Cambridge Assessment
International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/21**

Paper 21 Fundamental Problem Solving & Programming Skills **May/June 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 May/June 2022 series for most Cambridge IGCSE, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

This document consists of **12** 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).

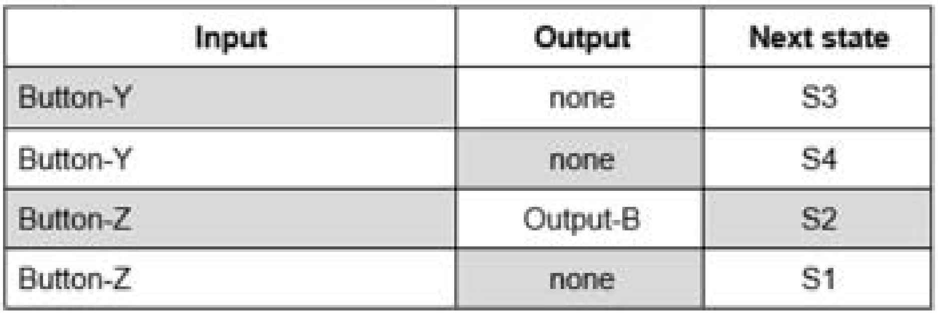
GENERIC MARKING PRINCIPLE 6:

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.

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>1(a)</td><td>An algorithm</td><td>1</td></tr>
<tr><td>1(b)(i)</td><td>
<table>
<tr><th>Variable</th><th>Use of variable</th><th>Data type</th></tr>
<tr><td>Temp</td><td>Stores the average temperature</td><td>REAL</td></tr>
<tr><td>PetName</td><td>Stores the name of my pet</td><td>STRING</td></tr>
<tr><td>MyDOB</td><td>To calculate how many days until my next birthday</td><td>DATE</td></tr>
<tr><td>LightOn</td><td>Stores state of light; light is only on or off</td><td>BOOLEAN</td></tr>
</table>
<p>One mark for each data type</p>
</td><td>4</td></tr>
<tr><td>1(b)(ii)</td><td>
<p>One mark for variable name, and one for reason</p>
<p>Variable: Temp</p>
<p>Reason: Name does not indicate what the variable is used for</p>
</td><td>2</td></tr>
<tr><td>1(c)</td><td>
<table>
<tr><th>Expression</th><th>Evaluation</th></tr>
<tr><td>INT((31 / 3) + 1)</td><td><b>11</b></td></tr>
<tr><td>MID(TO_UPPER("Version"), 4, 2)</td><td><b>"SI"</b></td></tr>
<tr><td>TRUE AND (NOT FALSE)</td><td><b>TRUE</b></td></tr>
<tr><td>NUM_TO_STR(27 MOD 3)</td><td><b>"0"</b></td></tr>
</table>
<p>One mark per row</p>
</td><td>4</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(a)</td><td>
<p>One mark per row</p>
<table>
<tr><th></th><th>Answer</th></tr>
<tr><td>The number of different inputs</td><td><b>3</b></td></tr>
<tr><td>The number of different outputs</td><td><b>3</b></td></tr>
<tr><td>The single input value that could result in S4</td><td><b>Button-Y</b></td></tr>
</table>
</td><td>3</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>2(b)</td><td>One mark per row

Example answer

<table>
<tr><th>Input</th><th>Output</th><th>Next state</th></tr>
<tr><td>Button-Y</td><td>none</td><td>S3</td></tr>
<tr><td>Button-Y</td><td>none</td><td>S4</td></tr>
<tr><td>Button-Z</td><td>Output-B</td><td>S2</td></tr>
<tr><td>Button-Z</td><td>none</td><td>S1</td></tr>
</table>
<b>Note</b>: Accept other valid answers</td><td>4</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>3(a)</td><td>One mark per description of appropriate sub-problem for given scenario.

