
COMPUTER SCIENCE

9608/21

Paper 2 Written Paper

October/November 2019

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 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

This document consists of **15** 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)	One mark for each feature: 1. meaningful / sensible identifier names // use of Camel case for identifier names // use of constants 2. blank lines / white space 3. comments	3

Question	Answer	Marks
1(a)(ii)	<p>Mark as follows:</p> <ul style="list-style-type: none"> One mark for START and END One mark per area outlined <p>At least one decision box label (YES/NO) must be present</p> <pre> graph TD Start([START]) --> V1[V ← GetLevel()] V1 --> L[L ← V * 1.34] L --> C[C ← 0] C --> N1[N ← 1] N1 --> D1{Is N > 10?} D1 -- NO --> N2[N ← N + 1] N2 --> D1 D1 -- YES --> Out[/OUTPUT "Process complete"/] Out --> Ret[RETURN C] Ret --> End([END]) D1 -- NO --> V2[V ← GetLevel()] V2 --> D2{Is V > L?} D2 -- YES --> C2[C ← C + 1] C2 --> N2 D2 -- NO --> D1 </pre>	5

Question	Answer	Marks										
1(b)(i)	One mark per row	4										
	<table><tr><th>Example value</th><th>Data type</th></tr><tr><td>"NOT TRUE"</td><td>STRING</td></tr><tr><td>−4.5</td><td>REAL</td></tr><tr><td>NOT FALSE</td><td>BOOLEAN</td></tr><tr><td>132</td><td>INTEGER</td></tr></table>		Example value	Data type	"NOT TRUE"	STRING	−4.5	REAL	NOT FALSE	BOOLEAN	132	INTEGER
	Example value		Data type									
	"NOT TRUE"		STRING									
	−4.5		REAL									
	NOT FALSE		BOOLEAN									
132	INTEGER											
1(b)(ii)	One mark per row	4										
	<table><tr><th>Expression</th><th>Evaluates to</th></tr><tr><td>LEFT("Start", 3) & RIGHT("Apple", 3)</td><td>"Staple"</td></tr><tr><td>MID("sample", 3, 5)</td><td>ERROR</td></tr><tr><td>NUM_TO_STRING(12.3 * 2)</td><td>"24.6"</td></tr><tr><td>INT(STRING_TO_NUM("53.4")) + 7</td><td>60</td></tr></table>		Expression	Evaluates to	LEFT("Start", 3) & RIGHT("Apple", 3)	"Staple"	MID("sample", 3, 5)	ERROR	NUM_TO_STRING(12.3 * 2)	"24.6"	INT(STRING_TO_NUM("53.4")) + 7	60
	Expression		Evaluates to									
	LEFT("Start", 3) & RIGHT("Apple", 3)		"Staple"									
	MID("sample", 3, 5)		ERROR									
NUM_TO_STRING(12.3 * 2)	"24.6"											
INT(STRING_TO_NUM("53.4")) + 7	60											

Question	Answer	Marks
2(a)	<p>One mark for each feature:</p> <ol style="list-style-type: none"> 1. Module <u>hierarchy</u> 2. The <u>parameters</u> that are passed (between modules) // the module <u>interface</u> 3. Selection / Decisions (which modules are executed) 4. Iteration / Repetition 	4
2(b)	<p>One mark for name and one mark for explanation.</p> <p>Example:</p> <ul style="list-style-type: none"> • PrettyPrint // Colour coding • Colour coding of command words / key words • Expand and collapse code blocks • Allows programmer to focus on a section of code // allows quicker navigation of the code • Auto(matic) indentation • Allows the programmer to clearly see the different code sections / easier to see the code structure <p>Accept suitable alternatives</p>	2
2(c)	<p>One mark for identification, one mark for description:</p> <ul style="list-style-type: none"> • By reference / ref • The <u>address</u> of / <u>pointer</u> to the parameter is passed to the subroutine // if the parameter value is changed in the subroutine this changes the original value 	2
2(d)	<p>One mark per bullet point:</p> <ul style="list-style-type: none"> • Changes made to // Updating // Editing a program / algorithm / data structure / software / system • ...as a result of changes to requirements / specification / legislation / available technology 	2

Question	Answer	Marks
3	One mark per row:	7
	Answer	
	The number of the line containing a variable being	
	24 / 26 / 28	
	The range of line numbers containing a pre-condition loop	
	20 – 30	
	The number of initialisation statements	
	3	
	The number of the line containing a logical operator	20
	22 – 27 / 32 – 37	
	The range of line numbers containing a selection statement	
	22 – 27 / 32 – 37	
	The name of a built-in function	
	MID / LENGTH	
	The name of a parameter	
	InString / Index	

