Cambridge Assessment International Education

Example Candidate Responses – Paper 3

Cambridge International AS & A Level Computer Science 9618

For examination from 2021

Cambridge Pathway

Contents

Introduction

The main aim of this booklet is to exemplify standards for those teaching Cambridge International AS & A Level Computer Science 9618, and to show how different levels of candidates' performance (high, middle and low) relate to the subject's curriculum and assessment objectives.

In this booklet candidate responses have been chosen from the June 2021 exam series to exemplify a range of answers.

For each question, the response is annotated with a clear explanation of where and why marks were awarded or omitted. This is followed by examiner comments on how the answer could have been improved. In this way, it is possible for you to understand what candidates have done to gain their marks and what they could do to improve their answers. There is also a list of common mistakes candidates made in their answers for each question.

This document provides illustrative examples of candidate work with examiner commentary. These help teachers to assess the standard required to achieve marks beyond the guidance of the mark scheme. Therefore, in some circumstances, such as where exact answers are required, there will not be much comment.

The questions, mark schemes and inserts used here are available to download from the School Support Hub. These files are:

9618 June 2021 Question Paper 32

9618 June 2021 Mark Scheme 32

Past exam resources and other teaching and learning resources are available on the School Support Hub:

www.cambridgeinternational.org/support

How to use this booklet

This booklet goes through the paper one question at a time, showing you the high-, middle- and low-level response for each question. The candidate answers are set in a table. In the left-hand column are the candidate answers, and in the right-hand column are the Examiner comments.

Example Candidate Response – high	Examiner comments
2 (a) Describe the purpose of a user-defined data type. data type created by user using other built in data types and to extend built-in data types to suit their program's needs and criteria [2] (b) Define, using pseudocode, the following enumerated data types: (i) SchoolDay to hold data about the day's students are usually in school. SchoolDay (Monday, Tuesday, Wednesday, Thursday, Friday) DECLARE [1] [1]	1 The candidate correctly identifies that the new data type uses existing data types. 2 The candidate correctly identifies that user-defined data types extend the flexibility of the programming language to suit their needs. Mark for (a) = 2 out of 2 Mark for (b)(i) = 0 out of 1

Answers are by real candidates in exam conditions. These show you the types of answers for each level. Discuss and analyse the answers with your learners in the classroom to improve their skills.

Examiner comments are alongside the answers. These explain where and why marks were awarded. This helps you to interpret the standard of Cambridge exams so you can help your learners to refine their exam technique.

How the candidate could have improved their answer

- **(a)** The candidate could have specifically explained that this would extend the flexibility of the programming language, rather than just referring to their program's needs.
- **(b)(i)** and **(b)(ii)** The candidate needed to use the word `TYPE` rather than `DECLARE` when they defined both the data types.

This section explains how the candidate could have improved each answer. This helps you to interpret the standard of Cambridge exams and helps your learners to refine their exam technique.

Common mistakes candidates made in this question

- **(c)**, **(b)(i)** and **(b)(ii)** Many candidates used `DECLARE` instead of `TYPE`.
- **(d)** Some candidates missed out `DECLARE`.
- **(c)** Some candidates used the same identifier for the declaration as they did for the `TYPE` in **(b)(i)** and **(b)(ii)**.

Often candidates were not awarded marks because they misread or misinterpreted the questions.

Lists the common mistakes candidates made in answering each question. This will help your learners to avoid these mistakes and give them the best chance of achieving the available marks.

Question 1

Example Candidate Response – high

1 Real numbers are stored in a computer system using floating-point representation with:

- 10 bits for the mantissa
- 6 bits for the exponent
- Two's complement form for both the mantissa and the exponent.

(a) Calculate the normalised floating-point representation of –7.25 in this system.
Show your working.

Mantissa										Exponent					
1	0	0	0	1	1	0	0	0	0	0	0	0	0	1	1

1 2

Working 7.25 = 111.01 = 0.11101 × 2^3

0111010000 000011

one's comp.: 1000101111

two's comp: 1000110000 3

[3]

(b) Calculate the denary value of the given binary floating-point number.
Show your working.

Mantissa										Exponent					
1	0	1	1	0	0	0	1	1	1	0	0	0	1	1	1

Working 1.0111000111 × 2^7 000111 = 7 4

10111000.111 5

-128 + 49.75 = -78.25 6

Answer

[3]

Examiner comments

1 The candidate is awarded one mark for the correct answer.

2 The candidate calculates the exponent.

3 The candidate finds the two's complement of the mantissa.

Mark for (a) = 3 out of 3

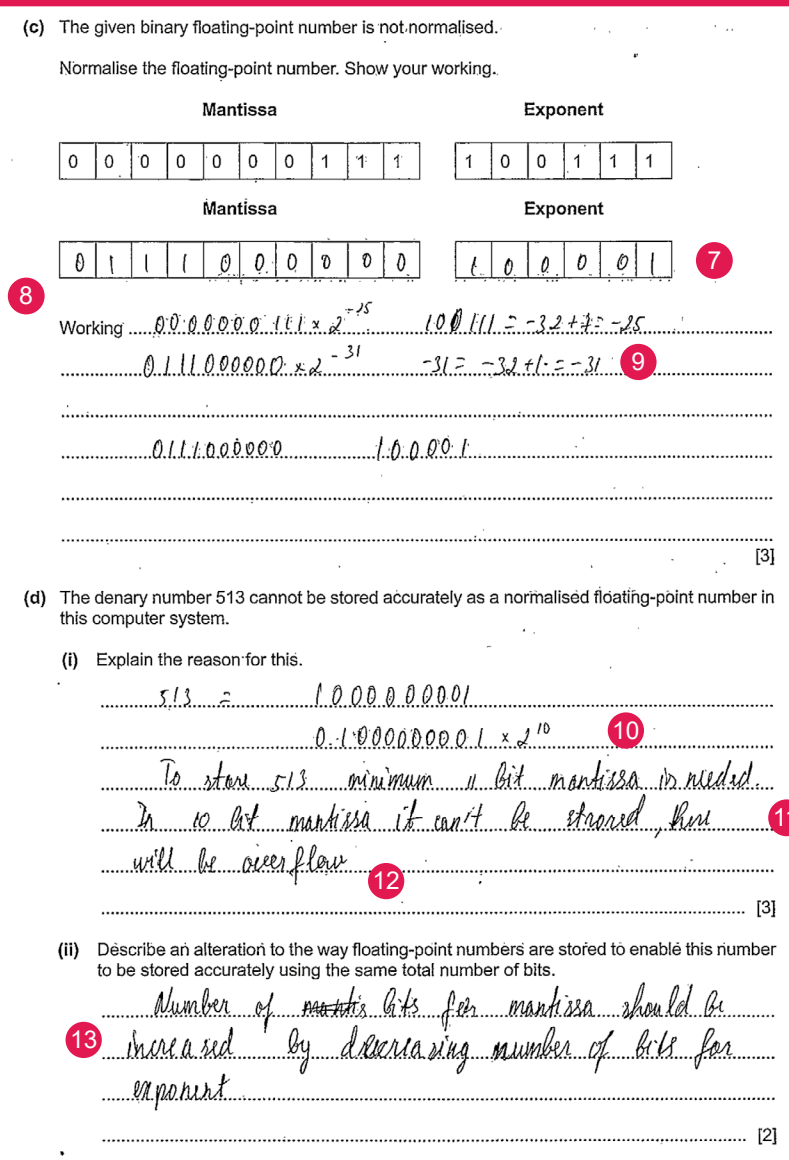
4 The candidate calculates the denary value of the exponent.

5 The candidate moves the binary point of the value stored in the mantissa by the number of places given in the exponent.

6 The candidate is awarded one mark for showing the correct answer including the sign.

Mark for (b) = 3 out of 3

Example Candidate Response – high, continued



(c) The given binary floating-point number is not normalised.

Normalise the floating-point number. Show your working.

Mantissa										Exponent					
0	0	0	0	0	0	0	1	1	1	1	0	0	1	1	1

Mantissa										Exponent					
0	1	1	1	0	0	0	0	0	0	1	0	0	0	0	1

7

8

Working 00.0000011 × 2^{-25} 10011 = −32 + 7 = −25

0.1110000000 × 2^{-31} −31 = −32 + 1 = −31 9

0.1110000000 10001

[3]

(d) The denary number 513 cannot be stored accurately as a normalised floating-point number in this computer system.

(i) Explain the reason for this.

513 = 1000000001

0.1000000001 × 2^{10} 10

To store 513 minimum 11 bit mantissa is needed. In 10 bit mantissa it can't be stored, thus 11 will be overflow 12

[3]

(ii) Describe an alteration to the way floating-point numbers are stored to enable this number to be stored accurately using the same total number of bits.

