OCR
Oxford Cambridge and RSA

Friday 19 November 2021 – Afternoon

GCSE (9–1) Computer Science

J276/02 Computational thinking, algorithms and programming

Time allowed: 1 hour 30 minutes

Do not use:
- a calculator

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

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

INSTRUCTIONS
- Use black ink.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.

INFORMATION
- The total mark for this paper is **80**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **16** pages.

ADVICE
- Read each question carefully before you start your answer.

Answer **all** the questions.

1 ASCII, extended ASCII and Unicode are all examples of character sets.

(a) Tick (✓) **one or more** boxes in each row to identify whether each statement applies to each character set.

	ASCII	**Extended ASCII**	**Unicode**
Can represent thousands of different characters, including Russian and Chinese symbols.			
Can represent European characters such as ç or â.			
Uses different character codes for upper-case and lower-case letters.			

[3]

(b) The character **D** is represented by the binary ASCII code **1000100**

Give the ASCII code for the following characters in binary.

E .....

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H .....

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[2]

(c) Sound data is also sampled and stored in binary.

A 30-second section of sound data is sampled at a rate of 48 KHz using 24 bits per sample.

(i) Describe the data that is recorded when sound is sampled.

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

(ii) Explain what is meant by a sample rate of **48 KHz**.

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(iii) Describe how the file size of the sound recording could be reduced.

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

2 An insertion sort is used to put the following words into ascending alphabetical order.

pumpkin	flour	wall	house	wall

(a) Tick (✓) **one** box in each row to identify whether each statement about the insertion sort is true or false.

Statement	True (✓)	False (✓)
The list of words is initially split into a sorted set and an unsorted set.		
The insertion sort uses a divide stage and then a conquer stage.		
The list of words must be in order before the insertion sort can start.		
Each word is inserted into the correct place in the array, one by one.		
The insertion sort will not work because the word “wall” appears twice.		

[5]

(b) The sorted list of words is shown below.

flour	house	pumpkin	wall	wall

Explain how a binary search would be used to try to find whether the word “house” appears in this list.

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

3 Taylor is writing an algorithm to record the results of an experiment.

Taylor needs to be able to enter a numeric value which is added to a total which initially starts at 0.

Every time she enters a value, the total is output.

The algorithm repeats until the total is over 100.

(a) Write an algorithm to implement Taylor's requirements.

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

(b) The input to the program could be an integer or real value.

(i) State what is meant by a real data type **and** give an example of this data type.

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

(ii) State what is meant by an integer data type **and** give an example of this data type.

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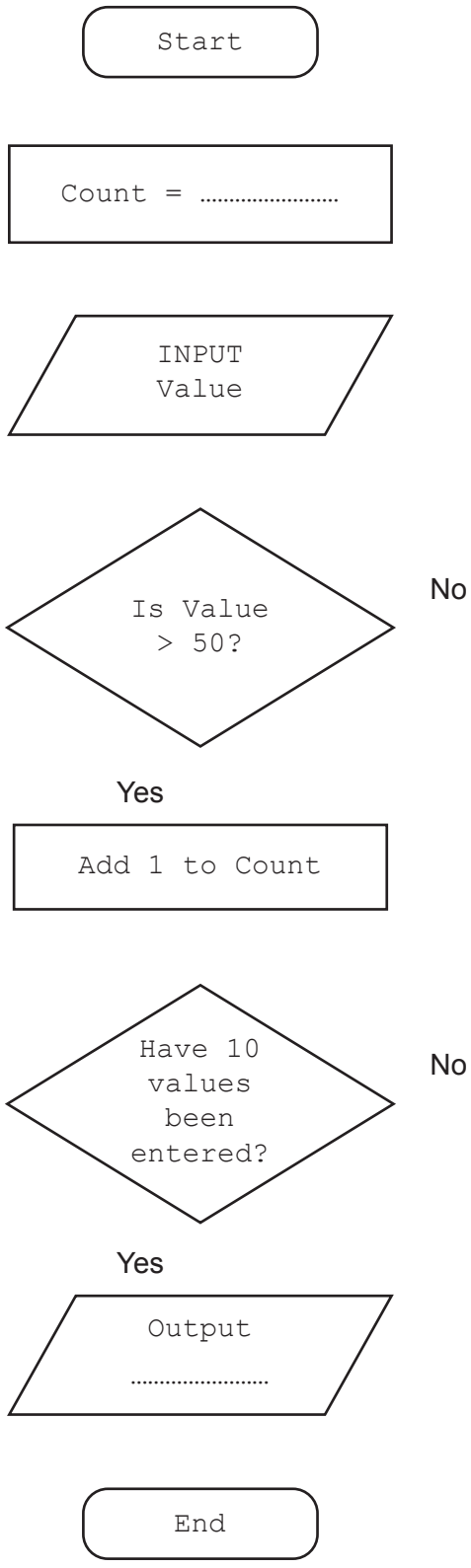
..... **[2]**

