Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/21**

Paper 2 Problem Solving & Programming **October/November 2022**

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 October/November 2022 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

[Turn over

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.

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>One mark per point:

1 They are tried and tested so free from errors
2 They perform a function that you may not be able to program yourself (for example encryption)
3 They are readily available / speed up development time</td><td>3</td></tr>
<tr><td>1(b)(i)</td><td>One mark per point:

1 Algorithm to process / search / organise the data is easier to implement // Values may be accessed via a loop-controlled variable / iterated through using index
2 Makes the program easier to design / code / test / understand
3 Multiple instances referenced via a single identifier / so fewer identifiers needed // Easier to amend the program when the number of students increases</td><td>3</td></tr>
<tr><td>1(b)(ii)</td><td>One mark per point:

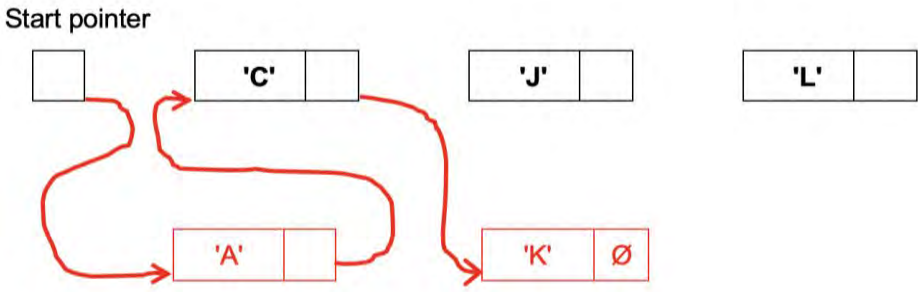
Purpose: It identifies / references an individual array element // provides the index to the array

Data type: Integer</td><td>2</td></tr>
<tr><td>1(c)</td><td>One mark per row:

<table>
<tr><th>Statement</th><th>Error</th></tr>
<tr><td><code>IF EMPTY ← "" THEN</code></td><td>Should be "=" not ←</td></tr>
<tr><td><code>Status ← IS_NUM(-23.4)</code></td><td>Parameter should be a string (or char) // should not be a real</td></tr>
<tr><td><code>X ← STR_TO_NUM("37") + 5</code></td><td>NO ERROR</td></tr>
<tr><td><code>Y ← STR_TO_NUM("37" + "5")</code></td><td>Wrong operator – should be & or
Parameter is not a string</td></tr>
</table>
</td><td>4</td></tr>
</table>

Question	Answer	Marks
2(a)	One mark for Explanation: • Abstraction is used to filter out information / data that is not necessary for the task Or the opposite: • To keep only information / data that is necessary for the task One mark for each **TWO** data items (not dependent on 'Explanation'): Items include: • Car details: ID, Car Registration, car type etc • Customer details: ID, name, address, licence details etc • Start date (of hire) • Return date / Number of days (of hire) • Cost of hire	**3**
2(b)	One mark for each (**Max 2**) Examples include: 1 Input customer details 2 Input car details 3 Input payment details 4 Create hire / start hire 5 Return car / end hire 6 Change / check car status (hired / available / written-off) 7 Cancel hire 8 Process payment / calculate hire cost	**2**

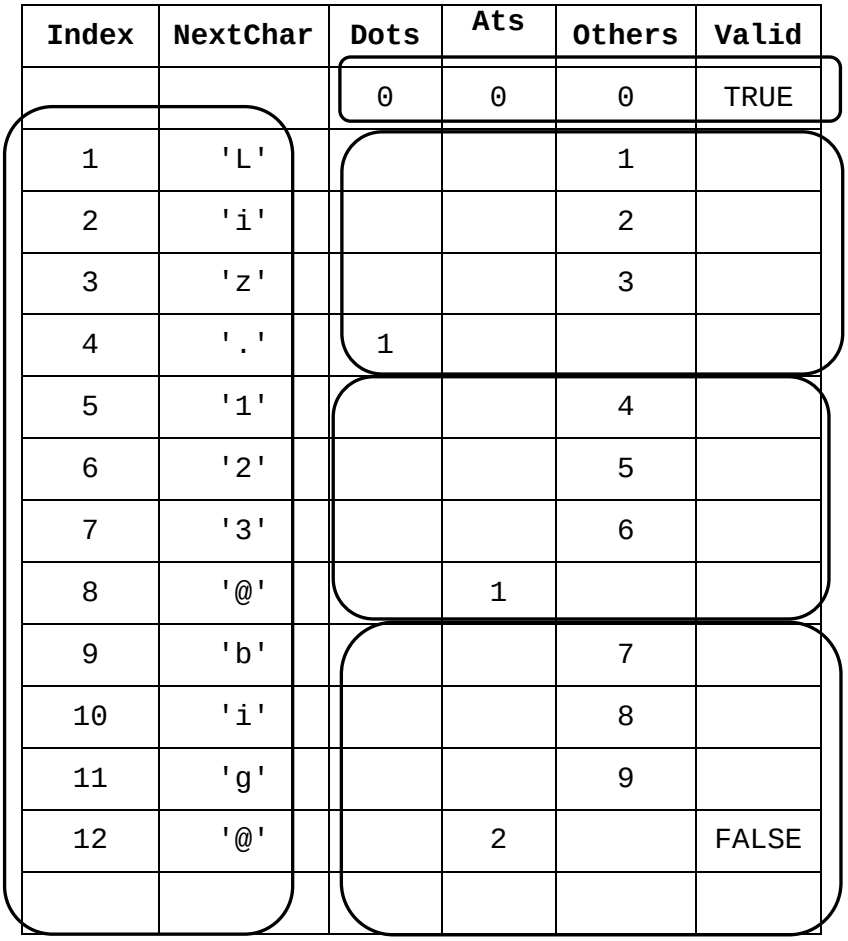
Question	Answer	Marks
3	One mark per point (**Max 5**): 1 Declare a variable / an integer `Max` 2 Assign value of first / any element to `Max` 3 Set up a loop to repeat 200 times / from start to end of array 4 Use the loop counter as the array index 5 If value of current element is greater than `Max`... 6 ...then assign value to `Max` 7 After the loop, Output `Max`	**5**