Number of ~~mantis~~ bits for mantissa should be increased by decreasing number of bits for exponent 13

[2]

Examiner comments

7 The candidate correctly calculates the exponent.

8 The candidate correctly calculates the mantissa.

9 The candidate correctly calculates that the exponent should move the point six places left.

Mark for (c) = 3 out of 3

10 The candidate correctly converts 513 to binary.

11 The candidate correctly identifies that 11 bits are needed to store the mantissa.

12 The candidate correctly identifies that there will be overflow.

Mark for (d)(i) = 3 out of 3

13 The candidate correctly identifies that the mantissa requires more bits.

Mark for (d)(ii) = 1 out of 2

Total mark awarded = 13 out of 14

How the candidate could have improved their answer

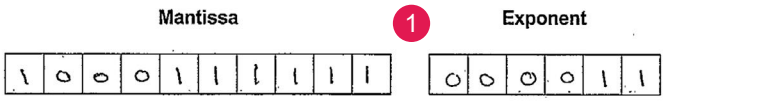
- **(a)** The candidate gave correct answers to the floating-point conversions from denary to binary and vice versa, but their working for the answers could have been more clearly annotated in places.
- **(b)** The candidate needed to write their answer to **(b)** in the space provided.
- **(c)** The candidate could have shown the point being moved six places left.
- **(d)(ii)** The candidate provided a general description of the alteration required to store the number accurately using the same number of bits, but they could have applied this to the situation described in the question. For example, the number of bits in the mantissa needed to be increased to 11 and the number of bits in the exponent needed to be decreased to 5.

Example Candidate Response – middle

1 Real numbers are stored in a computer system using floating-point representation with:

- 10 bits for the mantissa
- 6 bits for the exponent
- Two's complement form for both the mantissa and the exponent.

(a) Calculate the normalised floating-point representation of –7.25 in this system.
Show your working.



Working 7 → 0111 0.25 → 01

+7.5 → 0111.01 2

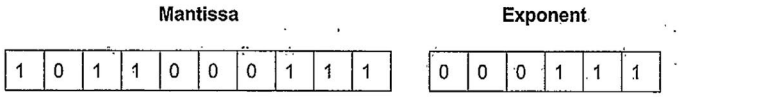
-7.5 → 1000.11

3 1.00011 x 2^3

exponent = 3

[3]

(b) Calculate the denary value of the given binary floating-point number.
Show your working.



Working exponent = 7 1.011000111 x 2^7 0.10001110001 x 2^7 4

= 1011000.111 = 01000111.01

= 1+16+32+128+2+4+0.25 = 2+4+8+64+0.25 5

= 177.25 = 78.25

Answer = 78.25 6

[3]

Examiner comments

1 The candidate incorrectly copies the value for the mantissa.

2 The candidate correctly converts +7.25 to binary.

3 The candidate correctly calculates the exponent.

Mark for (a) = 2 out of 3

4 The candidate converts the binary for the exponent to denary.

5 The candidate moves the binary point in the mantissa then converts the binary to denary.

6 The candidate writes the correct answer.

Mark for (b) = 3 out of 3

Example Candidate Response – middle, continued

(c) The given binary floating-point number is not normalised.

Normalise the floating-point number. Show your working.

Mantissa

0	0	0	0	0	0	0	1	1	1

Exponent

1	0	0	1	1	1

Mantissa

0	1	1	1	0	0	0	0	0	0

(7)

Exponent

0	1	1	1	1	1

Working ~~0.0000000111 x2~~ ~~exponent = ...~~

0.0.0.000000111 x 2^{-25} exponent = 011001 = -25

~~01110000000000000 x2~~

0.000000000000000000000000000000111 x 2^{31}

exponent = 31 = 011111 (8) 2 | 31, −16, 15

[3]

(d) The denary number 513 cannot be stored accurately as a normalised floating-point number in this computer system.

(i) Explain the reason for this.

– not enough bits for the mantissa (9)

– when number of bits for mantissa increases, accuracy of numbers increases

– must increase number of bits for mantissa

[3]

(ii) Describe an alteration to the way floating-point numbers are stored to enable this number to be stored accurately using the same total number of bits.

decreasing number of exponent bits and increasing mantissa bits by same number (10)

[2]

Examiner comments

(7) The candidate completes the mantissa correctly, but completes the exponent incorrectly with a positive value.

(8) The candidate shows their working which shows the incorrect movement of the binary point with a mantissa that is not normalised.

Mark for (c) = 1 out of 3

(9) The candidate outlines the problem without applying it to 513.

Mark for (d)(i) = 1 out of 3

(10) The candidate correctly identifies that the number of bits in the mantissa must increase.

Mark for (d)(ii) = 1 out of 2

Total mark awarded = 8 out of 14

How the candidate could have improved their answer

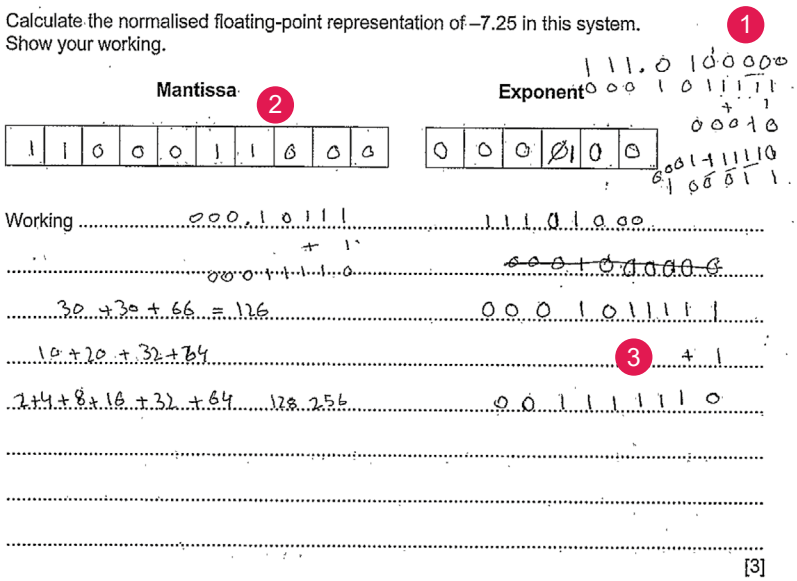
- **(a)** The candidate needed to copy the value of the mantissa after normalisation to the answer box.
- **(c)** The candidate needed to work with the given negative value for the mantissa, instead of incorrectly using the positive value.
- **(d)(i)** The candidate needed to extend the outline given to specifically explain the problem with the number 513.
- **(d)(ii)** The candidate provided a general description of the alteration required to store the number accurately using the same number of bits. To improve their answer, they could have applied this to the situation described in the question. For example, the number of bits in the mantissa needed to be increased to 11 and the number of bits in the exponent needed to be decreased to 5.

Example Candidate Response – low

1 Real numbers are stored in a computer system using floating-point representation with:

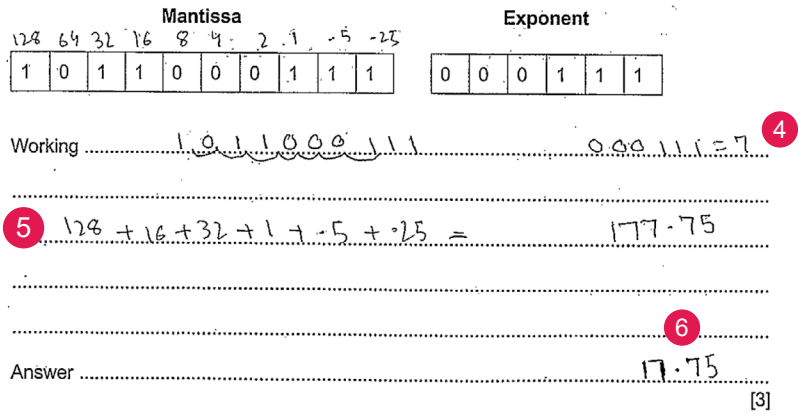
- 10 bits for the mantissa
- 6 bits for the exponent
- Two's complement form for both the mantissa and the exponent.

(a) Calculate the normalised floating-point representation of –7.25 in this system.
Show your working.



[3]

(b) Calculate the denary value of the given binary floating-point number.
Show your working.



[3]

Examiner comments

1 The candidate correctly converts +7.25 to binary.

2 Both the mantissa and the exponent show incorrect binary values.

3 The candidate's attempts at ones complement followed by twos complement are incorrect. They do not use leading zeros.

Mark for (a) = 1 out of 3

4 The candidate calculates the exponent correctly.

5 The candidate moves the binary point correctly, but the conversion to denary is incorrect because 128 should be negative.

6 The candidate gives an incorrect answer.

Mark for (b) = 1 out of 3

Example Candidate Response – low, continued

(c) The given binary floating-point number is not normalised.

Normalise the floating-point number. Show your working.

Mantissa										Exponent						
										32	16	8	4	2	1	
0	0	0	0	0	0	0	1	1	1	1	0	0	1	1	1	

1

Mantissa										Exponent						
512	256	128	64	32	16	8	4	2	1							
1	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	

Working 2

0.0000000111 7 39 − 7 = 32

1.1100000000 = 32

1.110

[3]

(d) The denary number 513 cannot be stored accurately as a normalised floating-point number in this computer system.

(i) Explain the reason for this.

As it has no decimal value.

