler	Interpreter	Produces a single executable file that is portable between machines	Source code needs special environment to run	Needs to be compiled for a particular architecture	Can run on any architecture that has the translator/interpreter	Entire source code file is translated at once	Code is translated line by line	Provides error report at the end of the compilation	Errors more obvious in sequence	The program source code is not available (so helps protect IP)	Source code is available	Only has to be translated once (affecting the speed of execution)	Has to be translated each time therefore (affecting the speed of execution)	Requires two files to be maintained (one for execution and for editing purposes)	Requires only one file to be maintained		6
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Requires two files to be maintained (one for execution and for editing purposes)	Requires only one file to be maintained																		

11 May 2020

(b) A team of developers is using an audit trail when working on a program.

State two advantages of keeping an audit trail. (2)

Question Number	Answer	Additional Guidance	Mark
5(b)	One mark for each to a maximum of 2: <ul style="list-style-type: none"> <li>• There's a record of who changed what when (1)</li> <li>• Identifies the point at which an error/security issue was introduced (1)</li> <li>• Enables the program to be rolled back to a previous state (1)</li> <li>• Improve accountability/produces robust code (1)</li> </ul>		2

September 2020

### Embedded Systems

3. A waterpark uses electronic wristbands that allow access to each ride.

(a) The wristband operates a safety bar across the entrance to a slide. The bar rises to allow each person through.

(i) Select the general term used to describe mechanisms that translate one form of energy to another. (1)

- A Switches
- B Actuators
- C Registers
- D Buses

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	B – Actuators		1

Sample Paper 2

A mechanism automatically recognises when a person reaches the end of the slide.

(ii) Select the general term used to describe mechanisms that either respond to an action or measure a quantity in the physical world. (1)

- A Caches
- B Motors
- C Logic gates
- D Sensors

Question Number	Answer	Additional Guidance	Mark
3(a)(ii)	D - Sensors		1

Sample Paper 2

(g) Describe how an embedded system that uses a sensor could control car windscreen wipers. (2)

Question Number	Answer	Additional Guidance	Mark
2(g)	A description to include <b>two</b> from: If set pressure levels / moisture levels are reached (1) a switch could be turned on/off / windscreen wipers could be turned on/off / (wiper) motor speed altered (1).		2

Paper 1 Specimen

(d) Describe how an embedded system within a baby monitor can be used to alert parents about changes in room temperature. (3)

Question Number	Answer	Additional Guidance	Mark
4(d)	A description such as: <ul style="list-style-type: none"> <li>• Input from sensor (1)</li> <li>• The input level is compared against pre-set values (1)</li> <li>• Output to LED/speaker (1)</li> </ul>		3

13 May 2019

1. (c) One of the embedded systems in the car collects real-time data. The data is encrypted.

- (i) Identify one reason why encryption is used. (1)
- A To prevent data corruption
  - B To reduce network transmission times
  - C To keep data secure
  - D To prevent viruses

Question Number	Answer	Additional Guidance	Mark
2(c)(i)	C - to keep data secure (1)		1

14 May 2018

(d) The Internet of Things has allowed devices with embedded systems to function independently and to collect and exchange data without the need for humans.

One such device is a battery-powered mower for the garden.

(i) Give one way each category could be used by the mower. (4)

Connectivity.....

.....

Input.....

.....

Process.....

.....

Output.....

Question Number	Answer	Additional Guidance	Mark
5(d)i	<p>One mark for each to a maximum of 4, with at least one in each category</p> <p>Connectivity:</p> <ul style="list-style-type: none"> <li>• The mower could connect to a wireless/wired (1) network.</li> <li>• The mower could have a GPS device (1).</li> </ul> <p>Input:</p> <ul style="list-style-type: none"> <li>• A phone/desktop/software application (1) could be used to schedule when it will work.</li> <li>• A map of the garden would be stored (1) on the mower.</li> <li>• The mower would have sensors (1) to know if it ran into things/if it was dark/if it were raining/if it ran outside the garden.</li> </ul> <p>Process:</p> <ul style="list-style-type: none"> <li>• The microcontroller (1) in the mower would run a program (1).</li> <li>• A map of the garden would be read (1) by the program so the mower would know where to go.</li> <li>• The program would monitor (1) the power status to know if it needed recharging.</li> </ul> <p>Output:</p> <ul style="list-style-type: none"> <li>• The program on the mower could upload (1) statistics/information back to the application.</li> <li>• The mower could have a digital readout/flashing lights (1) to indicate status.</li> </ul>		4

September 2020

2. (b) One example of an embedded system in a car is windscreen wipers that automatically come on when it rains.

(i) Explain how an embedded system could control the headlights of a car (3)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	A response such as:  A sensor (1) could be used (with a microprocessor) to determine light levels (1) to activate a switch / turn on/off the headlights (1)	Accept responses that refer to any system that takes input, carries out a process and provides an output. Without a process, this essentially becomes a switch.	3

14 May 2018

### High and Low Level Languages

(b) The subprogram will be written in a high-level language.

(i) Explain one benefit of using high-level programming language for this subprogram. (2)

<b>4 b)(i)</b>	Any <b>one</b> suitable benefit with expansion: <ul style="list-style-type: none"> <li>• makes code easier to understand (1) because it uses user-friendly language (1)</li> <li>• quicker to write subprogram (1) because standard routines (wizards) available (1)</li> <li>• easier to modify (maintain)(1) because of meaningful variable names/clarifying comments (1)</li> <li>• machine independent/can run on a variety of hardware (1) because program can be compiled as required for particular computers</li> </ul>		2 (1,1)
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Paper 1

(b) The subprogram will be written in a high-level language. (2)

(i) Explain one benefit of using high-level programming language for this subprogram.

<b>4 b)(i)</b>	Any <b>one</b> suitable benefit with expansion: <ul style="list-style-type: none"> <li>• makes code easier to understand (1) because it uses user-friendly language (1)</li> <li>• quicker to write subprogram (1) because standard routines (wizards) available (1)</li> <li>• easier to modify (maintain)(1) because of meaningful variable names/clarifying comments (1)</li> <li>• machine independent/can run on a variety of hardware (1) because program can be compiled as required for particular computers</li> </ul>		2 (1,1)
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Sample Paper 1

(d) Discuss the features of high-level and low-level programming languages. (6)

3(d)	HLLs	LLs
	Rich set of instructions for sequencing, selection, repetition, and iteration, supplemented by a library of ready-made functions.	Limited instruction set.
	A few lines of code can represent a complex task, such as a loop	There are no complex constructs, so every task, such as an if-statement, has to be made from smaller steps.
	Support many different data types, such as string, integer, and Boolean.	There are no data types, such as string and integer.
	Variables and data can be used in dynamic ways and created only when needed.	The programmer is responsible for managing all their own data.
	One line of high-level language generates several executable instructions.	One line of low-level code maps directly to one execution instruction.
	There are usually several different editors available which incorporate syntax checkers.	There may be a limited set of tools available for syntax checking.
	There are usually several different development environments which provide debugging tools.	There may be a limited set of tools available for helping to debug programs.
	Translation is required by all HLLs	Assembly language requires an assembler and machine code does not require translation at all.
	Programmers don't have to know the details of a specific machine architecture to write code in a HLL	Programmers have to know the details of a specific machine architecture to write code in a LLL.
	HLL uses English-like command words and is therefore easier for a novice programmer to	Mnemonics; or binary code is harder for a novice programmer to read/write/understand.
	read/write/understand	
	HLLs require more memory space.	LLs require less memory space.

13 May 2019

5. A student has decided to learn how to program. \*(a) Discuss the suitability of compiled and interpreted programming languages for the student. (6)

Question Number	Answer	Additional Guidance	Mark
5(a)	<p>Compiler – Any of the following:</p> <ul style="list-style-type: none"> <li>• Translates all the source code as a single block</li> <li>• Object code is produced which can be linked to other modules</li> <li>• Compilers can perform optimisation on object code</li> <li>• Generated executable does not need compiler to execute</li> <li>• Executable can be moved between machines independent of compiler</li> <li>• Executable file runs more quickly than an interpreter with source code</li> <li>• Needs to be recompiled with each code change therefore development is slower.</li> </ul> <p>Interpreter – Any of the following:</p> <ul style="list-style-type: none"> <li>• Code is translated one line at a time and immediately executed</li> <li>• Code needs the interpreter to be run</li> <li>• Code cannot be moved between machines, unless the interpreter is moved as well</li> <li>• Debugging could be easier as interpreter <b>immediately</b> identifies line with error</li> <li>• Readable source code may need to be given to people who use the program</li> <li>• Runs less quickly than an executable file</li> <li>• Very good for creating prototypes due to quick development environments</li> </ul> <p>Quality of Written Communication</p>	<ul style="list-style-type: none"> <li>• A bulleted list of advantages or disadvantages is only worth 2 marks max.</li> </ul>	6

<ul style="list-style-type: none"> <li>• 1-2: Some basic points from <b>at least one</b> of the categories; No recommendation or recommendation is not justified; Spelling, grammar, and punctuation <b>errors hinder meaning</b>.</li> <li>• 3-4: At least one relevant point <b>from each category</b>; Includes recommendation with minimal justification. Spelling, grammar, and punctuation <b>errors occur</b>, but do not hinder meaning.</li> <li>• 5-6: Relevant points from <b>both categories</b>; Includes well-justified recommendation. Spelling, grammar, and punctuation are <b>used accurately</b> and meaning is clear.</li> </ul> <p><b>Example:</b> A compiler translates all the code at one time. The program can be run on any machine. (One category only; no recommendation; QWC ok; 2 marks max)</p> <p><b>Example:</b> A compiler can perform optimisation on the code to make it more efficient. An interpreter can't because it executes one line at a time. A compiler makes a program that can be run on any machine. A compiler would be better for the pupil. (Two categories; unjustified recommendation; QWC ok; 4 marks max)</p> <p><b>Example:</b> A compiler translates source code in a whole block to make an executable file. The executable file can run on any machines with the target operating system. It does not need the compiler to run. An interpreter translates each line of source code one at a time and executes it. To run the program on another machine, you need the interpreter and the source code. I recommend a compiler for the pupil because it makes</p>		
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<p>giving the program to another person easier, as they don't need the interpreter. (Two categories; justified recommendation; QWC ok; 6 marks max)</p> <p><b>Example:</b> I recommend an interpreter because:</p> <ul style="list-style-type: none"> <li>• Translates one line at a time</li> <li>• Easier to see errors</li> <li>• Good for quick development</li> </ul> <p>I don't recommend a compiler because:</p> <ul style="list-style-type: none"> <li>• It's slow</li> <li>• Have to give away interpreter as well as code</li> </ul> <p>(Two categories; justified recommendation; QWC unmarkable; 2 marks max)</p>		
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3 June 2015

(b) Charles is writing program code for the IT department to use.

(i) Identify the type of programming language most suitable for each situation.