Question	Answer	Marks
4(a)(i)	One mark for each: 1 Data A and K stored in new / existing nodes 2 Start pointer points to Node A 3 Node A points to Node C **and** Node C points to Node K 4 Node K contains Null Pointer 	**4**
4(a)(ii)	One mark per point: 1 Pointers determine the ordering of data // only the pointers need to be changed when data changed 2 Easier to add / delete data (to maintain correct sequence) in a linked list // description of moving data to maintain correct sequence when array used	**2**
4(a)(iii)	One mark per point: 1 Need to store pointers as well as data 2 More complex (to setup / implement)	**2**
4(b)	One mark per point (**Max 4**): 1 Declare **two** (1D) arrays 2 One for data, one for pointers 3 Elements from same index represent one node 4 Declare an integer / variable for `StartPointer` // explain its use 5 Define appropriate value for null pointer // explain its use 6 Declare an integer / variable for `FreeList` pointer // explain its use 7 Routines are needed to add / delete / search Alternative MP1, 2 and 3 for record-based implementation: 1 Define a record type with fields for data and pointer 2 Declare **one** (1D) array 3 ...of the defined record type	**4**

Question	Answer	Marks

5	Mark as follows (**Max 5**):
	
	1 Procedure heading and ending **and** declaration of both indexes
	2 Loop to process all elements from `Array1`
	3 Sum (any) three consecutive values from `Array1` **and** divide by 3 **in a loop**
	4 Convert result to Integer
	5 Assign value to correct element of `Array2` **in a loop**
	6 Increment `Array2` index **in a loop**
	
	`PROCEDURE Summarise()`
	`  DECLARE Value : REAL`
	`  DECLARE IxA, IxB : INTEGER // Index variables`
	
	`  IxB ← 1`
	
	`  FOR IxA ← 1 TO 598 STEP 3`
	`  Value ← Array1[IxA] + Array1[IxA + 1] + Array1[IxA + 2]`
	`  Value ← Value / 3`
	`  Array2[IxB] ← INT(Value)`
	`  IxB ← IxB + 1`
	`  NEXT IxA`
	
	`ENDPROCEDURE`
		5

Question	Answer	Marks
6(a)	One mark for **any** part correct (accept equivalent wording) (**Max 1**): • Condition evaluates to TRUE if bracket contents evaluate to FALSE: • Bracket contents evaluate to FALSE if: • Dots: zero / less than one or • Ats: not equal to one or • Others: less than nine	**1**

Question	Answer	Marks
6(b)(i)	One mark for each area as outlined: 	**5**
6(b)(ii)	FALSE	**1**

Index	NextChar	Dots	Ats	Others	Valid
		0	0	0	TRUE
1	'L'			1	
2	'i'			2	
3	'z'			3	
4	'.'	1			
5	'1'			4	
6	'2'			5	
7	'3'			6	
8	'@'		1		
9	'b'			7	
10	'i'			8	
11	'g'			9	
12	'@'		2		FALSE

Question	Answer	Marks

7(a)(i)	One mark per point (**Max 7**) as follows:
	
	1 Declaration of local variables for `Par1` `Par2` and `Par3`
	2 Loop to end of (parameter) string // until operator is found
	3 Extract a character **in a loop**...
	4 Attempt at extraction of three parts of expression using substring functions
	5 Completely correct extraction of all three parts of expression
	6. Convert string to Integer using `STR_TO_NUM(<something sensible>)`
	7 Attempt to interpret at least two operators (`Par2`): + - * /
	8 Corresponding correct calculation (all operators) **and** final Output of result
	
	`PROCEDURE Calculate(Expression : STRING)`
	`  DECLARE Val1, Val2, Index : INTEGER`
	`  DECLARE Result : REAL`
	`  DECLARE Par1, Par2, Par3 : STRING`
	
