

Cambridge International AS & A Level

COMPUTER SCIENCE**9618/23**

Paper 2 Fundamental Problem-solving and Programming Skills

May/June 2024

MARK SCHEME

Maximum Mark: 75

Published

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

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This document consists of **13** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptions for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Mark scheme abbreviations

/	separates alternative words / phrases within a marking point
//	separates alternative answers within a marking point
underline	actual word given must be used by candidate (grammatical variants accepted)
max	indicates the maximum number of marks that can be awarded
()	the word / phrase in brackets is not required, but sets the context

Note: No marks are awarded for using brand names of software packages or hardware.

Question	Answer	Marks										
1(a)(i)	<p>Two marks for the benefits:</p> <ol style="list-style-type: none">1. The code can be called when needed2. Any subsequent change to the algorithm / calculation needs to be made once only // Easier to manage / maintain (the program)3. Less code / no code duplication4. The algorithm / code / calculation can be designed / coded / tested once <p>Note: Max 2 marks</p>	2										
1(a)(ii)	<p>One mark per point:</p> <ol style="list-style-type: none">1. Create a module / function / procedure / subroutine using the (old) code / algorithm2. Replace the old code / algorithm wherever it appears with a call to the module / function / procedure / subroutine3. Pass the data as parameter(s) // Use of <u>global variable(s)</u>4. <u>Return</u> the result (of the calculation) // Assign result to <u>global variable(s)</u> / <u>BYREF parameter(s)</u>5. Create <u>local</u> variables as needed (to perform the calculation) <p>Note: Max 3 marks</p>	3										
1(b)	<table><tr><th>Pseudocode expression</th><th>Evaluates to</th></tr><tr><td>MID ("Random", 2, 3)</td><td>"and"</td></tr><tr><td>5 + DAY (10/11/2023)</td><td>15</td></tr><tr><td>IS_NUM ("45000")</td><td>TRUE</td></tr><tr><td>(20 MOD 3) + 1</td><td>3</td></tr></table> <p>One mark per row</p>	Pseudocode expression	Evaluates to	MID ("Random", 2, 3)	"and"	5 + DAY (10/11/2023)	15	IS_NUM ("45000")	TRUE	(20 MOD 3) + 1	3	4
Pseudocode expression	Evaluates to											
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IS_NUM ("45000")	TRUE											
(20 MOD 3) + 1	3											

Question	Answer	Marks
2(a)	<p>One mark per point:</p> <ol style="list-style-type: none"> 1. Open the file (in read mode and subsequently close) 2. Initialise an index variable (to 1 // 0) 3. Repeat (the next three steps) until the end of file is reached 4. Read a line from the file (into a string variable) 5. Store the line / variable in the array at the index 6. Increment the index in a loop <p>Note: max 5 marks</p>	5

Question	Answer	Marks
2(b)	<p>One mark per point:</p> <p>Construct: a <u>conditional</u> loop</p> <p>Use: To keep repeating until the end of the file is reached</p> <p>ALTERNATIVE:</p> <p>Construct: a <u>selection</u> statement</p> <p>Use: To test / check the value returned by the <code>EOF()</code> function</p>	2

Question	Answer	Marks
3(a)(i)	<p>Example solution using AND</p> <pre>IF Batch[ThisIndex].Weight >= Min AND Batch[ThisIndex].Weight <= Max THEN</pre> <p>Alternative solution using OR</p> <pre>IF Batch[ThisIndex].Weight < Min OR Batch[ThisIndex].Weight > Max THEN</pre> <p>Mark as follows:</p> <ol style="list-style-type: none"> 1. Reference to <code>Batch[ThisIndex].Weight</code> 2. A valid check for one boundary 3. A valid check for other boundary with correct logic operator 	3
3(a)(ii)	<p>One mark for either:</p> <ul style="list-style-type: none"> • Set the <code>Item_ID</code> field to an empty string / NULL / invalid value • Set <code>Weight</code> to <code><= 0</code> / zero 	1