Situation	High-level programming language	Low-level programming language
Keeping a list of computers that need fixing.	<input type="checkbox"/>	<input type="checkbox"/>
Increasing the speed of part of a computer program so that it runs in 1 hour instead of 20 hours.	<input type="checkbox"/>	<input type="checkbox"/>
Keeping track of how many users log into the company's file servers each day.	<input type="checkbox"/>	<input type="checkbox"/>
Writing a program for a new computer processor.	<input type="checkbox"/>	<input type="checkbox"/>

Question Number	Answer		Additional Guidance	Mark
<b>2(b)(i)</b>	<b>High-Level Programming Language</b>	<b>Low-Level Programming Language</b>		<b>4</b>
	X			
	X	X		
		X		

8 June 2016

## Open and Closed Source

(c) Discuss the advantages and drawbacks of choosing open source software, as opposed to proprietary software, to develop Forhad's app. (6)

Question Number	Answer	Additional Guidance	Mark
<b>5(c)</b>	<p>Indicative content:</p> <p>Monetary cost:</p> <ul style="list-style-type: none"> <li>Open source software is often developed by a non-profit community and is free to use.</li> <li>Proprietary software is usually purchased from a software company who licenses its use.</li> </ul> <p>Availability of source code:</p> <ul style="list-style-type: none"> <li>Open source software can be distributed and modified without permission. Anyone can fix bugs and create updates, without any need to wait for a new release.</li> </ul> <p>Availability of support:</p> <ul style="list-style-type: none"> <li>Open source software usually has help available from the community of experts who are interested and contribute to forums.</li> <li>Proprietary development software will not have issues with ongoing parallel developments as updates / changes are controlled, avoiding confusion between versions.</li> <li>Proprietary development software will be supported by the originators.</li> </ul> <p>Stability, reliability, suitability</p> <ul style="list-style-type: none"> <li>Open source is based on open standards that are accessible to everyone - avoids compatibility problems.</li> <li>Open source code is continually analysed by a large community of experts and therefore is stable / reliable.</li> <li>Proprietary development software will be less vulnerable to malicious users who could exploit the level of access provided to open source code.</li> </ul>		<b>6</b>

2017 Paper 1 Specimen

Software may be classified as open source or proprietary.

(b) State four features of open source software licensing. (4)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)</b>	<p>Any 4 from:</p> <ul style="list-style-type: none"> <li>Software can be redistributed</li> <li>Source code is available</li> <li>Source code can be modified</li> <li>Modified code can be redistributed</li> <li>A fee can be charged for the software</li> <li>A fee is not usually charged for the software</li> <li>Modified code must be made available under the same licence as original code.</li> <li>Licence may require an acknowledgement of the original author to be included in the code.</li> <li>Source code can be freely used, changed and shared by anyone subject to conditions specified in the license.</li> </ul>	<ul style="list-style-type: none"> <li>Accept any other correct feature</li> <li>Do not award "free" or "no cost" by itself</li> </ul>	<b>4</b>

3 June 2015

## Operating Systems

(c) One function of an operating system is file management.

State one other function of operating systems. (1)

Question Number	Answer	Additional Guidance	Mark
2(c)	Any one of <ul style="list-style-type: none"> <li>• input/output</li> <li>• resource allocation</li> <li>• process management</li> <li>• network management</li> <li>• user management</li> </ul>	Accept reasonable answers which relate to any of the bullet points.	<b>1</b>

Sample Paper 2

The operating system assigns memory to the image file.

(ii) Describe the function of memory. (2)

<b>1 a)(ii)</b>	A temporary store (1) for data and instructions/programs (1)	<b>2 (1,1)</b>
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Paper 1

(f) Describe two ways an operating system manages processes. (4)

Question Number	Answer	Additional Guidance	Mark
2(f)	<b>Two</b> linked descriptions from: <ul style="list-style-type: none"> <li>• Uses paging / allocates addresses/sections [of RAM] (1) to share memory between processes (1)</li> <li>• Extends main memory (1) by using part of secondary storage (1) (as virtual memory)</li> <li>• The memory of inactive processes (1) is stored in virtual memory and swapped back when the process becomes active (1)</li> <li>• Uses scheduling algorithm (1) to share processing time between competing processes (1)</li> </ul>		<b>4</b>

Paper 1 Specimen

(e) An operating system is the software that provides the interface between a user and a computer system.

Describe two other functions of an operating system. (4)

Question Number	Answer	Additional Guidance	Mark
1(e)	Manages files (1) provides a structure and system / directories for the management of files / allows files to be manipulated (saved, renamed, moved, copied and deleted). (1)  Process management (1) allocating / sharing processor time / resources to running programs. (1)  Manages memory (1) assigning (blocks of) memory to running programs as required. (1)  Manages hardware / drivers (1) to receive data from input devices and to send processed data to output devices. (1)		<b>4</b>

2017 Paper 1 Specimen

(b) State two functions of utility software. (2)

Question Number	Answer	Additional Guidance	Mark
<b>3(b)</b>	Any two from: <ul style="list-style-type: none"> <li>• Repairing files</li> <li>• Compression</li> <li>• Defragmentation</li> <li>• Back up</li> <li>• Anti-virus / anti-spyware / anti-malware</li> <li>• Firewall</li> <li>• Managing application updates</li> <li>• Format disks/drives</li> <li>• System analysis tools</li> </ul>		<b>2</b>

13 May 2019

3. Shaneela is designing and coding a website. The files she creates will be stored on a computer.

- (a) File management is a function that an operating system performs.  
Describe how an operating system organises files. (3)

Question Number	Answer	Additional Guidance	Mark
<b>3(a)</b>	One mark for each concept: Organisation of files is in a <b>hierarchy/tree</b> structure A <b>node</b> is either a folder/directory/sub-folder/sub-directory or the file itself The top node/folder/directory/drive is the <b>root</b>		<b>3</b>

8 June 2016

4. (b) The computer needs an operating system and utility software.

- (i) The operating system controls the scheduling of processes.

Describe how the operating system uses scheduling to allocate processor time. (2)

Question Number	Answer	Additional Guidance	Mark
<b>4(b)(i)</b>	Any two from: <ul style="list-style-type: none"> <li>• All processes are held in a queue (1)</li> <li>• Processes are prioritised (1)</li> <li>• (and) Processes are switched (1)</li> <li>• On each clock cycle (1)</li> </ul>	<ul style="list-style-type: none"> <li>• Award explanations if attributable to a bullet point</li> </ul>	<b>2</b>

14 May 2018

(c) One function of an operating system is user management.

Describe one purpose of user management. (2)

Question Number	Answer	Additional Guidance	Mark
<b>5(c)</b>	A description to include: <ul style="list-style-type: none"> <li>• To provide access (1) to the device by controlling who can log on (1) to the device</li> <li>• To allow a user to log on (1) by checking the username/password (1)</li> <li>• By authenticating (1) the user before allowing them to log on (1)</li> </ul>		<b>2</b>

September 2020

- (ii) Identify the function of utility software. (1)

A Repairing secondary storage

B Formatting cache memory

C Converting files

D Translating programs

Question Number	Answer	Additional Guidance	Mark
4(b)(ii)	C - Converting files (1)		1

14 May 2018

## ROM and RAM

(b) State the type of memory used to store a computer's start up program. (1)

Question Number	Answer	Additional Guidance	Mark
1(b)	ROM / Read only memory (1)		1

2017 Paper 1 Specimen

Name the type of main memory used to store a computer's startup process. (1)

Question Number	Answer	Additional Guidance	Mark
4(c)	ROM / Read Only Memory		1

11 May 2020

(ii) State what ROM and RAM store. (2)

- ROM
- RAM

Question Number	Answer	Additional Guidance	Mark
4(a)(ii)	<ul style="list-style-type: none"><li>• ROM stores BIOS / bootstrap / start-up (1)</li><li>• RAM stores currently executing programs and data (1)</li></ul>		2

14 May 2018

## Software

Computer systems run software programs. The programs provide the instructions needed for the computer to handle the input, processing and output of data.

(a) Identify the type of software used to imitate a real world situation. (1)

A Applications software

B Simulation software

C Utility software

D Systems software

Question Number	Answer	Additional Guidance	Mark
1(a)	B - Simulation software (1)		1

2017 Paper 1 Specimen

The biologist collects data on a single bee colony each day. This includes the amount of available food, the number of bees in the colony, the amount of honey produced, the hours of sunshine, and the hours of rain. The biologist could use software to model the behaviour of the colony.

(f) Give two examples of how software could be used in this situation to model the real world. (2)

Question Number	Answer	Additional Guidance	Mark
2(f)	<p>Any two of:</p> <ul style="list-style-type: none"> <li>Implement formulas which represent the relationships between the given data variables, such as hours of sun and quantity of honey.</li> <li>Use a programming language to write a customised application to model the colony</li> <li>Allow user to input initial values for data variables (food, sun)</li> <li>Use graphical user interface components (boxes, sliders) to adjust input variables will show effects on outputs</li> <li>Present outputs using graphs showing relationships between food and sun, etc.</li> <li>Present outputs showing real number of bees and resources (yellow dots are bees; red dots are pollen)</li> <li>Variables could be changed in real-time with immediate update to the screen (e.g. move a slider, the amount of pollen decreases)</li> </ul> <p>Any other appropriate and correct response incorporating modelling, simulation, or visualisation should be awarded.</p>	<p>The idea here is modelling, simulation, or visualisation of the real world context. Award positively any appropriate responses indicating that software can be used in this manner. Explicit connection to the context is required.</p>	2

3 June 2015

(e) Explain how the operating system manages processes on a computer with a single microprocessor. (3)

Question Number	Answer	Additional Guidance	Mark
2(e)	<p>Accept any <b>three</b> from the following. 1 mark each to a max of 3 marks:</p> <ul style="list-style-type: none"> <li>The computer <b>appears to be running</b> more than one program/process at a time.</li> <li><b>More than one process can be loaded</b> into memory at one time.</li> <li>Each process has its <b>own memory space/partition</b>.</li> <li>Each process is given <b>a small amount of time</b> (time slice) to execute in the central processing unit.</li> <li>Processes are held in a <b>queue/FIFO list</b>.</li> <li>O/S <b>switches between processes</b></li> <li>Some processes may have <b>higher priority</b> than others may.</li> <li>Higher priority processes may be <b>given more time</b> slices/processing time.</li> <li>Processes can communicate by using shared memory</li> </ul>	<ul style="list-style-type: none"> <li>Thread is accepted as equivalent to process</li> <li>Program is accepted as equivalent to process</li> </ul> <p>There is a distinction between the assertion that "two programs <b>are running</b> at the same time" and that "two programs <b>appear to be running</b> at the same time".</p> <p>The first instance is an incorrect statement in the context of this question about a single microprocessor. As such, it cannot be awarded any marks.</p> <p>Ignore reference to multi-core processors.</p>	3

3 June 2015

2 A biologist uses application software to help him in his work. For example, the biologist uses spreadsheet software to model the behaviour of bee colonies.

(a) Identify two other types of application software and give an example of how the biologist could use them in his work.

Type 1 .....

Use

.....

Type 2 .....