[3]

(ii) Describe an alteration to the way floating-point numbers are stored to enable this number to be stored accurately using the same total number of bits. 3

Remove the decimal alteration

[2]

Examiner comments

1 The candidate gives two incorrect binary values.

2 The candidate moves the binary point one place too far to the left.

Mark for (c) = 0 out of 3

Mark for (d)(i) = 0 out of 3

3 Both of the candidate's statements in (d) are incorrect.

Mark for (d)(ii) = 0 out of 2

Total mark awarded = 2 out of 14

How the candidate could have improved their answer

- The candidate needed to be able to work with both positive and negative binary values.
- **(a)** The candidate needed to ensure that any conversion to twos complement of a negative denary number resulted in a mantissa that started with 1 rather than 0, as the first bit indicated the sign of the value stored.
- **(b)** The candidate needed to recognise that a mantissa starting with 1 needed to have a negative value.
- **(c)** When the candidate converted the binary value of the mantissa, they did not realise that if the first bit was 1 then the value of the mantissa must be negative. The candidate needed to ensure that the sign bit of the mantissa did not change during the process of normalisation.
- **(d)** The candidate needed to show that they understood how floating-point binary numbers were stored.

Common mistakes candidates made in this question

- **(a)**, **(b)** and **(c)** Many candidates did not annotate their working out.
- **(a)** and **(c)** Many candidates copied binary values incorrectly.
- **(d)(i)** Many candidates gave a general explanation that they did not apply to specific values given in the question.
- **(d)(ii)** Some candidates identified the general alteration required but did not describe how this alteration would be carried out for the situation given in the question.

Question 2

Example Candidate Response – high

2 (a) Describe the purpose of a user-defined data type.

data type created by user using other built in data types and to extend built in data types to suit to their program's needs and criteria

[2]

(b) Define, using pseudocode, the following enumerated data types:

(i) `SchoolDay` to hold data about the days students are usually in school.

SchoolDay (Monday, Tuesday, Wednesday, Thursday, Friday)

DECLARE

[1]

(ii) `WeekEnd` to hold data about the days that are not school days.

DECLARE WeekEnd (Saturday, Sunday)

[1]

(c) Define, using pseudocode, the composite data type `ClubMeet`. This will hold data about club members that includes:

- first name and last name
- the two days they attend:
  - one on a school day
  - one not on a school day.

Use the enumerated types you created in **part (b)**.

TYPE ClubMeet

DECLARE FirstName, LastName : STRING

DECLARE Day1 : SchoolDay

DECLARE Day2 : WeekEnd

ENDTYPE

[4]

Examiner comments

1 The candidate correctly identifies that the new data type uses existing data types.

2 The candidate correctly identifies that user-defined data types extend the flexibility of the programming language to suit their needs.

Mark for (a) = 2 out of 2

Mark for (b)(i) = 0 out of 1

3 The candidate uses `DECLARE` incorrectly in both definitions.

Mark for (b)(ii) = 0 out of 1

4 The candidate correctly defines the `ClubMeet` data type, using the enumerated types from **(b)**.

Mark for (c) = 4 out of 4

Total mark awarded = 6 out of 8

How the candidate could have improved their answer

- **(a)** The candidate could have specifically explained that this would extend the flexibility of the programming language, rather than just referring to their program's needs.
- **(b)(i)** and **(b)(ii)** The candidate needed to use the word `TYPE` rather than `DECLARE` when they defined both the data types.
- **(c)** The candidate could have used more meaningful identifiers than `Day1` and `Day2`.

Example Candidate Response – low

2 (a) Describe the purpose of a user-defined data type.

A type of enumerated data built by ourselves for ease of access. 1

Making a new data type which we can modify. 2

[2]

(b) Define, using pseudocode, the following enumerated data types:

(i) `SchoolDay` to hold data about the days students are usually in school.

SchoolDay : (Present, ~~Absent~~)

3 (Monday, Tuesday, Wendnesday, Thursday, Friday) [1]

(ii) `WeekEnd` to hold data about the days that are not school days.

WeekEnd : (Saturday, Sunday)

[1]

(c) Define, using pseudocode, the composite data type `ClubMeet`. This will hold data about club members that includes:

- first name and last name
- the two days they attend:
  - one on a school day
  - one not on a school day.

Use the enumerated types you created in **part (b)**.

TYPE ClubMeet 4

FirstName : STRING,

5 LastName : STRING,

Schoolday : (Friday),

WeekEnd : (Saturday), 6

ENDTYPE

[4]

Examiner comments

1 Not all user defined data types are enumerated data types.

2 The candidate correctly identifies that user defined data types are new.

Mark for (a) = 1 out of 2

3 `TYPE` is missing from the candidate's definition.

Mark for (b)(i) = 0 out of 1

Mark for (b)(ii) = 0 out of 1

4 The candidate correctly writes the `TYPE` and `ENTYPE` lines.

5 `DECLARE` is missing from all items.

6 The candidate puts the data types in brackets and they do not match those they have already defined.

Mark for (c) = 1 out of 4

Total mark awarded = 2 out of 8

How the candidate could have improved their answer

- **(a)** The candidate's first sentence was inaccurate because not all user defined data types were enumerated. The candidate needed to expand their description of a user defined data type to state that this would have increased the data types available to the program.
- **(b)(i)** and **(b)(ii)** The candidate needed to include the word `TYPE` when they defined both the data types.
- **(c)** The candidate needed to include the keyword `DECLARE` for all items. The types for the two enumerated data items should have matched those they defined in **(b)**.

Example Candidate Response – low

2 (a) Describe the purpose of a user-defined data type.

Inputting data by user to get output for that input 1

[2]

(b) Define, using pseudocode, the following enumerated data types:

(i) `SchoolDay` to hold data about the days students are usually in school.

```
DECLARE SchoolDay : INTEGER
```
2

[1]

(ii) `WeekEnd` to hold data about the days that are not school days.

```
DECLARE WeekEnd : INTEGER
```

[1]

(c) Define, using pseudocode, the composite data type `ClubMeet`. This will hold data about club members that includes:

- first name and last name
- the two days they attend:
  - one on a school day
  - one not on a school day.

Use the enumerated types you created in **part (b)**.

```
TYPE ClubMeet 3
    DECLARE FirstName : STRING
    DECLARE LastName : STRING 4
    DECLARE SchoolDay : INTEGER
    DECLARE WeekEnd : INTEGER 5
ENDTYPE
```

[4]

Examiner comments

1 The candidate does not answer the question.

Mark for (a) = 0 out of 2

2 The candidate incorrectly uses `DECLARE`. They need to use `TYPE`. `INTEGER` is not an enumerated data type.

Mark for (b)(i) = 0 out of 1

Mark for (b)(ii) = 0 out of 1

3 The candidate correctly writes the `TYPE` and `ENDTYPE` lines.

4 The candidate correctly declares the first name and last name.

5 These data types do not match those the candidate defines in part (b).

Mark for (c) = 2 out of 4

Total mark awarded = 2 out of 8

How the candidate could have improved their answer

- **(a)** The candidate's answer was incorrect. They needed to provide a suitable description, for example, 'the purpose of a user-defined data type is to create a new data type that is not available in the programming language'.
- **(b)(i)** and **(ii)** The candidate needed to use the word `TYPE` rather than `DECLARE` when they defined both the data types and they needed to include a finite list of acceptable values.
- **(c)** The candidate needed to make sure that the types for the two enumerated data items matched those defined in **(b)**.

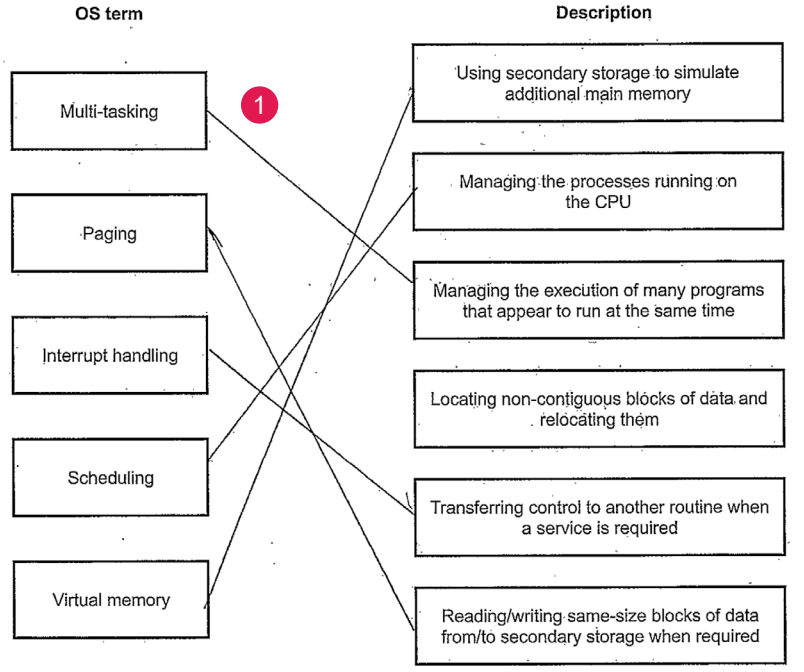
Common mistakes candidates made in this question

- **(b)(i)**, **(b)(ii)** and **(c)** Many candidates used `DECLARE` instead of `TYPE`.
- **(d)** Some candidates missed out `DECLARE`.
- **(c)** Some candidates used the same identifier for the declaration as they did for the `TYPE` in **(b)(i)** and **(b)(ii)**.

Question 3

Example Candidate Response – high

3 (a) Draw **one** line to connect each **Operating System (OS)** term to the **most appropriate** description about it.



[5]

(b) Explain how an interpreter executes a program without producing a complete translated version of it.