Question	Answer	Marks
4(a)	<p>One mark for process name, max 3 for structured English.</p> <p>Process:</p> <ul style="list-style-type: none"> Stepwise Refinement / Top-down design <p>Structured English:</p> <ul style="list-style-type: none"> Check that character is between 'A' and 'Z' Produce unique array index for this character Increment this array element 	4
4(b)	<pre> DECLARE Index : INTEGER DECLARE Count : INTEGER FOR Count ← 1 TO LENGTH(InString) NextChar ← UCASE(MID(InString, Count, 1)) IF NextChar >= 'A' AND NextChar <= 'Z' THEN Index ← ASC(NextChar) - 64 Result[Index] ← Result[Index] + 1 ENDIF ENDFOR FOR Index ← 1 TO 26 OUTPUT "Letter " & CHR(Index + 64) & " : " & NUM_TO_STRING(Result[Index]) ENDFOR </pre> <p>One mark for each of the following (max 7):</p> <ol style="list-style-type: none"> 1 First loop from 1 to length of <code>InString</code>: 2 Extract each character in turn in a loop 3 Check that character is alphabetic (must cater for lower & upper case) in a loop 4 Obtain array index using <code>ASC()</code> - 64 in a loop 5 Increment element of <code>Result</code> array in a loop 6 Second loop from 1 to 26: 7 Attempt to <code>OUTPUT</code> character A to Z and corresponding count in a loop 8 Fully complete <code>OUTPUT</code> including any necessary type conversion in a loop 	7

Question	Answer	Marks
5(a)	<p>One mark for each point.</p> <p>A valid string must contain:</p> <ul style="list-style-type: none">• At least two // more than one upper case character(s)• At least five // more than four lower case character(s)• More digit characters than 'other' characters	3

Question	Answer	Marks																																																																																										
5(b)(i)	<p>One mark for each area as outlined:</p> <table><tr><th>Index</th><th>NextChar</th><th>Upper</th><th>Lower</th><th>Digit</th><th>Other</th></tr><tr><td></td><td></td><td>0</td><td>0</td><td>0</td><td>0</td></tr><tr><td>1</td><td>'J'</td><td>1</td><td></td><td></td><td></td></tr><tr><td>2</td><td>'i'</td><td></td><td>1</td><td></td><td></td></tr><tr><td>3</td><td>'m'</td><td></td><td>2</td><td></td><td></td></tr><tr><td>4</td><td>'+'</td><td></td><td></td><td></td><td>1</td></tr><tr><td>5</td><td>'S'</td><td>2</td><td></td><td></td><td></td></tr><tr><td>6</td><td>'m'</td><td></td><td>3</td><td></td><td></td></tr><tr><td>7</td><td>'i'</td><td></td><td>4</td><td></td><td></td></tr><tr><td>8</td><td>'t'</td><td></td><td>5</td><td></td><td></td></tr><tr><td>9</td><td>'h'</td><td></td><td>6</td><td></td><td></td></tr><tr><td>10</td><td>'*'</td><td></td><td></td><td></td><td>2</td></tr><tr><td>11</td><td>'9'</td><td></td><td></td><td>1</td><td></td></tr><tr><td>12</td><td>'9'</td><td></td><td></td><td>2</td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>	Index	NextChar	Upper	Lower	Digit	Other			0	0	0	0	1	'J'	1				2	'i'		1			3	'm'		2			4	'+'				1	5	'S'	2				6	'm'		3			7	'i'		4			8	't'		5			9	'h'		6			10	'*'				2	11	'9'			1		12	'9'			2								5
Index	NextChar	Upper	Lower	Digit	Other																																																																																							
		0	0	0	0																																																																																							
1	'J'	1																																																																																										
2	'i'		1																																																																																									
3	'm'		2																																																																																									
4	'+'				1																																																																																							
5	'S'	2																																																																																										
6	'm'		3																																																																																									
7	'i'		4																																																																																									
8	't'		5																																																																																									
9	'h'		6																																																																																									
10	'*'				2																																																																																							
11	'9'			1																																																																																								
12	'9'			2																																																																																								
5(b)(ii)	<p>One mark per bullet point:</p> <ul style="list-style-type: none">Returned value is FALSEDigit - Other is not greater than zero // Number of Digit same as Other	2																																																																																										

