

Q1. A program is being developed that allows users to rate and review movies. A user will enter their rating (out of 10) and a written review for each movie they have watched.

Computational thinking skills are used during the development of the program.

Define the term **abstraction**.

(1 mark)

Q2. For a binary search algorithm to work correctly on an array of integers, what property must be true about the array?

(1 mark)

Q3. Define the term algorithm.

(2 marks)

Q4. The following are computer science terms (labelled **A – E**).

- A)** assignment
- B)** data type
- C)** decomposition
- D)** efficiency
- E)** input

For each of the following definitions, write the label of the most suitable computer science term. Use a label only once.

- 1) Breaking a problem down into a number of sub-problems
- 2) The process of setting the value stored in a variable
- 3) Defines the range of values a variable may take

(3 marks)

Q5a. A developer is developing a program for a client. The developer is given the following instructions.

“Many of my friends ask me to walk their dogs for them. All of these friends pay me to do this and the amount I get paid depends on how long I walk their dogs for. If they have more than one dog then I don’t charge the owner any extra. I like to walk the dogs in the afternoon when the weather is normally best because I often get colds. I need you to help me keep track of how much I’m owed – fortunately for me all of my friends have different first names so it is really easy to tell them apart. I charge £10 for every 30 minutes of the walk (and I always round this up so 47 minutes would be two half-hour charges or £20).”

The developer needs to remove all of the unnecessary detail from the client’s request. Which of the following options is the name for this process.

- A) Abstraction
- B) Conversion
- C) Decomposition
- D) Validation

(1 mark)

Q5b. The developer has decided that the following two points are the only important details from the client's request.

- The charge is based on time and not how many dogs are walked.
- The charge is £10 every 30 minutes.

State **two** other relevant details that the developer has missed.

(2 marks)

Q6. State **one** advantage and **one** disadvantage of merge sort when compared to bubble sort.

(2 marks)

Q7. A developer is using the structured approach to developing a solution and wants to write a subroutine to solve one of the sub-problems. This subroutine should have the following interface:

- The subroutine is called `find_minimum`
- The subroutine takes an array (of integers) as a parameter
- The subroutine returns the smallest value in the parameter array.

Using pseudo-code, write a subroutine that solves this sub-problem.

(7 marks)

Q8a. A programmer wants to implement a search algorithm to be used with small arrays. The figure below shows an example array.

[4, 6, 8, 12, 15, 16, 21]

Using the figure above, explain how linear search would search for the integer 15.

(4) marks

Q8b. What property of the example array in above the figure above means the programmer could use a binary search algorithm?

(1 mark)

Q8c. The programmer knows that a binary search algorithm is more efficient than a linear search algorithm. Explain why the efficiency of these two algorithms is not an important factor when choosing what algorithm to implement for the array in the figure above.

(2)

Q9. An English teacher wants to estimate how long it should take his students to read a book. You have been asked to develop an algorithm to calculate this estimate. The algorithm must do the following:

- ask the teacher how many pages the book has and store this in an appropriately named variable.
- for every page in the book the algorithm should:
 - ask the teacher if the page looks 'easy' or 'difficult'
 - if a page is 'difficult' then the total number of seconds should increase by 100
 - if a page is 'easy' then the total number of seconds should increase by 40
- after the teacher has entered the difficulty level for all the pages, the algorithm should output the estimated number of seconds that it should take to read the book.

Write pseudocode that represents this algorithm.

(9 marks)

Q10a. Write a program for a game (using either **pseudocode** or a **flowchart**) that does the following:

- assigns the value "mobile" to a variable called `answer`
- then assigns user input to another variable called `guess`
- if the user enters the value "mobile" then the program outputs "winner", otherwise it allows the user to have another guess
- allows the game to continue until the user guesses correctly.

(6 marks)

Q10b. The programmer is going to make a simple improvement to the game by including a variable to keep track of the number of guesses made.

State **two** other simple improvements that could be made to the program.

(2 marks)

Mark schemes

Q1.

Mark is for AO1 (recall)

Removing unnecessary detail (from the problem);
data / information in place of detail for this year only
(Max 1 mark)

Q2.

1 mark for AO1 (understanding)

(The array) must be ordered / sorted;
(Max 1 mark)

Q3.

2 marks for AO1 (recall)

A sequence of steps/instructions;
that can be followed to complete a task;
Different wording with similar meaning
(Max 2 marks)

Q4.