2 3

- Interpreter ~~the~~ translates program line by line and stops when it encounters an error 4
- Will only continue translating and executing when error is fixed
- Repeats until whole program is executed
- Interpreter does not produce seperate executable file so has to be present everytime during run-time

[4]

Examiner comments

1 The candidate draws the correct lines with a ruler.

Mark for (a) = 5 out of 5

2 The candidate does not mention execution here.

3 The candidate uses 'line' instead of 'statement'.

4 The candidate correctly identifies that the translator stops when it encounters an error.

Mark for (b) = 2 out of 4

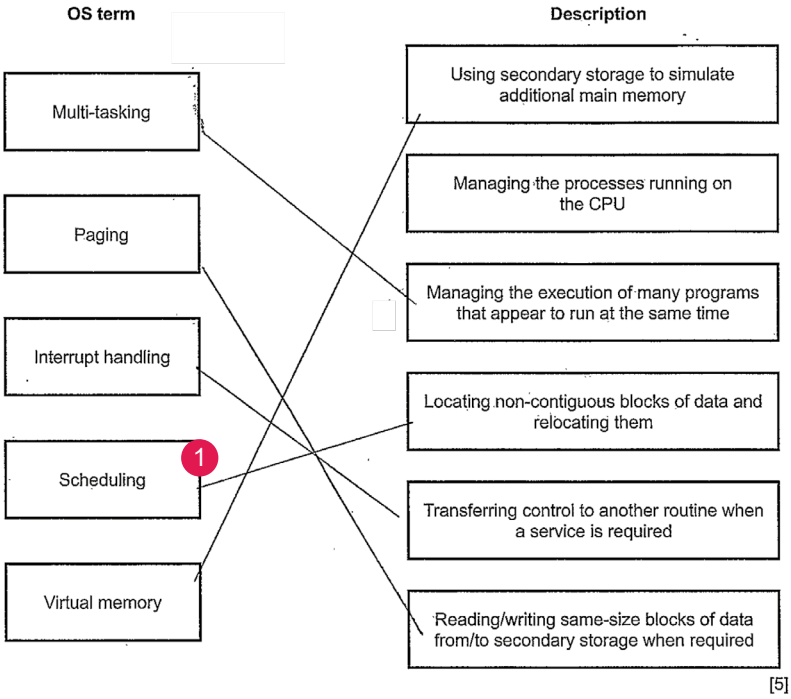
Total mark awarded = 7 out of 9

How the candidate could have improved their answer

(b) The candidate needed to use the word 'statement' instead of 'line' throughout their answer as each statement was translated and then executed if it was error free. Using the word 'line' in their explanation was acceptable, but not technically accurate. The candidate needed to include 'execution' as well as 'translation' in the first sentence, as both processes occurred. The candidate needed to state that each statement (line) was checked for errors.

Example Candidate Response – middle

3 (a) Draw **one** line to connect each **Operating System (OS)** term to the **most appropriate** description about it.



[5]

(b) Explain how an interpreter executes a program without producing a complete translated version of it.

Interpreter translates program line by line so once an error is detected the program stops and waits for user to correct the error in order to continue execution of the program

2 3

[4]

Examiner comments

1 The candidate does not connect scheduling to the most appropriate description.

Mark for (a) = 4 out of 5

2 The candidate identifies translation of a statement (line) at a time.

3 The candidate identifies what happens if there is an error, but does not mention that the statement is executed if there is no error.

Mark for (b) = 2 out of 4

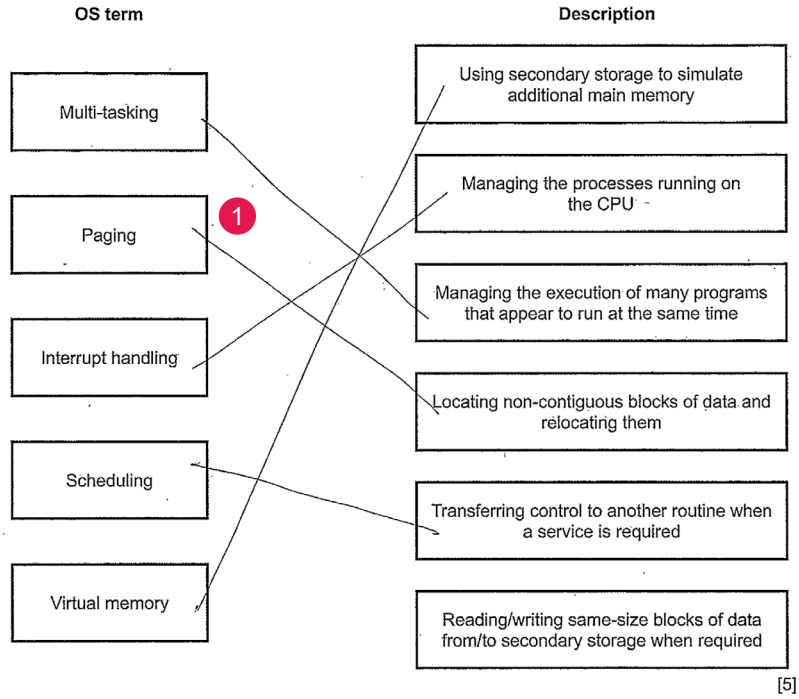
Total mark awarded = 6 out of 9

How the candidate could have improved their answer

- **(a)** The candidate needed to understand the term 'scheduling'.
- **(b)** The candidate needed to use 'statement' instead of 'line' throughout their answer as each statement was translated and then executed if it was error free. Using the word 'line' in their explanation was acceptable but not technically accurate. They also needed to include more detail about error handling, explaining what happened if no error was found.

Example Candidate Response – low

3 (a) Draw **one** line to connect each **Operating System (OS)** term to the **most appropriate** description about it.



[5]

(b) Explain how an interpreter executes a program without producing a complete translated version of it.

The interpreter examines the code sequentially or line by line and if there is an error found onto the line being executed, it stops the execution. It uses the syntax decoding and runs the code and then moves on to other line

[4]

Examiner comments

1 The candidate correctly matches two terms and descriptions, 'multi-tasking' and 'virtual memory'.

Mark for (a) = 2 out of 5

2 The candidate correctly identifies that the code is identified line by line (statement by statement).

3 The candidate explains that the execution of a program should be stopped if an error is found in the next line (statement) to be executed.

Mark for (b) = 2 out of 4

Total mark awarded = 4 out of 9

How the candidate could have improved their answer

- **(a)** The candidate needed to understand several operating system terms and learn this topic from the syllabus more thoroughly.
- **(b)** The candidate needed to use 'statement' instead of 'line' throughout their answer as each statement was translated and then executed if it was error free. Using the word 'line' in their explanation was acceptable, but not technically accurate. The candidate needed to include more detail about error handling, explaining what happened if no error was found.

Common mistakes candidates made in this question

- Some candidates did not understand the required terminology.
- **(b)** Many candidates used 'line' instead of 'statement'.
- **(b)** Some candidates did not include all the details required for a full answer to this question. They needed to give an explanation that included both halting the interpretation if an error was found in a statement and execution of that statement and checking the next statement for errors.

Question 4

Example Candidate Response – high

4 (a) (i) Explain why Reverse Polish Notation (RPN) is used to carry out the evaluation of expressions.

• It is easier to convert from reverse polish notation to infix and vice versa

1 • Infix notation is ~~was~~ better understood by humans computers so provides easier communication with software [2]

(ii) Identify, with reasons, a data structure that could be used to evaluate an expression in RPN:

• A stack is best used when evaluating as

2 it is a LIFO structure

• operands can be pushed to stack and popped when opcode is arrives. [2]

(b) Write the infix expression in RPN.

(a - b) * (a + c) / 7

3 ~~&~~ ab- ac+* 7/

[1]

(c) Write the RPN expression as an infix expression.

a b / 4 * a b + -

4 (a/b)*4 - (a+b)

[1]

(d) Evaluate the RPN expression:

5 a b + c d / /

where a = 17, b = 3, c = 48 and d = 12.

Show your working.

	12		
3	48	4	Evaluates to → 5
17	20	20	5

[2]

Examiner comments

1 The candidate states 'easier to convert' and 'better understood' but does not apply them to the evaluation of the expression.

Mark for (a)(i) = 0 out of 2

2 The candidate identifies a suitable data structure and provides a supporting reason.

Mark for (a)(ii) = 2 out of 2

3 The candidate gives a correct answer.

Mark for (b) = 1 out of 1

4 The candidate gives a correct answer.

Mark for (c) = 1 out of 1

5 The candidate shows their working using a stack.

Mark for (d) = 2 out of 2

Total mark awarded = 6 out of 8

How the candidate could have improved their answer

(a)(i) The candidate needed to consider the evaluation of the expression in their answer, for example, 'evaluation is easier because there is no need to use brackets or rules of precedence'.

Example Candidate Response – middle	Examiner comments

4 (a) (i) Explain why Reverse Polish Notation (RPN) is used to carry out the evaluation of expressions.

It's is easier to understand as you go left to right, push if a number, pop if an expression (mainly DIV etc) and push the results.

[2]

(ii) Identify, with reasons, a data structure that could be used to evaluate an expression in RPN.

online calculators

Fast and efficient to understand than in a normal form since orders implimented.