Question	Answer	Marks
3(b)	<div><pre>graph TD; START([START]) --> Zone1[Set Index to 0
Set Count to 0]; Zone1 --> Zone2[Set Index to Index + 1]; Zone2 --> D1{Is Index = 1001?}; D1 -- Yes --> END([END]); D1 -- No --> D2{Is InRange(Index) = TRUE?}; D2 -- Yes --> Zone3[]; D2 -- No --> Zone4[Set Count to Count + 1]; Zone4 --> D3{Is Count > 5?}; D3 -- Yes --> Zone5[OUTPUT "Reject Batch"]; D3 -- No --> Zone2; Zone3 --> Zone2; Zone5 --> END;</pre><p>The flowchart starts with a 'START' terminal, followed by a process box 'Set Index to 0' and 'Set Count to 0' (Zone 1). It then enters a loop starting with 'Set Index to Index + 1' (Zone 2). A decision 'Is Index = 1001?' (Zone 2) leads to 'END' if 'Yes'. If 'No', it goes to 'Is InRange(Index) = TRUE?' (Zone 3). If 'Yes', it loops back to 'Set Index to Index + 1'. If 'No', it goes to 'Set Count to Count + 1' (Zone 4), then to 'Is Count > 5?' (Zone 5). If 'Yes', it outputs 'Reject Batch' and then loops back to 'Set Index to Index + 1'. If 'No', it loops back to 'Is InRange(Index) = TRUE?'.</p></div>	5

