



Cambridge International AS & A Level

COMPUTER SCIENCE

9618/22

Paper 2 Problem Solving & Programming Skills

May/June 2021

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.

Cambridge International is publishing the mark schemes for the May/June 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **10** 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 descriptors 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:

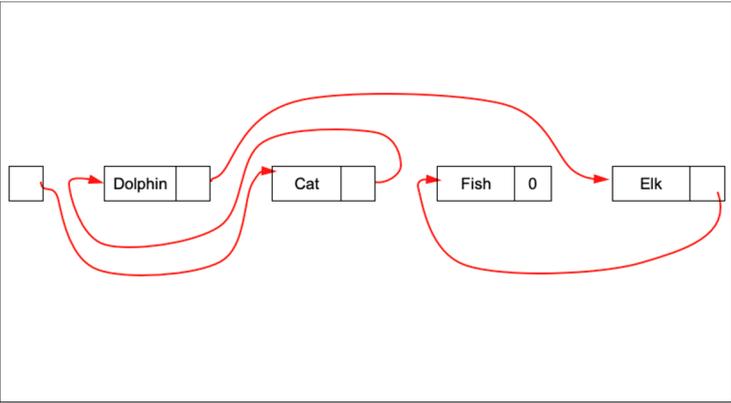
Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks																
1(a)(i)	<table border="1"> <thead> <tr> <th>Variable</th> <th>Example data value</th> <th>Data type</th> </tr> </thead> <tbody> <tr> <td>Name</td> <td>"Catherine"</td> <td>STRING</td> </tr> <tr> <td>Index</td> <td>100</td> <td>INTEGER</td> </tr> <tr> <td>Modified</td> <td>FALSE</td> <td>BOOLEAN</td> </tr> <tr> <td>Holiday</td> <td>25/12/2020</td> <td>DATE</td> </tr> </tbody> </table>	Variable	Example data value	Data type	Name	"Catherine"	STRING	Index	100	INTEGER	Modified	FALSE	BOOLEAN	Holiday	25/12/2020	DATE	4	
	Variable	Example data value	Data type															
	Name	"Catherine"	STRING															
	Index	100	INTEGER															
	Modified	FALSE	BOOLEAN															
Holiday	25/12/2020	DATE																
One mark per data type																		
1(a)(ii)	<table border="1"> <thead> <tr> <th>Expression</th> <th>Evaluates to</th> </tr> </thead> <tbody> <tr> <td>Modified OR Index > 100</td> <td>FALSE</td> </tr> <tr> <td>LENGTH("Student: " & Name)</td> <td>18</td> </tr> <tr> <td>INT(Index + 2.9)</td> <td>102</td> </tr> <tr> <td>MID(Name, 1, 3)</td> <td>"Cat"</td> </tr> </tbody> </table>	Expression	Evaluates to	Modified OR Index > 100	FALSE	LENGTH("Student: " & Name)	18	INT(Index + 2.9)	102	MID(Name, 1, 3)	"Cat"	4						
	Expression	Evaluates to																
	Modified OR Index > 100	FALSE																
	LENGTH("Student: " & Name)	18																
	INT(Index + 2.9)	102																
MID(Name, 1, 3)	"Cat"																	
One mark per value																		
Quotation marks must be present for final row and must be capital C																		
1(b)	<table border="1"> <thead> <tr> <th>Statement</th> <th>Selection</th> <th>Assignment</th> <th>Iteration</th> </tr> </thead> <tbody> <tr> <td>Index ← Index + 1</td> <td></td> <td>✓</td> <td></td> </tr> <tr> <td>IF Modified = TRUE THEN</td> <td>✓</td> <td></td> <td></td> </tr> <tr> <td>ENDWHILE</td> <td></td> <td></td> <td>✓</td> </tr> </tbody> </table>	Statement	Selection	Assignment	Iteration	Index ← Index + 1		✓		IF Modified = TRUE THEN	✓			ENDWHILE			✓	3
	Statement	Selection	Assignment	Iteration														
	Index ← Index + 1		✓															
	IF Modified = TRUE THEN	✓																
ENDWHILE			✓															
One mark per row																		

Question	Answer	Marks								
2(a)(i)	<table border="1"> <tbody> <tr> <td>The number of transitions that result in a different state</td> <td>3</td> </tr> <tr> <td>The number of transitions with associated outputs</td> <td>2</td> </tr> <tr> <td>The label that should replace 'X'</td> <td>Start</td> </tr> <tr> <td>The final or halting state</td> <td>S3</td> </tr> </tbody> </table>	The number of transitions that result in a different state	3	The number of transitions with associated outputs	2	The label that should replace 'X'	Start	The final or halting state	S3	4
	The number of transitions that result in a different state	3								
	The number of transitions with associated outputs	2								
	The label that should replace 'X'	Start								
The final or halting state	S3									
One mark per row										