[2]

(b) Write the infix expression in RPN.

ab- ac+
(a - b) * (a + c) / 7 ab - ac + 7 / *

ab - ac + 7 / *

[1]

(c) Write the RPN expression as an infix expression.

a b / 4 * a b + -

a / b * 4 - (a + b)

[1]

(d) Evaluate the RPN expression:

a b + c d / / (a + b) / (c / d)

where a = 17, b = 3, c = 48 and d = 12.

12
24
36
48

Show your working.

(a + b) / (c / d)

(17 + 3) / (48 / 12) = 20 / (4)

= 5

[2]

1 The candidate identifies one reason with extra information about how the evaluation is carried out.

Mark for (a)(i) = 1 out of 2

2 The candidate's data structure is incorrect.

Mark for (a)(ii) = 0 out of 2

3 The candidate needed to include the * before the 7.

Mark for (b) = 0 out of 1

4 The candidate correctly writes the infix expression.

Mark for (c) = 1 out of 1

5 The candidate's structure and substitution are correct.

Mark for (d) = 2 out of 2

Total mark awarded = 4 out of 8

How the candidate could have improved their answer

- **(a)(i)** The candidate needed to add another reason why RPN was used for the evaluation of the expression, not explain how RPN was used for the evaluation of the expression.
- **(a)(ii)** The candidate needed to identify a suitable data structure. An online calculator was not a recognised data structure.
- **(b)** The candidate needed to include the * after + to ensure a correct conversion to infix.

Example Candidate Response – low

4 (a) (i) Explain why Reverse Polish Notation (RPN) is used to carry out the evaluation of expressions.

1 As it gives out the simplest form of data

[2]

(ii) Identify, with reasons, a data structure that could be used to evaluate an expression in RPN.

2 Stacks
As it can pop or push/add or remove/ from the stack

[2]

(b) Write the infix expression in RPN.

```
(a - b) * (a + c) / 7
```

AB + AC - BA - BC / 7
A / B / C - B / - BC / B
c /

3 17 - B / 7

[1]

(c) Write the RPN expression as an infix expression.

```
a b / 4 * a b + -
```

4

[1]

(d) Evaluate the RPN expression:

```
a b + c d / /
```

where a = 17, b = 3, c = 48 and d = 12.

Show your working.

04
12 | 48
x12 3 36
x12 4 48

4 + 12 / /
3 48 48 4
17 17 20 20 20 5

[2]

Examiner comments

1 The candidate does not give a reason.

Mark for (a)(i) = 0 out of 2

2 The candidate identifies a suitable data structure and needs to apply it to RPN.

Mark for (a)(ii) = 1 out of 2

3 Both of the candidate's expressions are incomplete.

Mark for (b) = 0 out of 1

Mark for (c) = 0 out of 1

4 The candidate correctly provides working and substitution using a stack.

Mark for (d) = 2 out of 2

Total mark awarded = 3 out of 8

How the candidate could have improved their answer

- **(a)(i)** The candidate needed to include reasons why RPN was used for the evaluation of the expression.
- **(b)** The candidate needed to write a complete infix expression.
- **(c)** The candidate needed to write a complete infix expression.

Common mistakes candidates made in this question

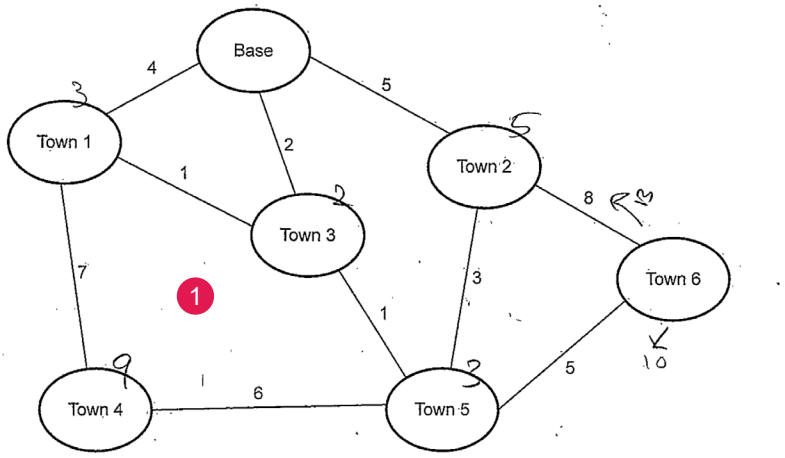
- **(a)(i)** Many candidates explained how RPN was used instead of explaining why RPN was used.
- **(a)(i)** Some candidates did not give a reason why the benefit they identified was a benefit. The explanation needed to include a reason about why it was a benefit.
- **(b)** and **(c)** Some candidates did not include the whole expression.

Question 5

Example Candidate Response – high

5 (a) Calculate the shortest distance between the base and each of the other towns in the diagram using Dijkstra's algorithm.

Show your working **and** write your answers in the table provided.



Working

Visited: (Town1, Town2, Town3, Town4, Town5, Town6)

Unvisited: (~~Town1~~, ~~Town2~~, ~~Town3~~, ~~Town4~~, ~~Town5~~, ~~Town6~~)

Town 1 → shortest path through Town 3 = 3

Town 2 → shortest path = 5

Town 3 → Shortest path = 2 (2)

Town 4 → shortest path through Town 5 = 9

Town 5 → shortest path through Town 3 = 3

Town 6 → Shortest path through Town 5 = 10

Answers

Town 1	Town 2	Town 3	Town 4	Town 5	Town 6
3	5	2	9	3	10

(3)

[5]

(1) The candidate updates some nodes correctly.

(2) The candidate calculates more than one path correctly.

(3) The candidate's answers for the first five towns are correct.

Mark for (a) = 4 out of 5

Example Candidate Response – high, continued	Examiner comments
(b) Explain the use of graphs to aid Artificial Intelligence (AI). • They create regression models to calculate probabilities • They analyze data so that neural networks are updated 4 • learn from previous scenarios and improve performance of deep learning • Improve performance of unsupervised machine learning [3]	4 The candidate explains the use of graphs in machine learning. Mark for (b) = 3 out of 3 **Total mark awarded = 7 out of 8**

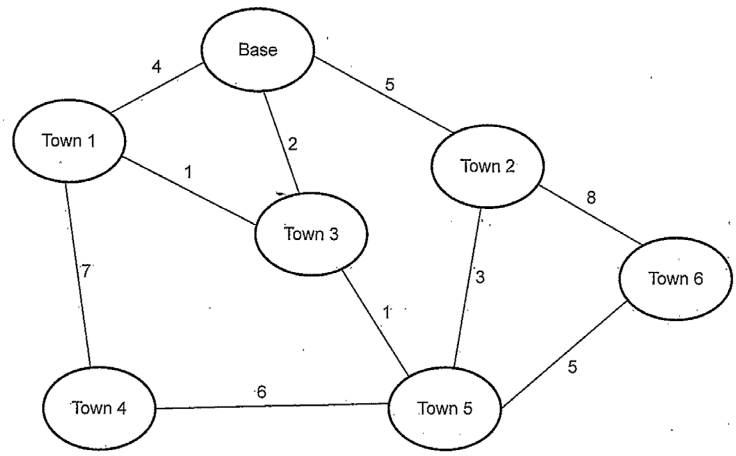
How the candidate could have improved their answer

(a) The candidate needed to show evidence for initialisation of the distance for the base node to zero, or give evidence of the total distance travelled to visit other nodes for all the routes available. They also needed to correctly calculate the shortest distance to town 6.

Example Candidate Response – middle

5 (a) Calculate the shortest distance between the base and each of the other towns in the diagram using Dijkstra's algorithm.

Show your working **and** write your answers in the table provided.



Working

Town 1: 4 — Town 2: 5 ✓
5 — 2+1+3=6
2+1=3 ✓ — 4+1+1+3=9
Town 3: 4+1 — Town 5: 4+1+1=6
2 ✓ (1) — 2+1=3 ✓
Town 4: 4+7=11 — Town 6: 5+8=13
2+1+7=10 — 2+1+5=8 ✓
2+1+6=9 ✓

Answers

Town 1	Town 2	Town 3	Town 4	Town 5	Town 6
3	5	2	9	3 (2)	8

[5]

[illegible]

[3]

Examiner comments

(1) The candidate calculates multiple routes for each town.

(2) The candidate provides correct answers for all the shortest distances.

Mark for (a) = 4 out of 5

Example Candidate Response – middle, continued	Examiner comments
(b) Explain the use of graphs to aid Artificial Intelligence (AI). 3 AI works out the shortest way of performance to get the best result in short time like in graphs. It take the graph calculates all the possible ways to get somewhere and chooses the shortest way to perform the task [3]	3 The candidate identifies possible relationships. Mark for (b) = 1 out of 3 **Total mark awarded = 5 out of 8**

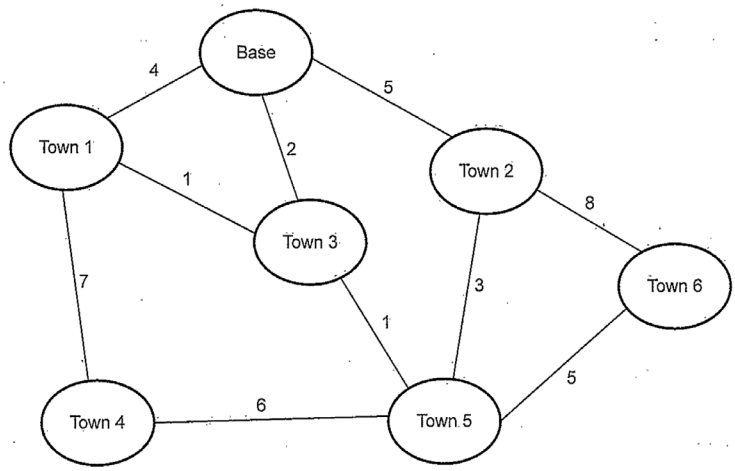
How the candidate could have improved their answer

- **(a)** The candidate needed to show evidence for initialisation of the distance for the base node to zero and give evidence of the total distance travelled to visit other nodes for all the routes available.
- **(b)** The candidate needed to give a more in-depth explanation and refer to algorithms and methods.