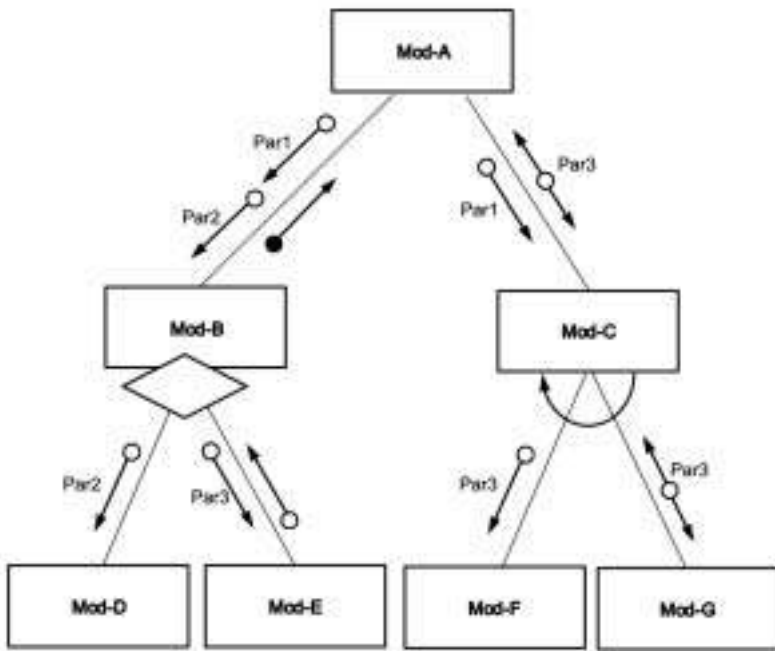
One mark per zone

Question	Answer	Marks
4(a)	<p>Example solution:</p> <pre> PROCEDURE TwoParts() DECLARE NextNum, Average : REAL TotalA ← 0.0 // 0 TotalB ← 0.0 // 0 REPEAT INPUT NextNum TotalA ← TotalA + NextNum UNTIL NextNum = 0 REPEAT INPUT NextNum TotalB ← TotalB + NextNum UNTIL NextNum = 0 Average ← (TotalA + TotalB) / 2 OUTPUT "The average is ", Average ENDPROCEDURE </pre> <p>Mark as follows:</p> <ol style="list-style-type: none"> 1. Procedure heading and ending 2. Declare all local variables 3. Initialise TotalA and TotalB 4. First conditional loop until zero entered, summing TotalA // Loop until both parts (sequences) have been entered 5. Second conditional loop until zero entered, summing TotalB // Loop summing appropriate Totals 6. Calculation of average and output with a message // Calculation of the average for the values making up the two totals and both output with a suitable message 	6
4(b)(i)	<p>(1D) <u>array</u> of <u>20 reals</u></p> <p>Marks as follows:</p> <p>1 mark for array 1 mark for 20 reals</p>	2
4(b)(ii)	<p>One mark per point:</p> <ol style="list-style-type: none"> 1 (Multiple instances referenced via a single identifier so) fewer identifiers needed 2 Easier to process / search / organise / access the data // Values may be accessed via a loop-controlled variable /an index //An array / data can be iterated through 3 Makes the program/algorithm easier to write / design / understand / maintain / modify // Simplifies the program // Easier to debug / test 	3

Question	Answer	Marks
5(a)	<p>One mark per point</p> <ul style="list-style-type: none"> Count-controlled loop the number of iterations is known 	2
5(b)	<p>Two mark for Statement of Problem:</p> <ol style="list-style-type: none"> The functions will return the same value every time they are called ... because <code>Label</code> / the parameter value does not change within the loop <p>Two marks for Solution:</p> <ol style="list-style-type: none"> Assign <code>FormatA(Label)</code> and <code>FormatB(Label)</code> to two (local) variables <u>before</u> the loop Use the (new) variables in place of the function calls / in the loop // Replace the references to <code>FormatA()</code> and <code>FormatB()</code> in the CASE clauses with the new variable names 	4

Question	Answer	Marks
6(a)	<p>Example Solutions:</p> <pre> PROCEDURE Progress(Percent : INTEGER, Root : STRING) DECLARE StepValue : INTEGER DECLARE Filename : STRING StepValue ← (Percent DIV 10) + 1 // INT(Percent / 10) + 1 FileName ← Root & "-" & NUM_TO_STR(StepValue) & ".bmp" CALL Display(Filename) ENDPROCEDURE </pre> <p>Alternative:</p> <pre> PROCEDURE Progress(Percent : INTEGER, Root : STRING) DECLARE StepValue : INTEGER DECLARE Filename : STRING DECLARE Found : BOOLEAN StepValue ← 1 Found ← FALSE REPEAT IF Percent < StepValue * 10 THEN Found ← TRUE ENDIF StepValue ← StepValue + 1 UNTIL Found Filename ← Root & "-" & NUM_TO_STR(StepValue - 1) & ".bmp" CALL Display(Filename) ENDPROCEDURE </pre> <p>Mark as follows for use of DIV/INT or loop solution:</p> <ol style="list-style-type: none"> 1 Procedure heading, parameters and ending 2 Calculate StepValue as integer value // Attempt at calculating file number 3 Add 1 to obtain file number // Completely correct file number calculation 4 Use of NUM_TO_STR() to convert file number to string and use 5 Concatenate Root, hyphen, file number and ".bmp" suffix 6 Call Display() with filename as parameter following a reasonable attempt 	6

Question	Answer	Marks
6(a)	<p>Example Selection Solution:</p> <pre> PROCEDURE Progress(Percent : INTEGER, Root : STRING) DECLARE Filename, StepValue : STRING CASE OF Percent < 10 : StepValue ← "1" < 20 : StepValue ← "2" < 30 : StepValue ← "3" < 40 : StepValue ← "4" < 50 : StepValue ← "5" < 60 : StepValue ← "6" < 70 : StepValue ← "7" < 80 : StepValue ← "8" < 90 : StepValue ← "9" < 100 : StepValue ← "10" OTHERWISE : StepValue ← "11" ENDCASE Filename ← Root & "-" & StepValue & ".bmp" CALL Display(Filename) ENDPROCEDURE </pre> <p>Mark as follows for loop solution:</p> <ol style="list-style-type: none"> 1 Procedure heading, parameters and ending 2 Correct selection construct(s) structure 3 Use of selection statement to obtain two file numbers 4 Use of selection statement to obtain all the file numbers 5 Concatenate Root, hyphen, file number and ".bmp" suffix 6 Call Display() once with filename as parameter following a reasonable attempt 	
6(b)(i)	<p>Example answer:</p> <pre> FUNCTION Progress2(Percent, Steps : INTEGER, Root : STRING) RETURNS STRING </pre> <p>One mark for each:</p> <ul style="list-style-type: none"> • Keyword FUNCTION Progress2 and three parameters of correct type • Keyword RETURNS and type string 	2
6(b)(ii)	The progress display will more accurately show the progress of the task	1