Question	Answer	Marks
2(a)(ii)	Number of outputs: 1 Current state: S2	2
2(b)(i)	Answers include: <ul style="list-style-type: none"> User ID / Username Book ID Date of loan / return date One mark for 1 correct Two marks for all 3 correct Note: Max 2 marks	2
2(b)(ii)	Many examples but must be data that is NOT required for a loan, but which COULD be required somewhere by the library system. Note: must be data relating to users, books or loans Answers include: <ul style="list-style-type: none"> Users name / address / phone number / DOB Book title / author / publisher / library rack number / ISBN number / price Date of loan / return date (if not already given in part (i)) The length of the loan (assumed to be the same for all books) 	1
2(b)(iii)	Many examples including: <ul style="list-style-type: none"> Create loan / borrow book Return book Send letter / email / contact a user ref an overdue book View the loan history for a given book View the loan history for a given user One mark for each Note: Max 2 marks	2

Question	Answer	Marks
3(a)	Linked list	1
3(b)	Start pointer	1
3(c)	One mark for each: Name: Null pointer Meaning: There are no further nodes in the list	2

Question	Answer	Marks
3(d)	<div style="border: 1px solid black; padding: 10px; margin-bottom: 10px;">  </div> <p data-bbox="319 683 502 716">One mark for:</p> <ul data-bbox="319 750 1005 817" style="list-style-type: none"> • Start Pointer pointing to 'Cat' node • Remaining arrows: Cat → Dolphin → Elk → Fish 	2

Question	Answer	Marks
4	<p data-bbox="319 963 1209 1030">Marks awarded for a description of each of the following steps of the algorithm:</p> <ol data-bbox="319 1064 1316 1344" style="list-style-type: none"> 1 Reference variables for <code>Count</code> of students and <code>Total</code> marks 2 Loop through all students (<code>Count</code>) 3 Input individual mark (in loop) 4 Compare mark with threshold / boundary values to determine grade (in loop) 5 Output the grade for a student (in loop) 6 Maintain a <code>Total</code> (and <code>Count</code> if required) (in loop) 7 Calculate average by dividing <code>Total</code> by <code>Count</code> and Output (after loop) <p data-bbox="319 1377 582 1411">Note: Max 6 marks</p>	6

Question	Answer	Marks										
5(a)(i)	<pre> DECLARE RNum : ARRAY[1:100] OF INTEGER DECLARE Index, Count : INTEGER Count ← 0 FOR Index ← 1 TO 100 RNum[Index] ← INT(RAND(200)) + 1 IF RNum[Index] >= 66 AND RNum[Index] <= 173 THEN Count ← Count + 1 ENDIF NEXT Index OUTPUT Count </pre> <p>Mark as follows:</p> <ol style="list-style-type: none"> 1 Array declaration 2 Loop for 100 iterations 3 Array element index 'syntax' (left-hand side of assignment expression) in a loop 4 Use of <code>RAND()</code> to generate value in range (and assign to array element) in a loop 5 Check if random number within range and if so, increment count in a loop 6 Output of count (following a reasonable attempt) after the loop 	6										
5(a)(ii)	<p>One mark per bullet / sub-bullet point</p> <ol style="list-style-type: none"> 1 Initialise the array to a rogue value (to indicate 'unassigned' element) 2 Add a conditional loop to: 3 Generate and store a random number (in the correct range) 4 Check the stored number against values already in the array 5 If the stored number is found then generate another random value 6 Otherwise add it to the array (and exit loop) <p>Note: Max 3 marks</p>	3										
5(b)(i)	<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th colspan="2" style="text-align: right; padding: 5px;">Answer</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Give a line number containing an example of an initialisation statement.</td> <td style="text-align: center; padding: 5px;">07</td> </tr> <tr> <td style="padding: 5px;">Give a line number containing the start of a repeating block of code.</td> <td style="text-align: center; padding: 5px;">09 / 10</td> </tr> <tr> <td style="padding: 5px;">Give a line number containing a logic statement.</td> <td style="text-align: center; padding: 5px;">12</td> </tr> <tr> <td style="padding: 5px;">Give the number of parameters of function <code>MID()</code>.</td> <td style="text-align: center; padding: 5px;">3</td> </tr> </tbody> </table> <p>One mark for each row</p>	Answer		Give a line number containing an example of an initialisation statement.	07	Give a line number containing the start of a repeating block of code.	09 / 10	Give a line number containing a logic statement.	12	Give the number of parameters of function <code>MID()</code> .	3	4
Answer												
Give a line number containing an example of an initialisation statement.	07											
Give a line number containing the start of a repeating block of code.	09 / 10											
Give a line number containing a logic statement.	12											
Give the number of parameters of function <code>MID()</code> .	3											
5(b)(ii)	<pre> IF (NextChar >= 'a') AND (NextChar <= 'z') THEN </pre> <p>One mark for <code>IF ... AND ...</code> One mark for both conditions</p>	2										