Example Candidate Response – low

5 (a) Calculate the shortest distance between the base and each of the other towns in the diagram using Dijkstra's algorithm.

Show your working **and** write your answers in the table provided.



Working Base to Town 4 through town 1 would leave 7+4 while if we use the route trough Town 3 2+1+6 = 9 will be faster then 11 1

Answers 2

Town 1	Town 2	Town 3	Town 4	Town 5	Town 6
4	5	2	2+1+6	2+1	2+1+5

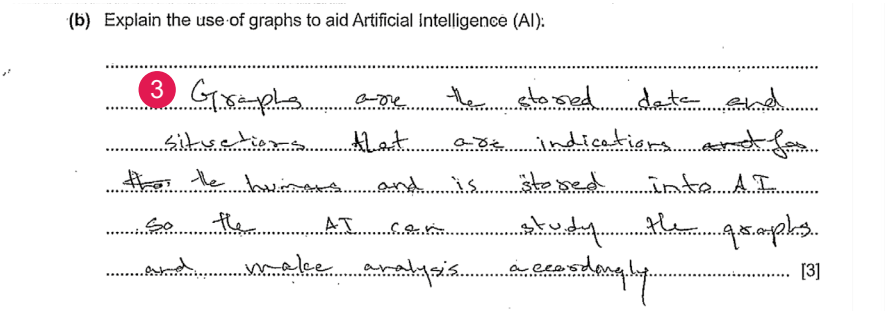
[5]

Examiner comments

1 The candidate identifies two different routes.

2 Town 1 shows an incorrect value and the candidate's calculations for towns 4, 5 and 6 are incomplete.

Mark for (a) = 2 out of 5

Example Candidate Response – low, continued	Examiner comments
	3 The candidate describes but does not explain. Mark for (b) = 0 out of 3 **Total mark awarded = 2 out of 8**

How the candidate could have improved their answer

- **(a)** The candidate needed to show evidence for initialisation of the distance for the base node to zero and give evidence of the total distance travelled to visit other nodes for all the routes available. They also needed to complete the calculations for all the town distances.
- **(b)** The candidate needed to refer to algorithms and methods in their explanation instead of the brief description they included.

Common mistakes candidates made in this question

- **(a)** Some candidates did not use the diagram to show the routes with the nodes visited in 5.
- **(a)** Some candidates only included the shortest routes for each town.
- **(a)** Some candidates did not show their working on or below the diagram.
- **(b)** Many candidates did not use Artificial Intelligence (AI) terminology in their answers.

Question 6

Example Candidate Response – high	Examiner comments
6 Give **two** benefits **and two** drawbacks of packet switching. Benefit 1 Packets do not have to be transmitted in order 1 ~~So no waiting for~~ Benefit 2 Packets can be routed to any destination according to IP address of reciever Drawback 1 Delay in recieving packets is non-uniform 2 Drawback 2 Packets can be lost on the way [4]	1 The candidate gives a benefit. 2 The candidate gives one drawback if both answers are read together. **Total mark awarded = 2 out of 4**

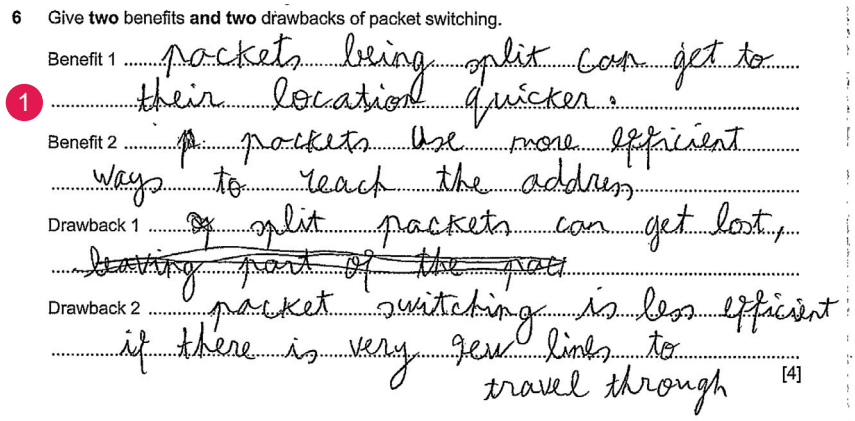
How the candidate could have improved their answer

The candidate needed to clearly identify each benefit or drawback as well as how packet switching provided this. They could have combined drawback 1 and drawback 2 to give one acceptable answer and then identify another drawback, for example ‘requires complex protocols for delivery’.

Example Candidate Response – middle	Examiner comments
6 Give **two** benefits **and two** drawbacks of packet switching. Benefit 1 ~~quick method to send data along the internet~~ ~~special~~ 1 inexpensive Benefit 2 ~~packet~~ packets reorganized once received to make sure everything is in order Drawback 1 interference could occur Drawback 2 Some packets may get lost and never reach their destination 2 [4]	1 The candidate does not identify any benefits. 2 The candidate identifies one drawback. **Total mark awarded = 1 out of 4**

How the candidate could have improved their answer

The candidate needed to clearly identify each benefit or drawback as well as how packet switching provided this.

Example Candidate Response – low	Examiner comments
	1 The candidate only makes general statements. **Total mark awarded = 0 out of 4**

6 Give **two** benefits **and two** drawbacks of packet switching.

Benefit 1 packets being split can get to their location quicker.

1

Benefit 2 packets use more efficient ways to reach the address

Drawback 1 split packets can get lost, ~~leaving part of the packet~~

Drawback 2 packet switching is less efficient if there is very few links to travel through [4]

How the candidate could have improved their answer

The candidate needed to clearly identify each benefit and drawback and state how packet switching achieved this. For example, 'the benefit is completeness of message because missing packets can be easily detected and a re-send request sent so the message arrives complete'.

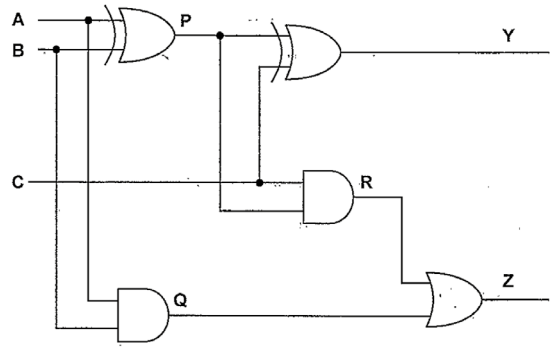
Common mistakes candidates made in this question

- Many candidates did not state the benefit and how packet switching achieved it.
- Many candidates did not state the drawback and identify the problem caused by packet switching.

Question 7

Example Candidate Response – high

7 The diagram shows a logic circuit.



(a) Complete the truth table for the given logic circuit. Show your working.

Inputs			Working space			Outputs	
A	B	C	P	Q	R	Y	Z
0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0
0	1	0	1	0	0	1	0
0	1	1	1	0	1	0	1
1	0	0	1	0	0	1	0
1	0	1	1	0	0	0	0
1	1	0	0	1	0	0	1
1	1	1	0	1	0	1	1

[3]

(b) State the name of the logic circuit.

Full adder ..... [1]

(c) Write the Boolean expressions for the two outputs **Y** and **Z** in the truth table as sum-of-products **and** state the purpose of each output.

Y = $A\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$

Purpose Sum

Z = $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$

Purpose Carry out

[4]

Examiner comments

1 The candidate is correct and they make their corrections clearly.

Mark for (a) = 3 out of 3

2 The candidate gives a correct answer.

Mark for (b) = 1 out of 1

3 The 2nd, 3rd and 4th terms are correct.

4 The candidate gives the correct answers.

Mark for (c) = 3 out of 4

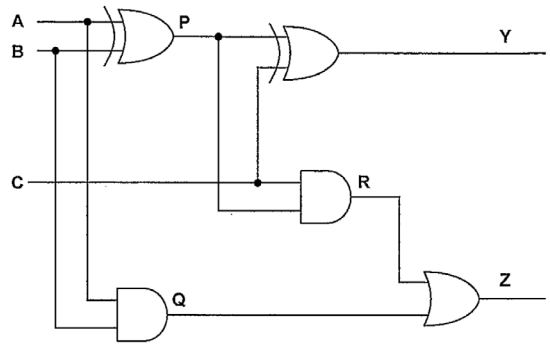
Total mark awarded = 7 out of 8

How the candidate could have improved their answer

- The candidate clearly crossed out and replaced their mistakes.
- The candidate could have noticed that one term appeared in both expressions, which indicated an error.