Use

Question Number	Answer	Additional Guidance	Mark
2(a)	<p>Identifying any two (2) of the following (Maximum 2 marks):</p> <ul style="list-style-type: none"> <li>• Database</li> <li>• Bibliographic</li> <li>• Project Management</li> <li>• Presentation</li> <li>• Desktop Publishing</li> <li>• Word Processing</li> <li>• Web Browser</li> <li>• Image Editing</li> <li>• Video Editing</li> <li>• Email</li> <li>• Animation</li> <li>• CAD (not expected)</li> <li>• Programming Environment</li> <li>• Live Chat – Only if example confirms working context</li> <li>• Exclude software whose main purpose is entertainment</li> <li>• Any other appropriate software which could sensibly be used in a general working environment</li> </ul> <p>Any two (2) examples of software use (Maximum 2 marks):</p> <p>Answers may include</p> <ul style="list-style-type: none"> <li>• Image Editing – Cropping images for insertion into a presentation</li> <li>• Live Chat – For getting technical support help from a vendor support site</li> <li>• Web Browser – For looking up the address of a colleague at a</li> </ul>	<p>Do not accept spreadsheet and bee colonies</p> <p>Marks must be awarded 2 x 2 Identifying 4 applications cannot earn 4 marks</p> <p>Do not award brand names (Excel, Google, EndNote, PhotoShop, etc.)</p> <p>Use must follow example software given; if mismatch, then do not award example mark</p> <ul style="list-style-type: none"> <li>• Use must be appropriate for a "general" working environment</li> <li>• Do not award examples indicating entertainment</li> <li>• Use must be main purpose of application. Although word processors can crop</li> </ul>	4

different university	<ul style="list-style-type: none"> <li>• Presentation – Showing results of his research to colleagues at a conference.</li> <li>• Bibliographic – Keeping track of sources for his research.</li> <li>• Video Editing – Creating a video to put on YouTube of his lectures for his students.</li> <li>• CAD - molecular, synthetic, and genetic biology</li> <li>• Programming environment – Creating customised models</li> </ul>	<p>images, the more appropriate software choice would be an image/picture editor.</p> <ul style="list-style-type: none"> <li>• A programming language is not an application; an IDE, editor, or compiler is an application.</li> </ul>	
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3 June 2015

### Types of Memory

A photographer uses a program on his computer to access an image file stored on a magnetic hard disk drive. (2)

(a) (i) Give two features of a magnetic hard disk drive that make it suitable for this purpose.

Question number	Answer	Mark
1 a)(i)	Any <b>two</b> of: <ul style="list-style-type: none"> <li>• Large storage capacity</li> <li>• Non-volatile</li> <li>• Fast data access speed</li> <li>• Portable</li> </ul>	2 (1,1)

Paper 1

(f) The photographer takes up to 2000 photographs per week. Each photograph requires 5 MB of storage on the camera's memory card.

(i) Select the camera memory card with the smallest capacity that can store 2000 photographs. Indicate your answer by putting a cross in the box. (1)

Capacity (GB)		
A	4	<input type="checkbox"/>
B	8	<input type="checkbox"/>
C	16	<input type="checkbox"/>
D	32	<input type="checkbox"/>

1 f)(i)	16		1 (1)
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(ii) At the end of each week, the photographer transfers the photographs from the camera's memory card to his computer's hard drive.

Explain how to calculate the time it will take to transfer 2000 photographs. (2)

1 f)(ii)	Number of bits = $5 \times 2000 \times 1024 \times 1024$ (1) Time = Number of bits/transfer rate OR Time = Number of bits/bps (1)	2 (1,1)
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Sample Paper 1

1. A photographer uses a program on his computer to access an image file stored on a magnetic hard disk drive. (2)

(a) (i) Give two features of a magnetic hard disk drive that make it suitable for this purpose.

Question number	Answer	Mark
1 a)(i)	Any <b>two</b> of: <ul style="list-style-type: none"> <li>• Large storage capacity</li> <li>• Non-volatile</li> <li>• Fast data access speed</li> <li>• Portable</li> </ul>	2 (1,1)

Sample Paper 1

The operating system assigns memory to the image file.

(ii) Describe the function of memory. (2)

1 a)(ii)	A temporary store (1) for data and instructions/programs (1)	2 (1,1)
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(a) Describe how data is stored on magnetic media. (2)

Question Number	Answer	Additional Guidance	Mark
<b>2(b)</b>	Any <b>two</b> from: There is a magnetic/chemical coating on surface of the media (1) The magnetic state/polarity of the chemical can be changed (1) to represent a 0 or 1 (1)		<b>2</b>

Paper 1 Specimen

(c) State the type of secondary storage that uses a laser to read the disk. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(c)</b>	Optical		<b>1</b>

Paper 1 Specimen

(b) Southlands Hotel and Spa keeps backups of its customer and booking files on a solid state disc. Explain how data is stored on a solid state disc. (3)

Question Number	Answer	Additional Guidance	Mark
<b>6(b)</b>	Any <b>three</b> from: <ul style="list-style-type: none"> <li>Data is stored digitally in a grid of transistors. (1)</li> <li>A save operation uses an electrical charge to create binary string. (1)</li> <li>Changing the value of some transistors from 1 to 0. (1)</li> <li>Cells are filled with electrons which represent 0s and empty cells represent 1s. (1)</li> <li>It uses semi-conductor chips called NAND flash. (1)</li> </ul>		<b>3</b>

2017 Paper 1 Specimen

3. A teacher uses tablet computers with students to teach programming online.

(a) Describe how data is stored on solid state devices. (3)

Question Number	Answer	Additional Guidance	Mark
<b>3(a)</b>	A description to include <b>three</b> from: <ul style="list-style-type: none"> <li>NAND (memory)</li> <li>If a row/column/set of transistors conduct current / are open/charged, then this represents a 1</li> <li>If row/column/set transistors do not conduct current / are closed/uncharged, then this represents a 0</li> <li>Arranged in a grid (columns/rows)</li> <li>At row/column intersections, two transistors (control gate and floating gate) create a 'cell'</li> <li>By applying voltage to the control gate transistors</li> <li>Electrons flow onto the floating gate</li> <li>Creates a net positive charge that interrupts current flow</li> </ul> <p>Accept 'Contain transistors' if mark not already awarded from MP2, MP3, MP5</p>	If the response contains content from mark point 2 or mark point 3 that <b>refers to the effect of current</b> on setting the state (0 or 1) of transistors; and contains an expansion to show that the opposite state is possible, then award 2 marks.	<b>3</b>

13 May 2019

(ii) Explain the best choice of secondary storage for the battery-operated mower. (2)

Question Number	Answer	Additional Guidance	Mark
<b>5(d)ii</b>	An explanation to include:  The mower should use solid-state secondary storage (1) because it has no moving parts/can use very little power from the battery/is robust to bumps and knocks (1)		<b>2</b>

5 Computers

(a) A slow magnetic hard disk may be affected by file fragmentation.

Describe fragmentation and the process of defragmentation. (3)

Question Number	Answer	Additional Guidance	Mark
5(a)	<p>A description to include (to a maximum of 3, with at least one in each category):</p> <p>Fragmentation:</p> <ul style="list-style-type: none"> <li>Files are written to disk in blocks (1).</li> <li>Blocks can be dispersed (1) across the disk.</li> </ul> <p>Defragmentation:</p> <ul style="list-style-type: none"> <li>Defragmentation is when file blocks are rearranged (1) on the disk.</li> <li>All the blocks for one file are moved closer together (1).</li> <li>All the free space is moved to be together (1).</li> </ul>	<ul style="list-style-type: none"> <li>Defragmentation does not 'make' more free space on the disk. It only rearranges what is already there.</li> </ul>	3

4 A company is developing a computer for use in schools.

(a) All computers have a CPU, memory and storage.

(i) Identify the type of physical storage that uses electronic circuits. (1)

- A Solid state
- B The cloud
- C Magnetic
- D Optical

Question Number	Answer	Additional Guidance	Mark
4(a)(i)	A - Solid state (1)		1

(e) Explain why solid state storage is the best choice for a fitness tracker. (2)

Question Number	Answer	Additional Guidance	Mark
4(e)	<p>An explanation such as:</p> <p>Because it will be subject to movement (1) and it does not use mechanical/moving parts (e.g. a read/write head) (1)</p> <p>OR</p> <p>Solid state storage is smaller/more compact (1) so better suited for a wearable device (1)</p> <p>OR</p> <p>Doesn't have moving parts (1) because they could be disrupted during use (1)</p>		2

## Unit 4 - Networks

### Components

Nara would like to know what different types of network media are available.

(ii) State two different types of physical network media. (2)

Question Number	Answer	Additional Guidance	Mark
2(a)(ii)	An example from any two of the following rows: <ul style="list-style-type: none"> <li>copper cable, twisted-pair, co-axial cable or mains network (networking over mains power line in building)</li> <li>fibre optic cable</li> <li>wireless, infrared or microwave</li> </ul>	Do not award copper cable, twisted-pair, co-axial cable, mains network as separate marks. Do not award wireless, infrared or microwave as separate marks.	2

Sample Paper 2

(c) Jane has decided to provide her warehouse staff with tablet computers and to install a wireless network in her warehouse. The network will include a wireless access point and router.

Describe the roles of the wireless access point and router on Jane's network. (4)

Question Number	Answer	Additional Guidance	Mark
2(c)	Any <b>four</b> from (both must be addressed):  Wireless access point: <ul style="list-style-type: none"> <li>Wireless access point transmits and receives radio waves from the tablets.</li> <li>Enables the tablets to connect to the network using WiFi.</li> </ul> Router: <ul style="list-style-type: none"> <li>Directs data packets to / from tables to / from the Internet.</li> <li>Connects the LAN to the Internet.</li> <li>Uses routing information stored in its tables to forward data packets.</li> </ul>		4

2017 Paper 1 Specimen

7. The internet is the world's largest network.

(a) One function of a router is to forward data packets from one network to another across the internet. Describe how a router carries out this function. (2)

Question Number	Answer	Additional Guidance	Mark
7(a)	A linked description to include <b>two</b> from: <ul style="list-style-type: none"> <li>Reads the packet <b>header</b></li> <li>Takes the recipient's address</li> <li>Compares the (recipient's) address to the addresses of all devices that are connected to it (which are stored in the router's routing table)</li> <li>Forwards the packet / network traffic <b>to its destination</b></li> <li>Using the <b>quickest/most efficient</b> route.</li> </ul>		2

13 May 2019

6. (b) Routers have an important role in how the internet functions. Describe how a router directs data on the internet. (5)

Question Number	Answer	Additional Guidance	Mark
6(b)	<p>A description to include five from:</p> <ol style="list-style-type: none"> <li>1. Reads the data/packet to find the recipient's address (1)</li> <li>2. Has physical connections to &gt;=2 different networks (1)</li> <li>3. Holds a routing table (1)</li> <li>4. Stores information about (IP) addresses (1)</li> <li>5. Keeps packets inside a network by not forwarding them (1)</li> <li>6. Forwards data / directs/forwards/sends packets (1) [Not 'directs data' as in question]</li> <li>7. Chooses the most efficient path to the next node (1)</li> </ol>		5

14 May 2018

3. Gemma manages a network for an organisation.

(a) Two computers are assigned the same IP address. Explain why Gemma must change the IP address of one of the computers. (2)

Question Number	Answer	Additional Guidance	Mark
3(a)	<p>An explanation such as: Access to the network/Internet will be removed/unstable (1) because IP addresses have to be unique (1)</p> <p><i>Award one mark for a response such as: So that data is routed to the correct recipient</i></p>	<p>Example response: 'Devices must have a unique IP address (1) because otherwise, a switch would not know which of the two was the correct device to send packets to (1)</p>	2

11 May 2020

Data Speeds

(c) Network data speeds are measured in Mbps or Gbps.

(i) State the meaning of "bps". (1)

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	Bits per second		1

Sample Paper 2

(d) Construct an expression to calculate the minimum transmission rate required to transmit a 250MiB file in exactly one hour.