Question	Answer	Marks
6	<pre> PROCEDURE CountVowels(ThisString : STRING) DECLARE Index : INTEGER DECLARE ThisChar : CHAR FOR Index ← 1 to 6 CharCount[Index] ← 0 //initialise elements NEXT Index Index ← 1 FOR Index ← 1 TO LENGTH(ThisString) ThisChar ← LCASE(MID(ThisString, Index, 1)) CASE OF ThisChar 'a' : CharCount[1] ← CharCount[1] + 1 'e' : CharCount[2] ← CharCount[2] + 1 'i' : CharCount[3] ← CharCount[3] + 1 'o' : CharCount[4] ← CharCount[4] + 1 'u' : CharCount[5] ← CharCount[5] + 1 'a' TO 'z': CharCount[6] ← CharCount[6] + 1 ENDCASE NEXT Index FOR Index ← 1 to 6 OUTPUT CharCount[Index] //output results NEXT Index ENDPROCEDURE </pre> <p>1 mark for each of the following:</p> <ol style="list-style-type: none"> 1 Procedure heading (with parameter) and ending 2 Declare local variable for Index as loop counter but not CharCount array 3 Initialise elements of CharCount array to zero 4 Loop through all characters in ThisString 5 Use of MID() to extract single character 6 Test for each vowel and increment associated count 7 Test for consonants and increment associated count 8 Output the results (supporting text not necessary) after the loop <p>Note: Max 7 if CharCount not used to store count</p>	8

Question	Answer	Marks
7(a)	<p>Test string should contain:</p> <ul style="list-style-type: none">• At least one leading space (before the first word)• at least one trailing space (after the last word)• at least one instance of multiple spaces between words• At least one upper case character <p>Mark as follows: One mark for one correct Two marks for three correct Three marks for all correct</p>	3
7(b)	<p>One mark for each:</p> <ul style="list-style-type: none">• Dry run / produce a trace table / walk through the code• Add output statements to allow the code to be tracked• Insert a Breakpoint into the program // use single-stepping to execute instructions // monitor variables using a watch window• Try different test values to see which ones fail <p>Note: Max 2 marks</p>	2

Question	Answer	Marks
8(a)	<pre> FUNCTION IgnoreWord (ThisWord : STRING) RETURNS BOOLEAN DECLARE Found : BOOLEAN DECLARE Index : INTEGER Found ← False Index ← 1 ThisWord ← TO_LOWER(ThisWord) REPEAT IF TO_LOWER(IgnoreList[Index]) = ThisWord THEN Found ← TRUE ENDIF Index ← Index + 1 UNTIL Found = TRUE OR Index > 10 RETURN Found ENDFUNCTION </pre> <p>1 mark for each of the following:</p> <ol style="list-style-type: none"> 1 Loop through array elements 2 Convert both strings to same case 3 Compare array element with parameter in a loop 4 Set a flag (or similar) if match found (after reasonable attempt at MP3) in a loop 5 Return TRUE or FALSE in all cases <p>Note: Max 4 if function declaration incorrect</p>	5

Question	Answer	Marks
8(b)	<pre> Procedure GetInitials() DECLARE NewString, NextWord : STRING DECLARE ThisWordNum, Index : INTEGER ThisWordNum ← 0 NewString ← "" REPEAT ThisWordNum ← ThisWordNum + 1 Index ← GetStart(ThisWordNum) IF Index <> -1 THEN //if there is ThisWordNum NextWord ← GetWord(Index) IF IgnoreWord(NextWord) = FALSE THEN NewString ← NewString & UCASE(LEFT(NextWord, 1)) ENDIF ENDIF UNTIL Index = -1 OUTPUT NewString ENDPROCEDURE </pre> <p>1 mark for each of the following:</p> <ol style="list-style-type: none"> 1 Declare NewString and initialise to empty string 2 Conditional loop to pick out all words from FNString 3 Evaluate result of GetStart() in a loop 4 Test result <> -1 and if not: 5 Assign result of GetWord() to a variable in a loop 6 Test result of IgnoreWord() in a loop 7 If not ignored, add the next initial letter to NewString in a loop 8 Increment ThisWordNum (must have been initialised) in a loop 9 Output NewString (must be all upper case) outside loop <p>Note: Max 8 marks</p>	8