Example Candidate Response – middle

7 The diagram shows a logic circuit.



(a) Complete the truth table for the given logic circuit. Show your working.

Inputs			Working space			Outputs	
A	B	C	P	Q	R	Y	Z
0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0
0	1	0	1	0	0	1	0
0	1	1	1	0	1	0	1
1	0	0	1	0	0	1	0
1	0	1	1	0	1	0	1
1	1	0	0	1	0	0	1
1	1	1	0	1	0	1	1

[3]

(b) State the name of the logic circuit.

Full adder [1]

(c) Write the Boolean expressions for the two outputs **Y** and **Z** in the truth table as sum-of-products **and** state the purpose of each output.

Y = (A XOR B) XOR C

Purpose Sum

Z = ((A XOR B) AND C) OR (A AND B)

Purpose Carry (out)

[4]

1 The candidate completes the truth table correctly.

Mark for (a) = 3 out of 3

Mark for (b) = 1 out of 1

2 The candidate writes a Boolean expression that is not a sum-of-products.

3 The candidate writes a Boolean expression that is not a sum-of-products.

Mark for (c) = 2 out of 4

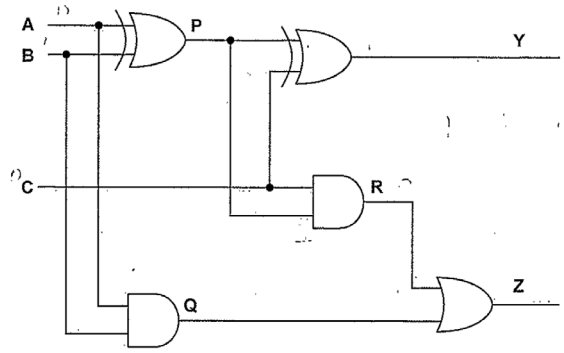
Total mark awarded = 6 out of 8

How the candidate could have improved their answer

(c) The candidate needed to write the Boolean expressions as a sum-of-products from the truth table completed in **(a)**.

Example Candidate Response – low

7 The diagram shows a logic circuit.



(a) Complete the truth table for the given logic circuit. Show your working.

Inputs			Working space			Outputs	
A	B	C	P	Q	R	Y	Z
0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0
0	1	0	1	0	0	1	0
0	1	1	1	0	0	0	0
1	0	0	1	0	0	1	0
1	0	1	1	0	0	0	0
1	1	0	0	1	0	0	1
1	1	1	0	1	0	1	1

1

[3]

(b) State the name of the logic circuit.

Full-Adder logic circuit 2 [1]

(c) Write the Boolean expressions for the two outputs **Y** and **Z** in the truth table as sum-of-products and state the purpose of each output.

Y = (A + B) + C 3

Purpose The 1st find the first digit

Z = (C . P) + (A . B) 4

Purpose To find the last digit 5

[4]

Examiner comments

1 The candidate writes 0 for every output from R. The fourth and sixth rows of Z are incorrect because of this.

Mark for (a) = 1 out of 3

2 The candidate gives the correct logic circuit.

Mark for (b) = 1 out of 1

3 The candidate writes a Boolean expression that is not a sum-of-products.

4 The candidate writes a Boolean expression that includes an incorrect input P.

5 Both purposes are incorrect and would not be the outputs from the full adder that the candidate identifies in (b).

Mark for (c) = 0 out of 4

Total mark awarded = 2 out of 8

How the candidate could have improved their answer

- **(a)** The candidate needed to give two outputs for R in the rows where C and P were 1 as this was an AND gate. This caused an error in the fourth and sixth rows of the output Z which needed to be 1 not 0.
- **(c)** The candidate needed to write the Boolean expressions as a sum-of-products from the truth table completed in **(a)**. Only inputs A, B and C could be used in the Boolean expression.
- The purposes of outputs in **(c)** needed to be relevant to the logic circuit identified in **(b)**, a full-adder, which only had two purposes: to find sum and carry.

Common mistakes candidates made in this question

- **(c)** Many candidates did not write the expressions as a sum-of-products.
- **(c)** Many candidates did not check that the purpose of the circuit matched the name given in **(b)**.

Question 8

Example Candidate Response – high

8 (a) State **two** factors that may affect the performance of a sorting algorithm.

- How sorted the numbers they are
- The size of the array or data being sorted

1

[2]

(b) The given algorithm is a simple bubble sort that arranges a set of scores stored in a one-dimensional array into **descending** order, and orders the corresponding students' names stored into a two-dimensional array in the same order as the scores. All the arrays are indexed from 1.

The contents of both arrays after sorting are shown.

	Score
1	98
2	97
...	
248	5
249	3

	Name	
	1	2
1	Smithfield	Tom
2	Johnson	Jane
...		
248	Peters	Jade
249	Allen	John

```
YearSize ← 249
Flag ← TRUE
WHILE Flag = TRUE
    Flag ← FALSE
    FOR Student ← 1 TO YearSize - 1
        IF Score[Student] < Score[Student + 1] THEN
           Temp1 ← Score[Student]
           Temp2 ← Name[Student,1]
           Temp3 ← Name[Student,2]
           Score[Student] ← Score[Student + 1]
           Name[Student,1] ← Name[Student + 1,1]
           Name[Student,2] ← Name[Student + 1,2]
           Score[Student + 1] ← Temp1
           Name[Student + 1,1] ← Temp2
           Name[Student + 1,2] ← Temp3
           Flag ← TRUE
        ENDIF
    NEXT Student
ENDWHILE
```

Examiner comments

1 The candidate identifies two factors.

Mark for (a) = 2 out of 2

Example Candidate Response – high, continued

Write an algorithm, using pseudocode, that will perform the same task using an insertion sort.

```
DECLARE Midpoint: INTEGER DECLARE Midpoint :INTEGER
DECL DECLARE LowerBound, UpperBound : INTEGER
Midpoint ← INT(Yearsize/2)+1)
LowerBound ← 1
UpperBound ← Yearsize
Yearsize ← 249
Flag ← TRUE
WHILE Flag =TRUE
  Flag ← FALSE
  FOR Student ← 1 TO Yearsize-1
    IF Score[Student] < Score[Student+1] THEN
      Temp1 ← Score[Student+1]
      Temp2 ← Name[Student+1, 1]
      Temp3 ← Name[Student+1, 2]
      Score[Student+1] ← Score[Student]
      Name[Student+1, 1] ← Name[Student, 1]
      Name[Student+1, 2] ← Name[Student, 2]
      Score[Student] ← Temp1
      Name Score[Student, 1] ← Temp2
      Name[Student, 2] ← Temp3
      Flag ← TRUE
    ENDIF
  NEXT Student
ENDWHILE
```

[6]

Examiner comments

2 The program cycles through the whole year group. A check is made on the next score in the array using an `IF` statement and the program temporarily stores the score and the corresponding names. If they are out of order, it swaps the elements.

Mark for (b) = 4 out of 6

Total mark awarded = 6 out of 8

How the candidate could have improved their answer

(b) The candidate needed to check for all elements in the `Score` array with a lower score not just the adjacent element. They needed to replace the `IF` statement with a `WHILE… DO` loop that checked for every element with a lower score and kept on swapping until the appropriate position in the `Score` and `Name` arrays were found for the elements being checked.

Example Candidate Response – middle

8 (a) State **two** factors that may affect the performance of a sorting algorithm.

unnecessary loops (takes more time)

multiple variables (takes time) 1

[2]

(b) The given algorithm is a simple bubble sort that arranges a set of scores stored in a one-dimensional array into **descending** order, and orders the corresponding students' names stored into a two-dimensional array in the same order as the scores. All the arrays are indexed from 1.

The contents of both arrays after sorting are shown.

	Score
1	98
2	97
...	
248	5
249	3

	Name	
	1	2
1	Smithfield	Tom
2	Johnson	Jane
...		
248	Peters	Jade
249	Allen	John

```
YearSize ← 249
Flag ← TRUE
WHILE Flag = TRUE
    Flag ← FALSE
    FOR Student ← 1 TO YearSize - 1
        IF Score[Student] < Score[Student + 1] THEN
           Temp1 ← Score[Student]
           Temp2 ← Name[Student,1]
           Temp3 ← Name[Student,2]
           Score[Student] ← Score[Student + 1]
           Name[Student,1] ← Name[Student + 1,1]
           Name[Student,2] ← Name[Student + 1,2]
           Score[Student + 1] ← Temp1
           Name[Student + 1,1] ← Temp2
           Name[Student + 1,2] ← Temp3
           Flag ← TRUE
        ENDIF
    NEXT Student
ENDWHILE
```

Examiner comments

1 The candidate makes statements that do not specifically apply to sorting an array.

Mark for (a) = 0 out of 2

Example Candidate Response – middle, continued	Examiner comments

Write an algorithm, using pseudocode, that will perform the same task using an insertion sort.
for n ← 1 to 249 do (2)
for y ← 1 to (249 - n - 1) (3)
if Score[y] < Score[y+1] then
t1 ← score[y]
t2 ← Name[y,1]
t3 ← Name[y,2]
Score[y] ← Score[y+1]
Name[y,1] ← Name[y+1,1]
Name[y,2] ← Name[y+1,2]
Score[y+1] ← t1 (4)
Name[y+1,1] ← t2
Name[y+1,2] ← t3
endif
next y
next n
	(2) The candidate's outer loop should stop one iteration sooner.
	(3) The candidate's inner loop should examine the last score.
	(4) The candidate attempts a bubble sort, not an insertion sort.
	Mark for (b) = 3 out of 6
	Total mark awarded = 3 out of 8

How the candidate could have improved their answer

- **(a)** The candidate needed to ensure that the factors they gave applied to the use of a sorting algorithm rather than programming in general. For example, the answer 'unnecessary loops' was too vague, a better answer would have been 'the efficiency of the sorting algorithm ensuring there are no unnecessary loops.'
- **(b)** The candidate needed to ensure that none of the array indexes went out of range by decreasing the limit of the outer loop to `ClassSize -1`. The candidate needed to check for all elements in the `Score` array with a lower score not just the adjacent element. The `IF` statement needed to be replaced by a `WHILE… DO` loop that checked for every element with a lower score and kept on swapping until the appropriate position in the `Score` and `Name` arrays were found for the elements being checked.