Question	Answer	Marks
7(a)(i)	Mod-B() and Mod-E()	1
7(a)(ii)	<p>Points required:</p> <ol style="list-style-type: none"> any change made to the parameter value / Par3 within Mod-G () is reflected in the (subsequent) value in the calling module / Mod-C () (after Mod-G () terminates) any change made to the parameter value / Par3 within Mod-F () is NOT reflected in the (subsequent) value in the calling module / Mod-C () (after Mod-F () terminates) <p>Mark as follows:</p> <p>1 mark for a reasonable attempt to explain</p> <p>2 marks for full explanation including context</p>	2
7(b)	 <p>One mark per bullet:</p> <ol style="list-style-type: none"> All modules correctly labelled and interconnected Parameters between Mod-A and Mod-B and return value from Mod-B Parameters between Mod-A and Mod-C Diamond applied to Mod-B only Iteration arrow applied to Mod-C only All parameters at lower level and return value 	6

Question	Answer	Marks
8(a)	<p>Example:</p> <pre> FUNCTION Header(Line : STRING) RETURNS STRING IF LENGTH(Line) >= 13 THEN IF TO_UPPER(LEFT(Line, 9)) = "FUNCTION " THEN RETURN "F" & RIGHT(Line, LENGTH(Line) - 9) ENDIF IF TO_UPPER(LEFT(Line, 10)) = "PROCEDURE " THEN RETURN "P" & RIGHT(Line, LENGTH(Line) - 10) ENDIF ENDIF RETURN "" ENDFUNCTION </pre> <p>Mark as follows:</p> <ol style="list-style-type: none"> 1 Function heading, parameter, return type and ending 2 Check that the line is at least 13 characters long before attempting to extract and return empty string 3 Attempt at: Extract characters, 9 or 10 characters, corresponding to keyword plus space and compare with appropriate keyword plus space 4 Completely correct MP3 5 Use of type case conversion to allow for 'any case' 6 Calculation of 'rest of line' and concatenation with 'P' or 'F' 7 Return string 	7

Question	Answer	Marks
8(b)	<p>Example:</p> <pre> PROCEDURE FindModules(FileName : STRING) DECLARE Line : STRING DECLARE Index, LineNum : INTEGER OPENFILE FileName FOR READ Index ← 1 LineNum ← 0 WHILE NOT EOF(FileName) READFILE FileName, Line LineNum ← LineNum + 1 Line ← Header(Line) IF Line <> "" THEN ModInfo[Index, 1] ← NUM_TO_STR(LineNum) ModInfo[Index, 2] ← LEFT(Line, 1) ModInfo[Index, 3] ← RIGHT(Line, LENGTH(Line) - 1) Index ← Index + 1 ENDIF ENDWHILE CLOSEFILE FileName ENDPROCEDURE </pre> <p>Mark as follows:</p> <ol style="list-style-type: none"> 1 Open file in READ mode and subsequently close 2 Loop to EOF(FileName) 3 Read a line from the file and maintain LineNum in a loop 4 Call Header() and use return value in a loop 5 Test return value for "" in a loop 6 Attempt at all three-array assignment for all columns in correct row 7 Correct values assigned to all columns of array 8 Maintain correct array row index 	8