There are 3600 seconds in an hour. (3)

Question Number	Answer	Additional Guidance	Mark
5(d)	<p>Total number of bits:</p> <ul style="list-style-type: none"> <li>• 250 x 1024 x 1024 (1)</li> <li>• x 8 (1)</li> </ul> <p>3600 as denominator (1)</p> <p>Award all marks for the correct answer (582,542bps)</p> <p>Example expression: (250 x 1024 x 1024 x 8) / 3600</p>	<p>Ignore conversion to Mbps etc.</p> <p>Award equivalent expressions.</p>	3

Paper 1 Specimen

(c) The network transfers data at 3 Gbps.

Construct an expression to show how many bytes can be transmitted in 10 seconds.

You do not need to carry out the calculation. (3)

Question Number	Answer	Additional Guidance	Mark
3(c)	$((3 \times 1000 \times 1000 \times 1000) \div 8) \times 10$  1 mark for $3 \times 1000^3$ 1 mark for $\div 8$ 1 mark for $\times 10$		3

11 May 2020

Internet

MAC addresses contain groups of hexadecimal digits with separators. An example of a MAC address is 70-18-8B-51-6A-FB.

(ii) Give two additional features of MAC addresses, not related to their format. (2)

Question Number	Answer	Additional Guidance	Mark
2(b)(ii)	Any two of: <ul style="list-style-type: none"> <li>MAC addresses provide a <b>permanent physical</b> identification of each device on a network</li> <li>MAC addresses are <b>unique</b> for each device</li> <li>MAC addresses are <b>assigned at manufacture</b></li> <li>MAC addresses <b>never change</b></li> <li>MAC addresses work at the <b>hardware level</b></li> <li>MAC addresses work at the <b>data link layer</b> (level 2) of the OSI model</li> </ul>	Do not award responses describing format, which is illustrated in the question.	2

Sample Paper 2

IP addresses also contain groups of digits with separators. An example of an IPv6 address is fe80::59a2:dc55:22b:12df%12. An example of an IPv4 address is 192.168.1.97.

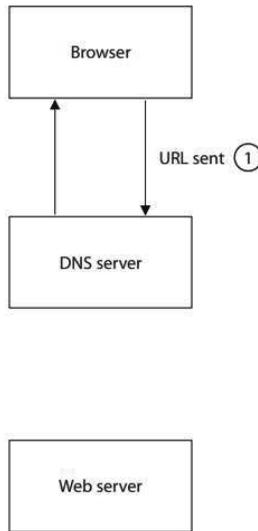
(iii) Give two additional features of IP addresses, not related to their format. (2)

Question Number	Answer	Additional Guidance	Mark
2(b)(iii)	Any two of: <ul style="list-style-type: none"> <li>IP address identifies a device on a network</li> <li>IP addresses may be <b>static or dynamic</b></li> <li>IP addresses <b>may change</b> on each reconnection to a network</li> <li>Dynamic IP addresses <b>are assigned when connecting to a network</b></li> <li>Usually are mapped to domain names like "www.google.co.uk"</li> <li>IP addresses work at the <b>network level</b> (level 3) of the OSI model</li> <li>IP addresses provide a way to represent <b>hierarchical organisations of machines</b></li> </ul>	Do not award responses describing format, which is illustrated in the question.	2

Sample Paper 2

(e) Complete the diagram to show the processes used to find the IP address of a web server and download a page.

Include labels, arrows and numbers in your diagram to show the order in which processes are carried out. (6)



Question Number	Answer	Additional Guidance	Mark
5(e)	<p>A drawing to include <b>six</b> from:</p> <ul style="list-style-type: none"> <li>• Label showing IP address being returned to browser</li> <li>• Arrow from Browser to Web server</li> <li>• HTTP GET request labelled</li> <li>• Arrow from Web server to Browser</li> <li>• HTTP response labelled</li> <li>• Correct order shown</li> </ul>		<b>6</b>

Paper 1 Specimen

2. Jane operates a vintage clothing business from a converted warehouse. She has decided to start an online shop for her products. She needs a local area network with Internet access.

(a) State the type of organisation Jane will have to pay to access the Internet. (1)

Question Number	Answer	Additional Guidance	Mark
2(a)	Internet service provider / ISP (1)		<b>1</b>

2017 Paper 1 Specimen

(f) The end user will use a browser to view the club's website. Describe one difference between the Internet and the World Wide Web. (2)

Question Number	Answer	Additional Guidance	Mark
2(f)	<p>Any two of:</p> <ul style="list-style-type: none"> <li>Implement formulas which represent the relationships between the given data variables, such as hours of sun and quantity of honey.</li> <li>Use a programming language to write a customised application to model the colony</li> <li>Allow user to input initial values for data variables (food, sun)</li> <li>Use graphical user interface components (boxes, sliders) to adjust input variables will show effects on outputs</li> <li>Present outputs using graphs showing relationships between food and sun, etc.</li> <li>Present outputs showing real number of bees and resources (yellow dots are bees; red dots are pollen)</li> <li>Variables could be changed in real-time with immediate update to the screen (e.g. move a slider, the amount of pollen decreases)</li> </ul> <p>Any other appropriate and correct response incorporating modelling, simulation, or visualisation should be awarded.</p>	<p>The idea here is modelling, simulation, or visualisation of the real world context. Award positively any appropriate responses indicating that software can be used in this manner. Explicit connection to the context is required.</p>	2

3 June 2015

(g) State the role of an ISP. (1)

Question Number	Answer	Additional Guidance	Mark
3(g)	To provide access to the Internet		1

11 May 2020

### Layouts (Topologies)

A railway company has 30 railway stations. Each station has a LAN that connects the ticket machines, barriers and information points. Each station is connected to the railway company head office where the main servers are located.

\*(b) Evaluate the use of a private WAN and a VPN for this purpose and recommend which would be most suitable for the railway company. (6)

number			
5 b)	<p>Indicative content:</p> <p><b>Security:</b> a private WAN is more secure because the railway company is the only user; a VPN uses a public network such as the internet, therefore is more vulnerable to attack. Encryption required.</p> <p><b>Performance, reliability and control:</b> Network/bandwidth solely for the railway company's use</p> <p><b>Control:</b> as sole user of the private WAN the railway company has complete control over how it is set up and run; if using a VPN the railway company will have far less control since the network service provider will need to balance the needs of all users of the network.</p> <p><b>Cost:</b> the railway company must bear all the cost of setting up and running the private WAN; the VPN uses a public network so the costs are spread between many users.</p> <p><b>Expertise:</b> setting up and running a private WAN requires technical/managerial expertise which the railway company may not have; using a VPN on a public network outsources these activities to a service provider.</p> <p><b>Quality of Written Communication</b></p>		6
1-2 marks QWC i-ii-iii	<ul style="list-style-type: none"> <li>Some basic points from at least one of the above examples.</li> <li>No recommendation is made or a recommendation is made but not justified.</li> <li>Response shows basic attempt to structure and control expression and meaning. Basic accuracy in spelling and punctuation hinders meaning.</li> </ul>		
2-4 marks QWC i-ii-iii	<ul style="list-style-type: none"> <li>Relevant points are provided from more than one of the above examples</li> <li>Response includes a recommendation, but does not fully justify it.</li> <li>Sentences show some attempt to structure and control expression and meaning. Spelling and punctuation sometimes accurate with meaning hindered on occasion.</li> </ul>		
5-6 marks QWC i-ii-iii	<ul style="list-style-type: none"> <li>A balanced response with sound and relevant points from more than one of the above examples</li> <li>Response includes a recommendation that is fully justified with regard to the rail company.</li> <li>Response is clearly structured, with sound control of expression and meaning. Spelling and punctuation are mostly accurate, with some errors.</li> </ul>		

Nara describes some different network topologies and their characteristics.

(iii) Complete the table to show the characteristics of these network topologies. (4)

Characteristic	Ring	Mesh	Star	Bus
A device, such as a switch, sits at the centre	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Nodes cooperate to take turns sending data	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Performance degrades quickly under heavy loads	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
May have a dedicated connection between each node and every other node	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question Number	Answer	Additional Guidance	Mark																									
2(a)(iii)	<table border="1"> <thead> <tr> <th>Characteristic</th> <th>Ring</th> <th>Mesh</th> <th>Star</th> <th>Bus</th> </tr> </thead> <tbody> <tr> <td>A device, such as a switch, sits at the centre</td> <td></td> <td></td> <td>x</td> <td></td> </tr> <tr> <td>Nodes cooperate to take turns sending data</td> <td>x</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Performance degrades quickly under heavy loads</td> <td></td> <td></td> <td></td> <td>x</td> </tr> <tr> <td>May have a dedicated connection between each node and every other node</td> <td></td> <td>x</td> <td></td> <td></td> </tr> </tbody> </table>	Characteristic	Ring	Mesh	Star	Bus	A device, such as a switch, sits at the centre			x		Nodes cooperate to take turns sending data	x				Performance degrades quickly under heavy loads				x	May have a dedicated connection between each node and every other node		x				4
Characteristic	Ring	Mesh	Star	Bus																								
A device, such as a switch, sits at the centre			x																									
Nodes cooperate to take turns sending data	x																											
Performance degrades quickly under heavy loads				x																								
May have a dedicated connection between each node and every other node		x																										

Sample Paper 2

(b) Describe one disadvantage of using a bus topology. (2)

Question Number	Answer	Additional Guidance	Mark
5(b)	<p>If the main cable fails / is damaged (1) the whole network will fail (1)</p> <p>If more computers are connected (1) the transmission time is increased / increased chance of data collisions (1)</p> <p>Every computer receives all of the data on the network (1) causing a security risk (1)</p>		2

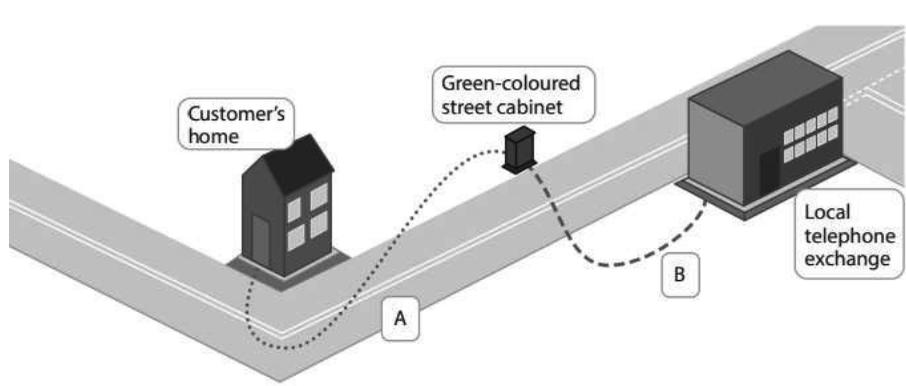
Paper 1 Specimen

(b) Describe the topology of a star network. (2)

Question Number	Answer	Additional Guidance	Mark
2(b)	<p>Every node / workstation connects to a central network device, like a hub or switch. (1)</p> <p>The central network device acts as a router / directs data to the intended peripherals. (1)</p> <p>All data passes through the central network device on route to its intended destination. (1)</p>	<ul style="list-style-type: none"> <li>No mark awarded for server as a central device.</li> </ul>	2

2017 Paper 1 Specimen

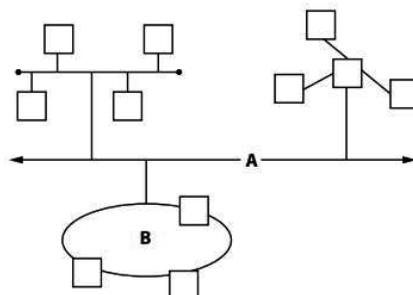
(e) The diagram shows two different types of connectivity media. State the different types of connectivity media used at A and B. (2)



Question Number	Answer	Additional Guidance	Mark
4(e)	A. Copper cable B. Fibre optic		2

13 May 2019

Here is a diagram showing the Internet as a network of networks. Each square represents a computing device.