Example Candidate Response – low

8 (a) State **two** factors that may affect the performance of a sorting algorithm.

~~The number of~~
Size of array 1
Number of variables
[2]

(b) The given algorithm is a simple bubble sort that arranges a set of scores stored in a one-dimensional array into **descending** order, and orders the corresponding students' names stored into a two-dimensional array in the same order as the scores. All the arrays are indexed from 1.

The contents of both arrays after sorting are shown.

	Score
1	98
2	97
...	
248	5
249	3

	Name	
	1	2
1	Smithfield	Tom
2	Johnson	Jane
...		
248	Peters	Jade
249	Allen	John

```
YearSize ← 249
Flag ← TRUE
WHILE Flag = TRUE
    Flag ← FALSE
    FOR Student ← 1 TO YearSize - 1
        IF Score[Student] < Score[Student + 1] THEN
           Temp1 ← Score[Student]
           Temp2 ← Name[Student,1]
           Temp3 ← Name[Student,2]
           Score[Student] ← Score[Student + 1]
           Name[Student,1] ← Name[Student + 1,1]
           Name[Student,2] ← Name[Student + 1,2]
           Score[Student + 1] ← Temp1
           Name[Student + 1,1] ← Temp2
           Name[Student + 1,2] ← Temp3
           Flag ← TRUE
        ENDIF
    NEXT Student
ENDWHILE
```

Examiner comments

1 The candidate only states one correct factor.

Mark for (a) = 1 out of 2

Example Candidate Response – low, continued	Examiner comments
Write an algorithm, using pseudocode, that will perform the same task using an insertion sort. YearSize ← 249 Flag ← TRUE WHILE Flag = TRUE (2) FOR Student ← 1 to YearSize - 1 (3) (4) Search Score[Student] < Score[Student+1] THEN INSERT Search Score[Student] <- Score[Student+1]	(2) The algorithm correctly loops through the whole year group. (3) The candidate writes an incomplete algorithm that does not include statements for sorting. (4) The candidate does not include `IF`. Mark for (b) = 1 out of 6 **Total mark awarded = 2 out of 8**

How the candidate could have improved their answer

- **(a)** All the factors the candidate gave needed to apply to the use of a sorting algorithm rather than programming in general. Their answer 'number of variables' was incorrect and instead they could have said 'number of data items to be sorted'.
- **(b)** The candidate needed to write a complete algorithm. Their comparison was incomplete and needed to be replaced by a `WHILE… DO` loop that checked for every element with a lower score and kept on swapping until the appropriate position in the `Score` and `Name` arrays were found for the elements being checked.

Common mistakes candidates made in this question

- **(a)** Many candidates stated factors that affected all algorithms, not specifically sorting algorithms.
- **(b)** Some candidates did not check if the indexes of the array elements would go out of range when coding loops.
- **(b)** Some candidates wrote a bubble sort rather than an insertion sort.

Question 9

Example Candidate Response – high

9 (a) Describe what is meant by **an imperative (procedural)** programming language.

- a programmer user has to show program how to do a task, give program instructions on how to implement task

1 - examples include the VB.NET, Python, Pascal, assembly language

[2]

(b) Describe what is meant by **a declarative** programming language.

- user doesn't have to show program how to implement a task

2 - user gives program facts and queries

- examples include prolog

[2]

(c) Identify the programming paradigm for each of these program code examples.

Program code example	Programming paradigm
male(john). female(ethel). parent(john, ethel).	declarative ~~- facts~~
FOR Counter = 1 TO 20 X = X * Counter NEXT Counter	imperative ~~- loop~~
Start: LDD Counter INC ACC STO Counter	imperative ~~- processor~~ 3

public class Vehicle
{
private speed;
public Vehicle()
{
speed = 0;
}
}
	imperative ~~- class~~

[4]

Examiner comments

1 The candidate gives examples that are not asked for in the question and does not describe what they mean.

Mark for (a) = 0 out of 2

2 The candidate gives facts and rules as a description.

Mark for (b) = 1 out of 2

3 The candidate identifies four paradigms.

Mark for (c) = 4 out of 4

Total mark awarded = 5 out of 8

How the candidate could have improved their answer

- **(a)** The candidate needed to make some statements about an imperative programming language rather than the user of the program or examples of names of imperative programming languages.
- **(b)** The candidate needed to make some statements about a declarative programming language rather than the user of the program or an example of a name of a declarative programming language. They were awarded one mark for using facts and rules.
- **(c)** The candidate identified all programming paradigms which was an acceptable answer, as imperative includes other programming paradigms such as low-level and object-oriented. A better answer would have included low-level as the third answer and object-oriented as the fourth answer.

Example Candidate Response – middle

9 (a) Describe what is meant by **an imperative (procedural)** programming language.

1 Imperative is where you can not move on to the next command without properly finishing the first command.

[2]

(b) Describe what is meant by **a declarative** programming language.

Declarative language is where the user needs to declare the data before it can be run or used as edited

2

[2]

(c) Identify the programming paradigm for each of these program code examples.

Program code example	Programming paradigm

`male(john).`
`female(ethel).`
`parent(john, ethel).`
	declarative

`FOR Counter = 1 TO 20`
`  X = X * Counter`
`NEXT Counter`
	loop 3

`Start: LDD Counter`
`  INC ACC`
`  STO Counter`
	Imperative

`public class Vehicle`
`{`
`  private speed;`
`  public Vehicle()`
`  {`
`  speed = 0;`
`  }`
`}`
	Implective

[4]

Examiner comments

1 The candidate implies that programming statements are executed in the order given.

Mark for (a) = 1 out of 2

2 The candidate gives information about the user, not the programming language.

Mark for (b) = 0 out of 2

3 The candidate identifies acceptable paradigms apart from the loop.

Mark for (c) = 3 out of 4

Total mark awarded = 4 out of 8

How the candidate could have improved their answer

- **(a)** The candidate needed to give more information about an imperative programming language.
- **(b)** The candidate needed to make some statements about a declarative programming language rather than the user of the program.
- **(c)** The candidate identified all programming paradigms which was an acceptable answer, as imperative includes other programming paradigms such as low-level and object-oriented. A better answer would have included low-level as the third answer and object-oriented as the fourth answer. Identification of the second paradigm should have been procedural not the programming concept of looping.

Example Candidate Response – low	Examiner comments

9 (a) Describe what is meant by **an imperative (procedural)** programming language.

Programming language that contains built in Procedures that make it ~~easy~~ easier to user to understand [2]

(b) Describe what is meant by **a declarative** programming language.

a Programming language that declares variables by different ways [2]

(c) Identify the programming paradigm for each of these program code examples.

Program code example	Programming paradigm

`male(john).`
`female(ethel).`
`parent(john, ethel).`
	Prolog

`FOR Counter = 1 TO 20`
`  X = X * Counter`
`NEXT Counter`
	loop

`Start: LDD Counter`
`  INC ACC`
`  STO Counter`
	~~Assembly~~ Assembly language

`public class Vehicle`
`{`
`  private speed;`
`  public Vehicle()`
`  {`
`  speed = 0;`
`  }`
`}`
	object ~~oriented~~ oriented Programming

[4]

1 The candidate repeats the question in their answer.

Mark for (a) = 0 out of 2

2 The candidate gives an incorrect answer. Variables are not used in a declarative programming language.

Mark for (b) = 0 out of 2

3 The final two programming paradigms the candidate gives are correct.

Mark for (c) = 2 out of 4

Total mark awarded = 2 out of 8

How the candidate could have improved their answer

- **(a)** The candidate needed to give some information about an imperative programming language that did not repeat the question.
- **(b)** The candidate needed to give some correct statements about a declarative programming language. Their answer was incorrect because variables are not used in a declarative programming language.
- **(c)** The candidate identified the last two programming paradigms correctly. Their identification of the first paradigm should have been declarative, not the name of a declarative programming language. Their identification of the second paradigm should have been procedural, not the programming concept of looping.

Common mistakes candidates made in this question

- **(a)** and **(b)** Some candidates wrote about users rather than the specific programming languages.
- **(a)**, **(b)** and **(c)** Some candidates stated the names of programming languages.
- **(c)** Some candidates gave a programming concept, 'looping' or 'iteration', for some of the programming paradigms.

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