Examples include:
<ul>
<li>Allows the user to search for films being shown // input name of film they want to see</li>
<li>Allows the user to search for available seats</li>
<li>Calculate cost of booking</li>
<li>Book a given number of seats for a particular screening</li>
</ul></td><td>3</td></tr>
<tr><td>3(b)</td><td>Function</td><td>1</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(a)</td><td>One mark per row
<table>
<tr><th></th><th>Answer</th></tr>
<tr><td>The value that has been on the stack for the longest time.</td><td><b>'H'</b></td></tr>
<tr><td>The memory location pointed to by <code>TopOfStack</code> if <b>three</b> POP operations are performed.</td><td><b>206</b></td></tr>
</table></td><td>2</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>4(b)</td><td>
<table>
<tr><th colspan="2">Stack</th><th>Pointer</th></tr>
<tr><th>Memory location</th><th>Value</th><th></th></tr>
<tr><td>200</td><td></td><td></td></tr>
<tr><td>201</td><td>'D'</td><td>← <code>TopOfStack</code></td></tr>
<tr><td>202</td><td>'C'</td><td></td></tr>
<tr><td>203</td><td>'A'</td><td></td></tr>
<tr><td>204</td><td>'X'</td><td></td></tr>
<tr><td>205</td><td>'Z'</td><td></td></tr>
<tr><td>206</td><td>'N'</td><td></td></tr>
<tr><td>207</td><td>'P'</td><td></td></tr>
</table>
One mark for:
1 <code>TopOfStack</code> pointing to 'D'
2 Value 'D' in 201
3 Values 'C' & 'A' in 202 and 203
4 Values 'X' to 'P' unchanged (204 to 207)
</td><td>4</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>5</td><td>One mark per point to <b>Max 6</b>
1 Open file in read mode
2 Set up a conditional loop, repeating until the value is found or the <code>EOF()</code> is reached
3 Read a line from the file in a loop
4 Extract Field 2
5 Description of how Field 2 could be extracted e.g. using substring function and lengths of Field 1 and Field 2
6 Compare extracted field with search value
7 If search value found, extract Field 1and Field 3 and output them
8 Close the file after loop has finished
</td><td>6</td></tr>
</table>

Question	Answer	Marks
6(a)	**Simple Solution:**	5

```
DECLARE ThisInt, Count : INTEGER
Count ← 0

FOR ThisInt ← 100 TO 200
   IF ThisInt MOD 10 = 7 THEN
      OUTPUT ThisInt
      Count ← Count + 1
   ENDIF
NEXT ThisInt

OUTPUT Count
```

Mark as follows:

1 Declare loop variable **and** counter as integers, counter initialised
2 Loop 100 to 200, no step defined
3 Test value **in a loop**
4 Output selected value **and** incrementing a counter **in a loop**
5 Output the counter, following a reasonable attempt, **after the loop**

Alternative Solution:

```
DECLARE ThisInt, Count : INTEGER
Count ← 0

FOR ThisInt ← 107 TO 197 STEP 10
   OUTPUT ThisInt
   Count ← Count + 1
NEXT ThisInt

OUTPUT Count
```

Mark as follows:

1 Declare loop variable **and** counter as integers, , counter initialised
2 Loop (107 to 197)
3 STEP 10 or explicit increment if conditional loop used
4 Output each value **and** incrementing a counter **in a loop**
5 Output the counter, following a reasonable attempt, **after the loop**

Question	Answer	Marks

6(b)	`IF MySwitch = 1 THEN`
	`   ThisChar ← 'a'`
	`ELSE`
	`   IF MySwitch = 2 THEN`
	`      ThisChar ← 'y'`
	`   ELSE`
	`      IF MySwitch = 3 THEN`
	`         ThisChar ← '7'`
	`      ELSE`
	`         ThisChar ← '*'`
	`      ENDIF`
	`   ENDIF`
	`ENDIF`
	
	Mark as follows:
	
	1. **ANY** test of `MySwitch` = 1, 2 or 3
	2. All three comparisons **and** corresponding assignments
	3. `OTHERWISE`, **or** initial assignment of default value
	4. Completely correct `IF...THEN...ELSE...ENDIF` syntax
		4

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(a)</td><td>

```
FUNCTION IsPalindrome(InString : STRING) RETURNS BOOLEAN
  DECLARE IsPal : BOOLEAN
  DECLARE Index, Num : INTEGER
  DECLARE CharA, CharB : CHAR

  IsPal ← TRUE
  Index ← 1

  Num ← INT(LENGTH(InString) / 2)

  WHILE Index <= Num AND IsPal = TRUE
     CharA ← MID(InString, Index, 1)
     CharB ← MID(Instring, LENGTH(Instring) – Index + 1,
                 1)
     IF UCASE(CharA) <> UCASE(CharB) THEN
        IsPal ← FALSE // RETURN FALSE
     ENDIF
     Index ← Index + 1
  ENDWHILE

  RETURN IsPal // RETURN TRUE

ENDFUNCTION
```