(ii) State the name of the high-speed Internet infrastructure shown at A. (1)

Question Number	Answer	Additional Guidance	Mark
1(a)(ii)	Any one of: <ul style="list-style-type: none"> <li>• Backbone</li> <li>• Connecting backbone</li> <li>• Internet backbone</li> <li>• Fibre backbone</li> <li>• Network backbone</li> </ul>		1

8 June 2016

(iii) State the name of the network topology shown at B. (1)

Question Number	Answer	Additional Guidance	Mark
1(a)(iii)	Ring		1

8 June 2016

(iv) Identify the type of network used in each situation. (4)

Situation	LAN	WAN	PAN	VPN
A delivery driver uses a hands-free car kit to connect to his mobile phone.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A dental nurse uses a computer to look at digital x-rays stored on a server in the basement of the building.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A manager, working from home, is able to access all the computers in his company as if he was in the company office.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
An office in Tokyo sends emails to all customers, whether they are in New York, Paris or Delhi.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question Number	Answer	Additional Guidance	Mark																				
<b>1(a)(iv)</b>	One mark for each correct cell. <table border="1" style="margin-left: 20px;"> <thead> <tr> <th>LAN</th> <th>WAN</th> <th>PAN</th> <th>VPN</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>X</td> <td></td> </tr> <tr> <td>X</td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td>X</td> </tr> <tr> <td></td> <td>X</td> <td></td> <td></td> </tr> </tbody> </table>	LAN	WAN	PAN	VPN			X		X							X		X				<b>4</b>
LAN	WAN	PAN	VPN																				
		X																					
X																							
			X																				
	X																						

8 June 2016

### 1 Networks

(a) Different protocols are used in the 4-layer TCP/IP model.

Complete the table by providing one item in each empty space. (4)

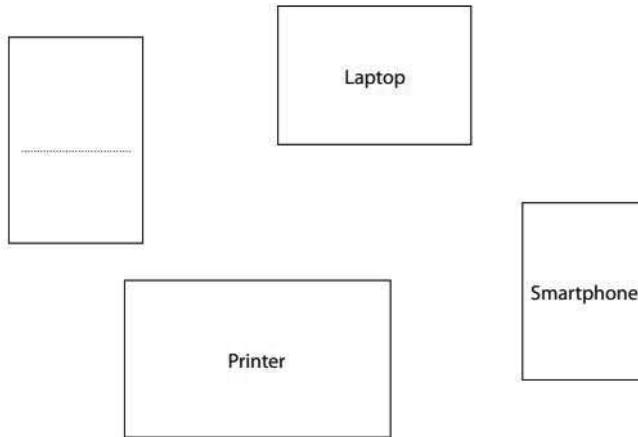
Layer	Protocol
Application	
	TCP
Internet	
	Ethernet

Question Number	Answer	Additional Guidance	Mark										
<b>1(a)</b>	<table border="1" style="margin-left: 20px;"> <thead> <tr> <th>Layer</th> <th>Protocol</th> </tr> </thead> <tbody> <tr> <td>Application</td> <td>HTTP / HTTPS / SMTP / POP3 / IMAP / FTP</td> </tr> <tr> <td>Transport</td> <td>TCP</td> </tr> <tr> <td>Internet</td> <td>IP</td> </tr> <tr> <td>Link / Data Link / Network interface</td> <td>Ethernet</td> </tr> </tbody> </table>	Layer	Protocol	Application	HTTP / HTTPS / SMTP / POP3 / IMAP / FTP	Transport	TCP	Internet	IP	Link / Data Link / Network interface	Ethernet		<b>4</b>
Layer	Protocol												
Application	HTTP / HTTPS / SMTP / POP3 / IMAP / FTP												
Transport	TCP												
Internet	IP												
Link / Data Link / Network interface	Ethernet												

September 2020

(b) Computers can be connected using a bus, mesh or star topology.

(i) Draw lines between the devices and label the unnamed device to show a star network topology diagram. (2)



Question Number	Answer	Additional Guidance	Mark
1(b)i	<p>One mark for each to a maximum of 2:</p> <ul style="list-style-type: none"> <li>Named device is switch/hub (1)</li> <li>Exactly three lines connecting devices to centre point/named device (1)</li> </ul>	<ul style="list-style-type: none"> <li>Marks are independent</li> <li>Do not award bullet 2 if there are extraneous lines</li> <li>'Router' would not gain a mark because it is a term that is often used to describe a hardware device that may contain a modem, router, switch and wireless access point.</li> </ul>	<b>2</b>

September 2020

(ii) Give two reasons for using a star topology rather than a bus topology. (2)

Question Number	Answer	Additional Guidance	Mark
1(b)ii	<p>Any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>A star is more scalable (1) than a bus because you can add extra devices without disrupting the network.</li> <li>A star is more fault tolerant/reliable (1) because a damaged cable/faulty device can be replaced/removed without disrupting the rest of the network.</li> <li>It is easier to troubleshoot/isolate faults (1) because all cables are attached to a central point.</li> <li>A star is capable of handling higher volumes of network traffic (1) than a bus.</li> </ul>		<b>2</b>

September 2020

(b) Identify the network topology that requires a server. (1)

- A Bus
- B Mesh
- C Ring
- D Star

Question Number	Answer	Additional Guidance	Mark
3(b)	D – Star		1

11 May 2020

### Network Security

(c) A company stores statistics about its business on a server.

Explain one type of access to the statistics file a student on work experience at the company should be given. (2)

Question Number	Answer	Additional Guidance	Mark
5(c)	<p>An explanation to include <b>one</b> mark for a type of access and <b>one</b> mark for a linked reason, such as:</p> <ul style="list-style-type: none"> <li>To recommend read only (1) because the student cannot accidentally change/delete the data / because the student cannot share the data (1)</li> <li>No access (1) because the student cannot see any sensitive/irrelevant information (1)</li> </ul>		2

Paper 1 Specimen

(d) A school implements two-part user authentication as a network security measure.

State the names of these two parts. (2)

Question Number	Answer	Additional Guidance	Mark
7(d)	<p>User name (1) Password (1)</p>		2

2017 Paper 1 Specimen

(a) Explain why it is important to review network and user policies. (2)

Question Number	Answer	Additional Guidance	Mark
7(b)	<p>An explanation such as: Changes in requirements / technology (1) mean that security can be improved/compromised (1) OR Changes in law/regulations (1) mean that requirements/technology must change (1)</p> <p><b>Do not accept</b> statements about unauthorised access / security that do not refer to <b>changes</b> in requirements / technology etc.</p>	Linked points required for two marks.	2

13 May 2019

(b) Data transmitted over a network is sometimes encrypted.

(i) State one reason why data encryption is used on a network. (1)

Question Number	Answer	Additional Guidance	Mark
1(b)(i)	<p>Any one of:</p> <ul style="list-style-type: none"> <li>To keep information private/secure/secret as it is being transmitted across networks</li> <li>So that unauthorised persons will not be able to translate/understand the transmitted data</li> </ul>	<p>Do not accept:</p> <ul style="list-style-type: none"> <li>to keep secure when stored on devices, which is not the context of the question</li> </ul>	1

8 June 2016

(e) A company needs to secure its network from attacks by its employees.

Explain the best choice of penetration testing the company should use. (2)

Question Number	Answer	Additional Guidance	Mark
1(e)	<p>An explanation that includes the ideas:            Permission is given to a person (1) to carry out investigation of security issues (1) in the network</p> <p>White-box / white-hat (1) because system information is provided to the tester (1)</p> <p>The company should give a security expert an ID and password and details of how the network is configured (1), and ask them to try to find vulnerabilities that would enable an employee to access, delete and/or leak sensitive data or install malicious software (1)</p>		2

September 2020

5. (d) The company is concerned about the security of its own network. It employs a network specialist to secure the network.

(i) Describe what is meant by the term 'penetration testing' when applied to networks. (2)

Question Number	Answer	Additional Guidance	Mark
5(d)(i)	<p>Any two from:</p> <ul style="list-style-type: none"> <li>• Networks are put under deliberate attack (1) in order to identify any weaknesses/vulnerabilities (1) so that they can be fixed (1)</li> </ul>		2

14 May 2018

## Protocols and Models

(b) Hara and Nara decide to have a network installed in their office.

(i) State the purpose of a network protocol. (1)

Question Number	Answer	Additional Guidance	Mark
2(b)(i)	<p>Any one of:</p> <ul style="list-style-type: none"> <li>• To allow connected machines to communicate</li> <li>• To provide the rules of communication between two networked devices</li> </ul>		1

Sample Paper 2

(iii) Explain why you would prefer HTTPS to HTTP for transmitting data, such as banking details, over the Internet. (2)

Question Number	Answer	Additional Guidance	Mark
1(c)(iii)	<p>Any two of:</p> <ul style="list-style-type: none"> <li>• HTTP is <b>not secure</b> and/or <b>not encrypted</b> so anyone who captures the data can easily read it.</li> <li>• HTTPS is <b>secure</b> and/or <b>encrypted</b>.</li> <li>• No one can <b>decrypt</b>/unscramble/decipher information sent over HTTPS, <b>unless they have the correct key</b>.</li> <li>• No <b>unauthorised</b> person can <b>decrypt</b> the data.</li> </ul>	Note: "No one can read/decrypt the data" is not enough to award mark.	2

Sample Paper 2

5. Networks (a) Identify the reason why all computers need a unique IP address. (1)

A Enables a firewall to protect devices

B Identifies devices on a network

C Increases the speed of transmission

D Reduces reliance on the transport layer

Question Number	Answer	Additional Guidance	Mark
<b>5(a)</b>	B Identifies devices on a network  <i>A is not correct because unique IP addresses do not enable a firewall to protect devices</i> <i>C is not correct because unique IP addresses do not increase the speed of transmission</i> <i>D is not correct because unique IP addresses do not reduce the reliance on the transport layer</i>		<b>1</b>

Paper 1 Specimen

8. Protocols provide standards for network communications.

(a) Identify the protocol used to send email messages to an email server. (1)

A POP3

B SMTP

C FTP

D IMAP

Question Number	Answer	Additional Guidance	Mark
<b>8(a)</b>	<b>B - SMTP (1)</b>		<b>1</b>

2017 Paper 1 Specimen

(b) Explain the role of Ethernet protocol. (2)

Question Number	Answer	Additional Guidance	Mark
<b>8(b)</b>	Ethernet protocols define standards for network cabling / types of cabling used at the physical layer (1) and corresponding transmission speeds. (1)  At the data link layer Ethernet protocols describe how network devices can format data for transmission (1) using frames / packets. (1)		<b>2</b>

2017 Paper 1 Specimen

(c) Data can be transmitted in packets using layered protocol stacks.