3 marks for AO1 (recall)

One mark for each correct distinct label.
Breaking a problem down into a number of sub-problems = C, decomposition
The process of setting the value stored in a variable = A, assignment
Defines the range of values a variable may take = B, data type
(Max 3 marks)

Q5a

1 mark for AO1 (recall)

Abstraction;
(Max 1 mark)

Q5b

2 marks for AO2 (apply)

All friends have different first names;
The time is rounded up to the nearest half-hour;

2

[3]

Q6.

2 marks for AO1 (knowledge and understanding)

Advantage of merge sort:

Algorithm can sort a list more quickly (in most cases); algorithm is more efficient

Disadvantage of merge sort (**Max 1**):

Algorithm requires additional storage space during the sort; **A.** more memory is needed
Algorithm is more difficult to code; **A.** algorithm requires more lines of code

(Max 2 marks)

Q7.

Marks are for AO3 (program)

Marks awarded as follows as part of the students pseudocode answer:

- A. Define a subroutine with the identifier `find_minimum`;
- B. The subroutine has an array as an input variable (inspect code to check this input variable is an array)
- C. Declare a variable to keep track of the minimum value (award even if logic to calculate minimum is incorrect)
- D. The variable in mark B has the capability in the pseudo-code to be assigned different values from the array
- E. Use of iteration to loop over entire array
- F. Use of selection to check if current element in array is less than variable in mark B (award even if iteration logic is incorrect or absent)
- G. The variable in mark B is returned at the end of the subroutine.

(Max 7 marks)

Q8a.

Marks are for AO2 (apply)

Max of 4 marks:

The search begins with the first element / 4;
The element is compared to the value being searched for / 15;
The search iterates over the elements sequentially;

If the element in the array does not match the value being searched for then the iteration continues;
 The search returns true / the position of the element if the value is found in the array;
 a Boolean value / flag is set to True if the value is found;
 If the value is not found then the search returns False / -1 / other appropriate value;

(Max 4 marks)

Q8b.

Mark is for AO2 (apply)

It is sorted;

(Max 1 mark)

Q8c.

Marks are for AO2 (apply)

The arrays are small (so);
 The run-time of both algorithms will be very similar //
 The difference in run-time will be negligible;
 (Max 2 marks)

Q9.

Marks awarded as follows (allow any logically equivalent and correct answer). The marks are labelled A – I and shown in the examples where they are awarded:

- A. **1 mark** for assigning user input to a variable (permit any variable name, `pages` has been used in the examples);
- B. **1 mark** for creating a variable that stores the total number of `seconds` (permit any variable name, `seconds` has been used in the examples) and instantiating this to zero (mark can only be awarded if this is declared **outside** of the loop);
- C. **1 mark** for using a loop to iterate over every page (two logically equivalent examples are given below although there are many logically equivalent ways to accomplish this);
- D. **1 mark** for asking for the user input for the page difficulty;
(Note that no marks are awarded for validating the user input)
- E. **1 mark** for using selection to decide if user input is `easy` (this does not need to be explicit and could possibly be the ELSE clause where the IF is asking if it is `difficult`);
- F. **1 mark** for using selection within the loop;
- G. **1 mark** for increasing the number of seconds by 40 within the correct selection block;
- H. **1 mark** for increasing the number of seconds by 100 within the correct selection block;
- I. **1 mark** for outputting the total number of seconds taken **outside** of the loop.

(Max 9 marks)

Q10a.

This question will be answered using pseudocode.

Pseudocode answer as follows (permit any correct solution that differs from here but marks can only be awarded for the points labelled below):

1 mark for correct assignment of mobile to answer (allow mobile without speech marks)

```
answer ← "mobile"
```

1 mark for correct assignment of user input to guess

```
guess ← USERINPUT
```

1 mark for correctly declared WHILE loop

1 mark for using a Boolean expression that checks that answer is not equal to guess (could also be "not (answer = guess)" or similar)

```
WHILE answer ≠ guess
```

1 mark for a statement that reassigns user input to guess within the WHILE loop.

```
    guess ← USERINPUT  
ENDWHILE
```

1 mark for outputting "winner" as long as it is declared outside of the loop (unless enclosed within correct IF statement)

```
OUTPUT "winner"
```

(Max 6 marks)

Q10b.

Any two different, suitable improvements such as:

- Keep a high score.

- Allow another user to enter the value to be guessed.

- Allow another go.

- Display corrected guessed letters

1 mark for each correct answer.

(Max 2 marks)