Mark as follows:

1 Functions header including parameter, ending and return type
2 Calculation of number of pairs to match (length or half length)
3 Loop for half or whole string
4 …Extracting characters to compare // create reverse string
5 Convert characters to same case
6 Check for_mismatch of characters inside loop / test for mismatch after loop for reversed string
7 Returning Boolean in both cases

</td><td>7</td></tr>
</table>

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>7(b)</td><td>
<table>
<tr><th>Label</th><th>Text</th></tr>
<tr><td>A</td><td>Set OutString to ""</td></tr>
<tr><td>B</td><td>Is Index > LENGTH(InString)?</td></tr>
<tr><td>C</td><td>Is MID(InString, Index, 1) = " "?</td></tr>
<tr><td>D</td><td>Set OutString to OutString & MID(InString, Index, 1)</td></tr>
<tr><td>E</td><td>Set Index to Index + 1</td></tr>
<tr><td>F</td><td>YES</td></tr>
<tr><td>G</td><td>NO</td></tr>
</table>

Mark for each of:
• B
• D
• C
• ...F and G

Note: The mark for F and G is dependent on a reasonable attempt at C
</td><td>4</td></tr>
</table>

Question	Answer	Marks

8(a)	`FUNCTION RandomChar() RETURNS CHAR`
	`  DECLARE ThisRange : INTEGER`
	`  DECLARE ThisChar : CHAR`
	
	`  //First select the range`
	`  ThisRange ← INT(RAND(3)) + 1 // 1 to 3`
	
	`  CASE OF ThisRange`
	`    1: ThisChar ← CHR(INT(RAND(26) + 65)) // 65 to 90: 'A' to 'Z'`
	`       ThisChar ← LCASE(ThisChar)      // 'a' to 'z'`
	`    2: ThisChar ← CHR(INT(RAND(26) + 65)) // 65 to 90: A to Z`
	`    3: ThisChar ← NUM_TO_STR(INT(RAND(10)) // '0' to '9'`
	`  ENDCASE`
	
	`  RETURN ThisChar`
	`ENDFUNCTION`
	
	Mark as follows:
	
	1 Generation of **any** integer random number
	2 Randomly decide which of the three ranges to select
	3 Selection structure based on range
	4 One alphanumeric character range correct
	5 All alphanumeric character ranges correct
	6 Return `ThisChar`, following a reasonable attempt to generate a character in each range
		6

Question	Answer	Marks

8(b)	`FUNCTION FindPassword(Name: STRING) RETURNS STRING`
	`  DECLARE Index : INTEGER`
	`  DECLARE Password : STRING`
	
	`  Password ← ""`
	`  Index ← 1`
	
	`  WHILE Password = "" AND Index <= 500`
	`     IF Secret[Index, 1] = Name THEN`
	`       Password ← Decrypt(Secret[Index, 2])`
	`     ELSE`
	`       Index ← Index + 1`
	`     ENDIF`
	`  ENDWHILE`
	
	`  IF Password = "" THEN`
	`     OUTPUT "Domain name not found"`
	`  ENDIF`
	
	`  RETURN Password`
	
	`ENDFUNCTION`
	
	Mark as follows:
	
	1 Declare all local variables used, attempted solution has to be reasonable
	2 Conditional loop while not found and not end of array
	3 Compare value of element in column 1 with parameter passed into function
	4 ...and use Decrypt() with element in column 2 as parameter
	5 …use the return value of `Decrypt()`
	6 Output warning message if parameter not found
	7 Return `STRING` value
		7

8(c)	One mark for the name, one for the description Name: • Stub testing Description: • A simple module is written to replace each of the modules. • The simple module will return an expected value // will output a message to show they have been called	3
8(d)	Accept **one** example of a valid password to **Max 2** One mark for each password example that breaks **one** of the rules due to: • Length too long // length too short • Invalid character • Incorrect grouping (including number of hyphens) • Duplicated characters	2

Question	Answer	Marks
8(e)	One mark for each part: • Generate a random integer divisible by 3 • Split range into 1/3 and set as numeric • Else alphabetic character	**3**