Describe the TCP/IP model for data transmission. (4)

Question Number	Answer		Mark
<b>8(c)</b>	<p>Each layer of the TCP/IP model prepares data for transmission from one computer to another. (1)</p> <p>Data is sent downwards from the application (application layer) (1) through protocol stack to the physical media (physical layer). (1)</p> <p>At each stage information is added to the packet such as destination address, source address, protocol, routing information, error correction. (1)</p> <p>At the receiving computer the packet passes through the layers in reverse. (1)</p> <p>There are four layers in a simple TCP/IP model (Application layer, Transport layer, Network layer, Data link layer). (1)</p>	<ul style="list-style-type: none"> <li>Award 4 or 5 layer model of TCP/IP with the fifth layer being the Physical Layer.</li> </ul>	<b>4</b>

2017 Paper 1 Specimen

7. (a) One of the main concerns when connecting devices to a network is security. HTTP is an Internet protocol. Explain the purpose of HTTP. (2)

Question Number	Answer	Additional Guidance	Mark
<b>7(a)</b>	HTTP provides the set of rules / mutual understanding / defines how messages are formatted and transmitted (1) that enables the exchange of data between a client / browser and a web server. (1)		<b>2</b>

2017 Paper 1 Specimen

(b) HTTPS is a version of HTTP with increased protection against cyberattacks.

(i) Identify the type of cyberattack from which HTTPS offers some protection. (1)

- A Phishing emails
- B Unpatched software
- C Denial of service
- D Eavesdropping

Question Number	Answer		Mark
<b>7(b)(i)</b>	D - Eavesdropping (1)		<b>1</b>

2017 Paper 1 Specimen

(ii) Explain how HTTPS provides increased security. (2)

Question Number	Answer		Mark
<b>7(b)(ii)</b>	<p>When a client / your browser connects to a website via HTTPS the browser and web server send each other unique codes which are used to encrypt any transmitted data / the data is encrypted before transmission. (1)</p> <p>If the data is intercepted by a third party / hacker it will not have any meaning. It can only be read / decrypted using the unique decryption key provided. (1)</p>		<b>2</b>

2017 Paper 1 Specimen

(c) The transport layer of network protocols splits data into packets before sending it. Describe the process that ensures the data received matches the original. (2)

Question Number	Answer	Additional Guidance	Mark
7(c)	A description such as: Each packet has a sequence number (added at the sending end) (1) The packets are put back into (sequence) order (at the destination) (1).		2

13 May 2019

(d) Identify the protocol used to transfer data in networks. (1)

- A HTML
- B TCP/IP
- C ISP
- D URL

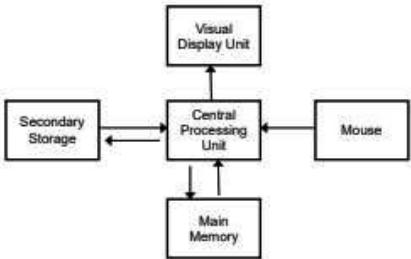
(1)

Question Number	Answer	Additional Guidance	Mark
2(d)	B - TCP/IP  <b>The only correct answer is B</b> <b>A</b> is not correct because HTML is not a protocol <b>C</b> is not correct because an ISP is not a protocol <b>D</b> is not correct because a URL is not a protocol		1

13 May 2019

(c) Network protocols break the files into packets before transmission. Three fields in a network packet are source, destination, and check sum.

Give two additional fields found in a network packet. (2)

Question Number	Answer	Additional Guidance	Mark
2(c)	<p>1 or 2 correct = 1 mark 3 or 4 correct = 2 marks 5 or 6 correct = 3 marks</p> <p><b>If there are more than 6 arrows, 2 marks Max.</b></p>  <p><b>If unsure, please send it to review</b></p>	<ul style="list-style-type: none"> <li>• Lines without direction cannot be awarded.</li> </ul>	3

3 June 2015

(d) State the purpose of a check sum. (1)

Question Number	Answer	Additional Guidance	Mark
<b>2(d)</b>	<p>One mark for name and one mark for use (must match)</p> <ul style="list-style-type: none"> <li>• Control Unit (CU) <ul style="list-style-type: none"> <li>◦ Sends signals to other components to coordinate the cycle</li> </ul> </li> <li>• Arithmetic / Logic Unit (ALU) <ul style="list-style-type: none"> <li>◦ Performs arithmetic (+,-,/,*, etc.) and logic (AND,NOT, OR, etc.)</li> </ul> </li> <li>• Registers <ul style="list-style-type: none"> <li>◦ Very fast storage locations which hold instructions, data, or memory addresses.</li> </ul> </li> <li>• Cache (Not expected) <ul style="list-style-type: none"> <li>◦ Sits between components in the microprocessor to make up for the difference in physical speed of the components</li> </ul> </li> <li>• Address Bus <ul style="list-style-type: none"> <li>◦ Holds the address of physical memory or the address of an input/output device that is to be read from/written to</li> </ul> </li> <li>• Data Bus <ul style="list-style-type: none"> <li>◦ If an instruction needs data, the data is loaded onto the data bus before being read by the CPU</li> <li>◦ All data/instructions moved here to go to or from Memory</li> </ul> </li> <li>• Clock <ul style="list-style-type: none"> <li>◦ Provides the timing for the cycle</li> </ul> </li> </ul> <p>Other correct uses should be awarded.</p>	<ul style="list-style-type: none"> <li>• "Bus" or "Buses" alone is not awarded; must include qualifier.</li> <li>• Allow "arithmetic" or "logic" unit</li> </ul>	<b>2</b>

3 June 2015

1 (a) Computer networks are valuable to many businesses and individuals.

(i) State the purpose of network protocols. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(a)(i)</b>	<p>Any one of:</p> <ul style="list-style-type: none"> <li>• To allow connected machines to communicate</li> <li>• To provide the rules of communication between two networked devices</li> </ul>	Any other response indicating communication	<b>1</b>

8 June 2016

(c) State one reason for splitting data into packets. (1)

Question Number	Answer	Additional Guidance	Mark
<b>1(c)</b>	<p>Any one from:</p> <ul style="list-style-type: none"> <li>• Speeds up data transfer</li> <li>• Reduces the reliability on a single pathway</li> <li>• Reduces the impact of data corruption</li> </ul>		<b>1</b>

September 2020

(d) Data is split up into packets for transmission over a network. Identify the item included in a packet header. (1)

- A Data being sent
- B Decryption key
- C Media restriction indicator
- D Packet number

Question Number	Answer	Additional Guidance	Mark
<b>1(d)</b>	D Packet number  <i>A is not correct because the data being sent is in another part of the packet</i> <i>B is not correct because if the packet were encrypted the key would not be sent in the header</i> <i>C is not correct because packets are not restricted to the type of media they can use</i>		<b>1</b>

September 2020

f) Identify the email protocol. (1)

A FTP

B HTTP

C SMTP

D TCP/IP

Question Number	Answer	Additional Guidance	Mark
<b>3(f)</b>	C – SMTP		<b>1</b>

11 May 2020

### Reasons for a Network

2 Hara and Nara Lee are estate agents. Nara wants to make better use of the computers they have at the office by installing a network.

(a) (i) State two advantages of connecting computers using a network. (2)

Question Number	Answer	Additional Guidance	Mark
<b>2(a)(i)</b>	Any two from: <ul style="list-style-type: none"> <li>• Sharing Internet connection</li> <li>• Share peripherals (printer, scanner, speakers, ...)</li> <li>• Cost savings by sharing hardware/software</li> <li>• Share data (files, database, ...)</li> <li>• Transfer files between computers</li> <li>• Collaboration on projects</li> <li>• Communicating (email, instant messaging, chat, ...)</li> <li>• Data can be backed up from one location</li> <li>• Network login to control access to all machines on network</li> <li>• Software installed to individual machines from a central location</li> <li>• Monitor usage of hardware/software</li> <li>• Monitor behaviours of users</li> </ul>	Do not accept "faster", "easier", "cheaper" and "better" without expansion.  Other responses awarded, as long they're distinct and not duplicates	<b>2</b>

Sample Paper 2

3. An organisation that supplies audiobooks over the internet is moving into a new office building.

(a) One reason for networking devices is to provide access to the internet.

(i) Give two other reasons for connecting devices to networks. (2)

Question Number	Answer	Additional Guidance	Mark
3(a)(i)	Any two from different categories: <ul style="list-style-type: none"> <li>Share peripherals/devices (e.g. printers, scanners) (1)</li> <li>Communicate (e.g. email, instant messaging, play games) (1)</li> <li>Share data (e.g. files/music/videos/backups on servers) (1)</li> <li>Deploy/update applications (1)</li> </ul>		2

14 May 2018

### Server (Client Server and Web Servers)

Members may log on to the club's website to view details of their training.

(e) Explain the server-side processing that takes place when a member views their training online. (3)

4 e)	Request from club member handled by a script server side (1). Server accepts request and retrieves training data from database (1) Constructs web page to display results of search (1) and sends to client computer (1)		3 (1,1,1)
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Sample Paper 1

A railway company has 30 railway stations. Each station has a LAN that connects the ticket machines, barriers and information points.

Each station is connected to the railway company head office where the main servers are located.

\*(b) Evaluate the use of a private WAN and a VPN for this purpose and recommend which would be most suitable for the railway company. (6)

Question number	Answer	Mark
5 b)	Indicative content: <b>Security:</b> a private WAN is more secure because the railway company is the only user; a VPN uses a public network such as the internet, therefore is more vulnerable to attack. Encryption required. <b>Performance, reliability and control:</b> Network/bandwidth solely for the railway company's use <b>Control:</b> as sole user of the private WAN the railway company has complete control over how it is set up and run; if using a VPN the railway company will have far less control since the network service provider will need to balance the needs of all users of the network. <b>Cost:</b> the railway company must bear all the cost of setting up and running the private WAN; the VPN uses a public network so the costs are spread between many users. <b>Expertise:</b> setting up and running a private WAN requires technical/managerial expertise which the railway company may not have; using a VPN on a public network outsources these activities to a service provider.	6

Sample Paper 1

6. Southlands Hotel and Spa uses a booking system to record details of room bookings.

(a) The booking system runs on a client-server network.

(i) Describe the role of a client workstation. (2)

Question Number	Answer	Additional Guidance	Mark
<b>6(a)(i)</b>	To provide a platform for users to run applications (1) and enable users to access network resources provided by the server. (1)  A client workstation accesses data from a server by making a connection to the server (1) and issuing a service request. (1)		<b>2</b>

2017 Paper 1 Specimen

(ii) Identify one alternative usage model to a client-server network, where all workstations have equal status. (1)

Question Number	Answer	Additional Guidance	Mark
<b>6(a)(ii)</b>	Peer-to-peer / model (1)		<b>1</b>

2017 Paper 1 Specimen

(b) The pages that Shaneela designs will be accessed via a web server.