(c) For the next part of the experiment, Taylor needs to be able to enter 10 values and count how many of the values are over 50, outputting this value once all values have been entered.

(i) Complete the following flowchart to implement this algorithm.



[5]

(ii) Write a pseudocode algorithm that uses iteration to allow Taylor to:

- enter 10 values
- count how many values are over 50
- output the count of values over 50 after all 10 values are entered.

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..... **[5]**

(d) Taylor used computational thinking techniques to develop the algorithms.

Give **two** computational thinking techniques that Taylor has used, describing how they have been used.

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[4]

4 A programmer declares the following variables.

```
first = "Computer Science"
second = "is great"
```

(a) State **one** difference between a variable and a constant.

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

(b) State the output from the following lines of program code.

(i) `print(first.length)`

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

(ii) `print(second.length DIV 3)`

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

(iii) `print(3 ^ 2)`

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

(c) Strings can be concatenated (joined together) using the `+` operator. For example, `print("Maths " + second)` will output `Maths is great`

Use string manipulation with the variables `first` and/or `second` to produce the following output.

(i) `great`

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

(ii) `Computer`

.....

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

(iii) `Science is great`

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

5 **(a)** Convert the denary value **178** into an 8-bit binary number.

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

(b) Computers make use of electronic switches called transistors.

Describe how transistors can be used to store a value in binary.

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

(c) Convert the binary value **1100 0111** into hexadecimal.

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

(d) Azmi says, "hexadecimal is used because it takes up less storage space in the computer's memory than binary."

Tick **one** box to identify whether Azmi is correct. Justify your answer.

	Tick (✓)
Correct	
Incorrect	

Justification .....

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[2]

(e) Binary shifts can be used for multiplication and division.

Draw **one** line from each shift on the left to its correct outcome on the right.

Binary shift	Outcome
Right shift of 2 places on 1010 1000	0011 1010, divides by 4 with a loss of precision
Left shift of 1 place on 0010 1101	0010 1010, divides by 4
Right shift of 2 places on 1110 1001	0101 1010, multiplies by 2
Left shift of 3 places on 0001 1111	1111 1000, multiplies by 8

[3]

(f) Add the following 8 bit binary integers, giving your answer in binary.

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  0 0 1 1 0 1 1 0
+ 1 0 0 1 0 1 1 0
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```

[2]

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6 OCRBlocks is a game played on a 5 × 5 grid. Players take it in turns to place blocks on the board. The board is stored as a two-dimensional (2D) array with the identifier `gamegrid`

Fig. 6.1 shows that players A and B have placed three blocks each so far.

	0	1	2	3	4
0	A			B	
1					
2		B			
3	A		B		
4			A		

Fig. 6.1

The function `checkblock()` checks whether a square on the board has been filled. When `checkblock(4,2)` is called, the value "A" is returned.

```
function checkblock(r,c)
    if gamegrid[r,c] == "A" or gamegrid[r,c] == "B" then
       outcome = gamegrid[r,c]
    else
       outcome = "FREE"
    endif
    return outcome
endfunction
```

(a) Give the returned value when the following statements are called.

Function call	Returned value
`checkblock(2,1)`	
`checkblock(3,0)`	
`checkblock(2,3)`	

[3]

(b) State **one** feature of `checkblock()` that shows that it is a function and not a procedure.

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

(c) When `checkblock(-1,6)` is called, an error is produced.

(i) State why this function call will produce an error.

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

(ii) Describe how validation could be added in to the `checkblock()` function to stop this error from occurring.

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

(d) Write an algorithm to allow player A to select a position for their next block on the game board.

The algorithm must:

- ask the player for the position of their block on the board
- use the `checkblock()` function to check if this position is free
- if the position is free, add the letter "A" to the position chosen in the `gamegrid` array
- if the position is not free, repeat the above steps until a free position is chosen.

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END OF QUESTION PAPER

ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).