	`  CONSTANT PLUS = '+'`
	`  CONSTANT MINUS = '-'`
	`  CONSTANT MULTIPLY = '*'`
	`  CONSTANT DIVIDE = '/'`
	
	`  FOR Index ← 1 TO LENGTH(Expression) //search for operator`
	`  ThisChar ← MID(Expression, Index, 1)`
	`  IF IS_NUM(ThisChar) = FALSE THEN`
	`  Par1 ← LEFT(Expression, Index – 1)`
	`  Par2 ← ThisChar`
	`  Par3 ← RIGHT(Expression, LENGTH(Expression) – Index)`
	`  ENDIF`
	`  NEXT Index`
	
	`  Val1 ← STR_TO_NUM(Par1)`
	`  Val2 ← STR_TO_NUM(Par3)`
	
	`  CASE OF Par2`
	`  PLUS : Result ← Val1 + Val2`
	`  MINUS : Result ← Val1 - Val2`
	`  MULTIPLY : Result ← Val1 * Val2`
	`  DIVIDE : Result ← Val1 / Val2`
	`  ENDCASE`
	
	`  OUTPUT Result`
	
	`ENDPROCEDURE`
		7

7(a)(ii)	`FUNCTION Calculate(Expression : STRING) RETURNS REAL`	**1**

Question	Answer	Marks
7(b)	**Example string**: "23/0" (Any divide by zero example) **Reason**: The result is infinity / cannot be represented / is undefined // will cause the program to crash	**2**

Question	Answer	Marks

8(a)	One mark for each point (**Max 7**) as follows:
	1 Function heading and ending **including** parameter and return type
	2 Declaration **and** initialisation of local Integer for `Count`
	3 OPEN in READ mode and CLOSE
	4 Conditional loop until `EOF()`
	5 Read a line **in a loop**
	6 If non-blank, increment count **in a loop**
	7 Terminate loop when 10 non-blank lines have been read
	8 Return Boolean in both cases
	
	`FUNCTION CheckFile(Thisfile : STRING) RETURNS BOOLEAN`
	`  DECLARE Valid : BOOLEAN`
	`  DECLARE ThisLine : STRING`
	`  DECLARE Count : INTEGER`
	
	`  Count ← 0`
	`  Valid ← FALSE`
	`  OPEN ThisFile FOR READ`
	
	`  WHILE NOT EOF(ThisFile) AND Valid = FALSE`
	`  READFILE ThisFile, ThisLine`
	`  IF ThisLine <> "" THEN`
	`  Count ← Count + 1`
	`  IF Count > 9 THEN`
	`  Valid ← TRUE`
	`  ENDIF`
	`  ENDIF`
	`  ENDWHILE`
	
	`  CLOSEFILE ThisFile`
	`  RETURN Valid`
	
	`ENDFUNCTION`
		7

8(b)	`CALL CountErrors("Jim01Prog.txt", 20)` One mark for each: 1 Module name, at least one parameter in brackets and one parameter correct 2 Completely correct statement	**2**

Question	Answer	Marks

8(c)	Mark as follows:
	1 Procedure heading and ending **including** parameters
	2 Declaration and initialisation of local Integer value for `ErrCount`
	3 Use of `CheckFile()`, output message **and** terminate if it returns `FALSE`
	4 Conditional loop until `EOF()`
	5 ...or `ErrCount > MaxErrors`
	6 Read line and use as parameter to `CheckLine()` **in a loop**
	7 Test return value and increment `ErrCount` if non-zero **in a loop**
	8 Output either message once only as appropriate
	
	`PROCEDURE CountErrors(ThisFile : STRING, MaxErrors : INTEGER)`
	`DECLARE ErrCount, ThisError : INTEGER`
	`DECLARE ThisLine : STRING`
	
	`ErrCount ← 0`
	
	`IF CheckFile(ThisFile) = FALSE THEN`
	`OUTPUT "That program file is not valid"`
	`ELSE`
	`OPEN ThisFile FOR READ`
	
	`REPEAT`
	`READFILE, ThisFile, ThisLine`
	`ThisError ← CheckLine(ThisLine)`
	`IF ThisError <> 0 THEN`
	`ErrCount ← ErrCount + 1`
	`ENDIF`
	`UNTIL ErrCount > MaxErrors OR EOF(ThisFile)`
	
	`IF EOF(ThisFile) = FALSE THEN`
	`OUTPUT "Check terminated – too many errors"`
	`ELSE`
	`OUTPUT "There were ", ErrCount, " errors."`
	`ENDIF`
	
	`CLOSEFILE ThisFile`
	`ENDIF`
	
	`ENDPROCEDURE`
		8

8(d)	One mark for each (**Max 2**): Examples: 1 Incorrect block structure. Missing keyword denoting part of block (for example `ENDPROCEDURE, ENDFUNCTION, ENDTYPE`) 2 Data type errors, for example, assigning an integer value to a string 3 Identifier used before it is declared 4 Incorrect parameter use	**2**