(i) Describe how someone will access the pages using the client-server model. (2)

Question Number	Answer	Additional Guidance	Mark
<b>3(b)(i)</b>	One mark for each concept:  The client makes a connection / shares its IP with the server The client machine (web browser) <b>sends a request to the server</b> for a web page The server machine <b>sends the (requested) page back</b> to the client machine		<b>2</b>

8 June 2016

## Wireless Networks

(ii) The organisation has chosen wireless connectivity over wired connectivity for its new office building. There is no significant difference in the cost of installing either. Give three reasons why the organisation might prefer wireless connectivity. (3)

Question Number	Answer	Additional Guidance	Mark
<b>3(a)(ii)</b>	Any three from: <ul style="list-style-type: none"> <li>• May not have space for cables to be installed (1)</li> <li>• Employees and visitors can move around the building without disconnecting (1)</li> <li>• Adding new users just means giving out the SSID and password (1)</li> </ul>		<b>3</b>

## Unit 5 – Issues and Impact

### Artificial Intelligence

(b) Identify the ethical issue associated with the use of artificial intelligence. (1)

- A Acceptable use policies
- B Algorithmic bias
- C Logic errors
- D Unpatched software

Question Number	Answer	Additional Guidance	Mark
1(b)	<p>B Algorithmic bias</p> <p><i>A is not correct because AUPs are not an ethical issue associated with the use of artificial intelligence</i></p> <p><i>C is not correct because logic errors are not an ethical issue associated with the use of artificial intelligence</i></p> <p><i>D is not correct because unpatched software is not an ethical issue associated with the use of artificial intelligence</i></p>		1

Paper 1 Specimen

5. Artificial intelligence is an emerging trend in computer science.

\*(a) Discuss the use of artificial intelligence by describing some of its characteristics, the ways in which it may be used and the ethical issues associated with its use. (6)

Question Number	Answer	Additional Guidance	Mark
5(a)	<p>Characteristics – Any of the following:</p> <ul style="list-style-type: none"> <li>• Branch of computer science based on enabling computers to behave like humans/mimic aspects of human intelligence</li> <li>• AI is implemented in software.</li> <li>• Combines psychology, biology, linguistics, mathematics, neuroscience, and philosophy (ethics)</li> <li>• AI is not the same as the general intelligence of human beings</li> </ul> <p>Uses – Any of the following:</p> <ul style="list-style-type: none"> <li>• Game playing (chess, quiz, video games)</li> <li>• Analytics (analyse buying patterns, predicting behaviours, predictive text, financial markets)</li> <li>• Image processing (recognising objects/patterns)</li> <li>• Logistics (scheduling, order fulfilment)</li> <li>• Control systems (cars, manufacturing, weapons, navigation)</li> <li>• Expert systems (medical, mechanical, electrical diagnosis)</li> <li>• Neural networks (simulating neuron behaviours as in brains)</li> <li>• Natural languages processing (chatterbots, chatbots, speech recognition)</li> <li>• Robotics (dangerous situations, help aged or disabled)</li> </ul> <p>Ethical issues – Any of the following:</p> <ul style="list-style-type: none"> <li>• Take the work of humans, thereby affecting employment rates</li> <li>• Is a computer to be trusted to make decisions (life-death)?</li> </ul>	<p>A bulleted list of facts is only worth 2 marks max.</p>	6

	<ul style="list-style-type: none"> <li>• If a computer discovers something that humans can't prove, should it be accepted as truth?</li> <li>• Do AI machines have rights?</li> <li>• Will people be comfortable interacting with machines that are considered intelligent?</li> </ul> <p>Quality of Written Communication:</p> <ul style="list-style-type: none"> <li>• 1-2: Some basic points from <b>at least one</b> of the categories; little clarification or expansion of points; spelling, grammar, and punctuation <b>errors hinder meaning</b>.</li> <li>• 3-4: At least one relevant point <b>from two categories</b>; some clarification or expansion of points; spelling, grammar, and punctuation <b>errors occur</b>, but do not hinder meaning.</li> <li>• 5-6: Relevant points from <b>three categories</b>; comprehensive clarification or expansion of points; spelling, grammar, and punctuation are <b>used accurately</b> and meaning is clear.</li> </ul> <p><b>Example:</b> Robots are machines that use artificial intelligence to do jobs that people tell them to. They are not as smart as real humans. One category only; no expansion; QWC ok; 2 marks max)</p> <p><b>Example:</b> Artificial intelligence is based on getting machines to behave like humans. The cleverness of AI is really in the software. AI is used in game playing. Recently the AI software has beat humans at some games. (Two categories; Some expansion; QWC ok; 4 marks max)</p>		
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	<p><b>Example:</b> AI is a branch of computer science that tries to make software imitate human intelligence. However, we're not there yet. It is used in expert systems to diagnose problems with car engines. It can also be used to predict which products people might buy in a grocery store based on their loyalty card purchases. There are problems with AI. One is the issue of ethics. Courts may decide that AI robots have the same rights as humans. People may not like the idea of computers making life and death decisions, such as when to turn off life support systems. This may make people very uncomfortable. (Three categories; Comprehensive expansion; QWC ok; 6 marks max)</p> <p><b>Example:</b> AI:  <ul style="list-style-type: none"> <li>• Making robots behave like humans</li> </ul> Uses:  <ul style="list-style-type: none"> <li>• Used to help people with disabilities live in normal homes</li> </ul> Ethical Issues:  <ul style="list-style-type: none"> <li>• They will be taking over human jobs and putting people out of work</li> </ul> (Three categories; QWC unmarkable; 2 marks max)</p>		
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8 June 2016

### Copyright, Patents and Trademarks

(b) To get a wristband, visitors fill in a form with their name, address, and email address.

(i) Identify a piece of legislation that will affect how the waterpark stores this data. (1)

Question Number	Answer	Additional Guidance	Mark
<b>3(b)(i)</b>	Any one of: <ul style="list-style-type: none"> <li>• Computer Misuse Act</li> <li>• Data Protection Act</li> </ul>		<b>1</b>

Sample Paper 2

Non-physical goods, such as an idea, design, song, or a programming algorithm, are susceptible to being illegally redistributed once they are stored on a computer. They may be covered by copyright, patent, or trademark laws.

(v) State the term for these non-physical goods, which are a result of original creative thought. (1)

Question Number	Answer	Additional Guidance	Mark
4(b)(v)	Intellectual property (IP)	Do not penalise spelling	1

Sample Paper 2

## Data Ownership and Rights

Byron's mobile phone tracks his location.

(c) Describe potential advantages to society of this technology and possible concerns for its use. (4)

Question Number	Answer	Additional Guidance	Mark
4(c)	<p>Any four of:</p> <ul style="list-style-type: none"> <li>• Phone can be located if reported stolen</li> <li>• Parents can track where their children are</li> <li>• Convicted law breakers can be tracked</li> <li>• Dementia patients can be located if they wander from home</li> <li>• Employees could track movement of employees, like delivery drivers</li> <li>• Emergency services can find you, even if you can't talk on the phone</li> <li>• Movements tied to other systems such as transport to be used as input to traffic control algorithms</li> <li>• Can be offered services/information relevant to location</li> <li>• Data may be collected and stored</li> <li>• Use of information may be seen as an invasion of privacy</li> <li>• Is it ethical to track vulnerable people (children, dementia)?</li> <li>• Is it ethical to track law breakers (sex offenders, parolees)?</li> <li>• Who should be allowed access to the collected position data?</li> <li>• Could law enforcement be granted automatic access or should they need a court order?</li> <li>• Employees, with a mobile phone, would still be tracked even when they weren't working for the company (evenings, holidays)</li> </ul>	<p>Any other appropriate advantage is awardable.</p> <p>Any other appropriate concern alluding to ethics or privacy.</p>	4

Sample Paper 2

(b) AJ's uses a database to structure its business data. Give two reasons for choosing to structure the business data. (2)

Question Number	Answer	Additional Guidance	Mark
4(b)	<p>Any two of the following</p> <p>Easier / faster to:</p> <ul style="list-style-type: none"> <li>○ Sort</li> <li>○ Search (by using queries)</li> <li>○ Produce reports</li> <li>○ Analyse data</li> <li>○ Keep organised</li> </ul>	<p>Do not accept:</p> <ul style="list-style-type: none"> <li>• Primary or foreign keys</li> <li>• Relationships</li> <li>• Tables</li> <li>• Relational Database</li> </ul>	2

3 June 2015

(c) A travel company supports international travellers.

Discuss the legal and ethical issues associated with the company's collection and use of data. Your answer should consider: (6)

- the rights of data subjects
- the responsibilities of the travel company

Question Number	Indicative content
4(c)	<p>Discuss the legal and ethical issues associated with the company's collection and use of data.</p> <p><b>Legal responsibilities of the travel company</b></p> <ul style="list-style-type: none"> <li>• Purpose of the data being collected must be revealed to the subject, e.g. personal/passport data used to book international travel</li> <li>• Data should only be used for the purpose specified and not be disclosed to third parties without permission, e.g. use of data to pass to third-party marketing companies (car hire / hotels / airlines)</li> <li>• Data collected must not be excessive, e.g. data must have some relevant connection to travelling</li> <li>• Data held must be accurate and up to date, so the company must check customers' personal details regularly</li> <li>• Ensure data must not be kept longer than necessary e.g. past one year on from last customer contact</li> <li>• Because the company supports travellers from other countries, they cannot transfer data to countries without adequate protection and should check that their own laws are comparable with those countries from which travellers originate and to which they will travel/share data</li> <li>• Data must be stored securely and prevent unauthorised access e.g. use of effective data security measures including policies and network practices.</li> </ul> <p><b>Legal rights of data subjects</b></p> <ul style="list-style-type: none"> <li>• Right for data to be processed appropriately (as outlined above)</li> <li>• Right to access data held about them to check and update it</li> </ul> <p><b>Ethical responsibilities of the travel company</b></p> <p>Where data subjects consent to wider uses, the company must</p> <ul style="list-style-type: none"> <li>• Consider how the data will be used, e.g. automated decision making to find the best/cheapest/environmentally friendly routes/destinations</li> <li>• Ensure that individuals' needs are considered, e.g. those with disabilities / different age groups / families</li> <li>• Anonymise data used for statistical analysis so that individuals cannot be identified</li> </ul>

September 2020

## Environmental considerations

(c) State one way users could reduce the environmental impact of digital technology. (1)

Question Number	Answer	Additional Guidance	Mark
1(c)	<p>Any <b>one</b> from:</p> <ul style="list-style-type: none"> <li>• Reduce use</li> <li>• Responsible Disposal (to prevent leaking chemicals)</li> <li>• Recycling</li> <li>• Reuse</li> <li>• Replace devices less frequently</li> <li>• Use power-saving options (such as black screen)</li> </ul>		<b>1</b>

Paper 1 Specimen

4. AJ's is a fast-food company with five outlets. The outlets are connected via the Internet to the head office. Data from each outlet is transmitted to the head office computers at the end of each day.

(a) AJ's chief executive is concerned about the environmental impact of using computers. Give three possible environmental impacts of using computing devices.

Suggest one possible action AJ's could take to reduce the environmental impact. (4)

- Impact 1
- Impact 2
- Impact 3
- Action

Question Number	Answer	Additional Guidance	Mark
4(a)	<p>Any three of the following impacts:</p> <ul style="list-style-type: none"> <li>• Pollution (water, air, noise) resulting from the manufacturing process</li> <li>• High energy and water volumes needed for the manufacturing process</li> <li>• Mineral mining contaminates ground water</li> <li>• Mineral (copper, gold, silver, lithium) resource depletion</li> <li>• High energy use to keep machines cool with air conditioning or fans</li> <li>• Contain toxic components which means computing devices are hazardous waste</li> <li>• Batteries (laptop, lithium cells) disposal is hazardous and needs specialised disposal facilities</li> <li>• Computing devices sent to landfills contaminate ground and water resources</li> <li>• Any other appropriate responses as long as they're distinct from each other</li> </ul> <p>Any one of the following actions:</p> <ul style="list-style-type: none"> <li>• Check national and local legislation</li> <li>• Some countries/states/regions require sellers to recycle own waste</li> <li>• Research recycling facilities to see if e-waste is acceptable</li> <li>• Find if local/national/regional government agencies charge for collection and disposal of e-waste</li> <li>• Find sellers offering exchange old for new + cost purchase options</li> <li>• Find charities (local, regional) which take donations of old devices</li> <li>• Turn off machines when not in use to save energy.</li> <li>• Any other appropriate response as long as it is interpretable to match an impact.</li> </ul>	<ul style="list-style-type: none"> <li>• 3 marks maximum for environmental impacts</li> <li>• 1 mark maximum for suggestion to reduce environmental impact</li> <li>• Suggestion does not have to follow impact.</li> <li>• Example: Mining of minerals pollutes the water and depletes valuable mineral stocks. Ground water is contaminated by sending batteries to landfill sites. Energy can be saved by turning the machines off at night. (4 marks)</li> </ul>	4

3 June 2015

(e) Explain why cloud storage companies often locate their servers in cold countries to protect the environment. (3)

2(e)	An explanation to include <b>three</b> linked points from: To reduce electricity usage (1) because servers generate lots of heat (1), which would otherwise require air conditioners (1) that can be replaced with natural cooling systems [e.g. water pumped from rivers] (1)		3
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11 May 2020

(c) The hotel chain is considering replacing local backup methods with 'cloud' storage. Discuss the advantages and disadvantages of using 'cloud' storage for backup. (6)

Question Number	Answer	Additional Guidance	Mark
2(c)	<p>Indicative content:</p> <ul style="list-style-type: none"> <li>• Cost - can be cheaper than hardware / can cost a lot for large amounts of data</li> <li>• Space - likely to get more than on physical drives</li> <li>• Scalability</li> <li>• Trust / Control</li> <li>• Physical security</li> <li>• Access (read/write) speeds and impact on uses/applications</li> <li>• Shared storage vs dedicated</li> <li>• Often belongs to a third party</li> <li>• Bandwidth limitation</li> <li>• Data vulnerability due to unknown provider</li> <li>• Access from any Internet devices</li> </ul>		6

13 May 2019

5. (c) Explain two ways in which the improper disposal of digital devices could be harmful to human health. (4)

Question Number	Answer	Additional Guidance	Mark
5(c)	<ul style="list-style-type: none"> <li>Disposal of digital devices in a landfill (1) could cause dangerous chemicals/toxins to leak (1) into drinking water (1).</li> <li>Reclaiming precious metals (1) exposes workers to more dangerous chemicals/materials (1) by contact during handling (1).</li> <li>Incineration of digital devices (1) causes chemicals/toxins to be released into the air (1), which could then be inhaled (1)</li> <li>If batteries are not removed / thrown in bin (1) they can catch fire (1) creating a risk of burns (1)</li> </ul>	<ul style="list-style-type: none"> <li>All points must be connected to human health, not just to environmental damage alone</li> </ul> <p>Max 2 marks per bullet point.</p>	4

14 May 2018

## Ethics

Quantum computing is an emerging trend in computing technology.

\*(e) Discuss this statement: Quantum computing has the potential to solve problems beyond the scope of conventional computing. (6)

Question Number	Answer	Additional Guidance	Mark
3(e)	<ul style="list-style-type: none"> <li>Computers use qubits (quantum bits)</li> <li>Implemented in hardware using quantum states of a physical particle such as the spinning direction of atoms, electrons, or magnetic fields</li> <li>Qubits can be 1, 0, anything between, or both simultaneously (superposition)</li> <li>Current materials need super cooling for implementing quantum computing</li> <li>Can be used to perform millions of calculations in parallel</li> <li>Have the potential to massively speed up processing in computers</li> <li>Are very expensive because of the hardware needed</li> <li>Suitable applications in security, vision recognition, and medical diagnosis</li> <li>May be used to solve problems not considered solvable by current computers (intractable)</li> <li>Could development costs be better spent?</li> <li>May lead to current encryption algorithms being easily broken</li> </ul> <p>Quality of Written Communication</p> <ul style="list-style-type: none"> <li>1-2: One or two basic points from above; Technical terminology may not be used correctly; May be high-level using everyday terms; Spelling, grammar, and punctuation errors hinder meaning.</li> <li>3-4: Three or more relevant points from above; Some technical terminology used appropriately; Spelling, grammar, and punctuation errors occur, but do not hinder meaning.</li> <li>5-6: Four or more relevant points from above; Technical terminology used appropriately and consistently; Spelling, grammar, and punctuation are</li> </ul>		6

	<p>used accurately and meaning is clear.</p> <p><b>Example:</b> In quantum computers the bits can be 1 and 0 at the same time. It's very expensive to make one. (One point; Lack of technical terminology; QWC ok; 2 marks max)</p> <p><b>Example:</b> Quantum computers use qubits, which can be 1 and 0 at the same time. They are very fast, so in the future our computers will be much quicker. (Three points; Technical terminology acceptable; QWC ok; 4 marks max)</p> <p><b>Example:</b> Quantum computers use qubits, which can be 1 and 0 at the same time. This speeds up the number of instructions done per second. These computers need super cooling to work, so they're very expensive to produce right now. Because they're so fast it means they could be used to solve problems that take a long time like cracking some encryption codes. (Five points; Technical terminology appropriate; QWC ok; 6 marks max)</p> <p><b>Example:</b> Quantum computing</p> <ul style="list-style-type: none"> <li>• Uses qubits</li> <li>• Can be 1 and 0 at the same time</li> <li>• Are very fast</li> </ul> <p>(Two points; Some technical terminology ; QWC unmarkable; 2 marks max)</p>		
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Sample Paper 2

(c) Describe the role of an ethical hacker. (3)

Question Number	Answer		Mark
<b>7(c)</b>	<p>An ethical hacker is a computer / networking expert who works on behalf of the system owners (carries out penetration testing) (1) to find security vulnerabilities that a malicious hacker could exploit. (1)</p> <p>They document vulnerabilities / provide advice on how to fix them. (1)</p>		<b>3</b>

2017 Paper 1 Specimen

1. Issues and impact (a) State two methods of protecting intellectual property. (2)

Question Number	Answer	Additional Guidance	Mark
<b>1(a)</b>	<p>Any <b>two</b> from:</p> <ul style="list-style-type: none"> <li>• Copyright</li> <li>• Patents</li> <li>• Trademarks</li> <li>• Licensing</li> <li>• Non-disclosure agreement</li> <li>• Limit access to sensitive information</li> <li>• Awareness training for employees</li> </ul>		<b>2</b>

Paper 1 Specimen

(d) Inclusion is an ethical concern.

A school has decided to allow students to bring their own digital device to use in class.

Assess the impact of the school's decision on its ability to be inclusive. (4)

Question Number	Answer	Additional Guidance	Mark
7(d)	<p>A response to include <b>two linked</b> points, such as:</p> <ul style="list-style-type: none"> <li>Some children may not have devices / can afford devices (1), so the school might have to provide them (1)</li> <li>Some students will have more advanced devices (1), thereby having different learning opportunities (1)</li> <li>Screen readers / facilitating programs (1) improve access for students with disabilities (1)</li> <li>Access may not be appropriate (1) for students from some religions / cultures (1)</li> <li>Opens opportunities for access to experts (1) thereby providing for individual needs (1)</li> </ul>		4

13 May 2019

## Laws

2. Charles is a computer programmer for a company that sells digital products through the Internet. He must be aware of the ethical and legal issues arising from the use of computers.  
(a) Identify the legislation that applies in each situation. (3)

Situation	EU Cookie Law (e-Privacy Directive)	Computer Misuse Act	Copyright, Designs and Patents Act
A teenager was given a computer game for her birthday. She gives a copy of the game to her friend.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A university student tries to gain access to government computers, even though he is not a registered user.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A company has been storing small files on users' computers to track the use of its website, but is not telling them.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Question Number	Answer	Additional Guidance	Mark												
2(a)	<table border="1"> <thead> <tr> <th>EU Cookie Law (e-Privacy Directive)</th> <th>Computer Misuse Act</th> <th>Copyright, Designs, and Patents Act</th> </tr> </thead> <tbody> <tr> <td></td> <td></td> <td>X</td> </tr> <tr> <td></td> <td>X</td> <td></td> </tr> <tr> <td>X</td> <td></td> <td></td> </tr> </tbody> </table>	EU Cookie Law (e-Privacy Directive)	Computer Misuse Act	Copyright, Designs, and Patents Act			X		X		X				3
EU Cookie Law (e-Privacy Directive)	Computer Misuse Act	Copyright, Designs, and Patents Act													
		X													
	X														
X															

8 June 2018

## Malware

- (d) Explain one reason why an employee who is logged on to the company network should not click on a link in an email from an unknown source. (2)

Question Number	Answer	Additional Guidance	Mark
1(d)	<p>An explanation to include <b>two</b> from:  It increases the risk to data / reduces cybersecurity (1) because the sender could be using social engineering techniques / the link could lead to a malicious website / could download malware (1)</p>		2

Paper 1 Specimen

- (d) This notification appears on a computer screen.

**Thank you for clicking our link.**  
Your important files are no longer accessible.



**Can I get access to my files?**  
Yes, you can. Simply send your payment as described below.

**How long do I have?**  
14 days.

**How do I pay?**  
Send £500 in Bitcoin to abc123def456ghi789.

Describe how this cyber attack operates. (3)

Question Number	Answer	Additional Guidance	Mark
6(d)	A description such as:  Ransomware / malicious attachment/download (1) encrypts the user's files (1). To get the key/decrypt the files (1) ... ...(the user must pay a ransom to the code writers / remove the malware)	Do not accept 'link' for mp1	3

13 May 2019

(a) Identify the two types of malware that replicate their code. (2)

- A Key logger
- B Ransomware
- C Trojan
- D Virus
- E Worm

Question Number	Answer	Additional Guidance	Mark
4(a)	D Virus E Worm  <i>A is not correct because keyloggers record keystrokes and send them to a third party</i> <i>B is not correct because Ransomware prevents access to a system, or files</i> <i>C is not correct because a Trojan is malware disguised as legitimate software</i>		2

September 2020

(b) Explain one reason why software should be patched regularly. (2)

Question Number	Answer	Additional Guidance	Mark
4(b)	An explanation to include <b>two</b> from:  It helps prevent unauthorised access to data (1) <ul style="list-style-type: none"> <li>• because security issues could be missed in development (1)</li> <li>• because there could be interactions with other software (1)</li> <li>• because a malicious user could have published a vulnerability on the web (1)</li> <li>• because sometimes vulnerabilities only become apparent after code has been released to the public (1)</li> </ul>		2

September 2020

Virtualisation

6. (d) Virtualisation uses layers of abstraction to hide the details of hardware devices and processes from the end user.

‘Cloud storage can be viewed as a virtualisation.’

Discuss this statement. (6)

Question Number	Answer	Additional Guidance	Mark
<b>6(d)</b>	<p>Indicative content</p> <ol style="list-style-type: none"> <li>1. All of the items appear to be stored on one single device.</li> <li>2. The virtual device appears to be storage on the local machine.</li> <li>3. Software sits between the physical devices and the user.</li> <li>4. The items stored on the cloud could be scattered over several different physical hard discs/servers.</li> <li>5. The items stored on the cloud could be resident in different locations.</li> <li>6. Files need to be accessed via a network/internet.</li> <li>7. Procedures (e.g. backup) happen without the end user being aware or involved.</li> </ol>		<b>6</b>

14 May 2018

Computer programs can also simulate other machines.

(ii) State the general term for a type of computational machine that is a software simulation of a real machine. (1)

Question Number	Answer	Additional Guidance	Mark
<b>4(a)(ii)</b>	Virtual Machine		<b>1</b>

Sample Paper 2