Question	Answer	Marks
6(a)	To retain data when the computer is shut down / turned off // after the program ends Accept equivalent answer.	1
6(b)	<p>'Pseudocode' solution included here for development and clarification of mark scheme. Programming language example solutions appear in the Appendix.</p> <pre> FUNCTION SearchFileNtoZ(AccNum : STRING) RETURNS BOOLEAN DECLARE FileData : STRING DECLARE Found : BOOLEAN CONSTANT SearchFile = "UserListNtoZ.txt" Found ← FALSE OPENFILE SearchFile FOR READ WHILE NOT EOF(SearchFile) AND NOT Found READFILE SearchFile, FileData IF AccNum & '*' = LEFT(FileData, LENGTH(AccNum)+ 1) THEN Found ← TRUE ENDIF ENDWHILE CLOSEFILE SearchFile RETURN Found ENDFUNCTION </pre> <p>One mark for each of the following:</p> <ol style="list-style-type: none"> 1. Function heading and ending, (ignore parameter) and returned BOOLEAN 2. File OPEN UserListNtoZ.txt in READ mode and CLOSE 3. Conditional loop repeating until EOF() or 'Found' 4. Read a line from the file in a loop 5. Compare the correct number of characters with AccNum in a loop 6. Set termination logic if found in a loop 7. Return Boolean value 	7

Question	Answer	Marks
6(c)	<pre> PROCEDURE FindDuplicates() DECLARE Index : INTEGER DECLARE FileData : STRING DECLARE Continue : BOOLEAN DECLARE AccNum : STRING Index ← 1 // assuming array is [1:100] Continue ← TRUE OPENFILE "UserListAtoM.txt" FOR READ WHILE NOT EOF("UserListAtoM.txt") AND Continue = TRUE READFILE "UserListAtoM.txt", FileData IF MID(FileData, 7, 1) = '*' // six character reference THEN AccNum ← LEFT(FileData, 6) ELSE AccNum ← LEFT(FileData, 9) ENDIF IF SearchFileNtoZ(AccNum) = TRUE THEN IF Index = 101 // is the array already full? THEN OUTPUT "Error - Array Full" Continue ← FALSE ELSE Duplicates[Index] ← AccNum Index ← Index + 1 ENDIF ENDIF ENDIF ENDWHILE CLOSEFILE "UserListAtoM.txt" ENDPROCEDURE </pre> <p>One mark for each of the following (max 8):</p> <ol style="list-style-type: none"> 1. Declaration and Initialisation of <code>Index</code> and used to index array <code>Duplicates</code> 2. OPEN file <code>UserListAtoM.txt</code> in READ mode and CLOSE 3. Pre-Condition loop to go through the file until <code>EOF()</code> and early termination if array full 4. Read line from file and extract account number (<code>AccNum</code>) in a loop 5. Call <code>SearchFileNtoZ</code> (with <code>AccNum</code>) following an attempt at MP4 in a loop 6. Check if return value is TRUE and if so: in a loop 7. store <code>AccNum</code> in correct array element 8. increment array <code>index</code> following an attempt at MP7 9. If array overflow OUTPUT error message 	8

Question	Answer	Marks
6(d)(i)	<pre>PROCEDURE ClearArray(BYREF ThisArray : ARRAY, NumElements : INTEGER, InitVal : STRING) DECLARE Index : INTEGER FOR Index ← 1 TO NumElements ThisArray[Index] ← InitVal ENDFOR ENDPROCEDURE</pre> <p>Mark as follows:</p> <ul style="list-style-type: none"> • Procedure header • Loop • Assignment within loop 	3
6(d)(ii)	<p>'Pseudocode' solution included here for development and clarification of mark scheme. Programming language example solutions appear in the Appendix.</p> <pre><u>CALL ClearArray(Duplicates, 100, "Empty")</u></pre> <p>Mark as follows:</p> <ul style="list-style-type: none"> • Procedure call • Parameter list (in brackets) 	2

Program Code Example Solutions**Question 6(b): Visual Basic**

```
Function SearchFileNtoZ(ByVal SearchString As String) As Boolean
    Dim FileData As String
    Dim Found As Boolean

    Found = FALSE

    FileOpen(1, "UserListNtoZ.txt", OpenMode.Input)

    While Not EOF(1) And Not Found

        Filedata = LineInput(1)
        If SearchString & '*' = Left(FileData, Len(SearchString)+1) Then
            Found = TRUE
        End If

    End While

    FileClose(1)

    Return Found

End Function
```

Question 6(b): Pascal

```
function SearchFileNtoZ (SearchString : string): boolean;
var
    FileData : string;
    Found : boolean;
    MyFile : text;

begin

    Found := FALSE;

    assign(MyFile, "UserListNtoZ.txt");
    reset (Myfile);

    while Not EOF(MyFile) And Not Found do
        begin
            readLn(MyFile, FileData);
            if SearchString + '*' = LeftStr(FileData, length(SearchString)+1)
then
                Found := TRUE;

            end;

        close(MyFile);

        result := Found; // SearchFileB := Found;

    end;
```

Question 6(b): Python

```
def SearchFileNtoZ(SearchString):  
    ## FileData : String  
    ## Found : Boolean  
    ## MyFile : Text  
  
    Found = False  
  
    MyFile = open("UserListNtoZ.txt", 'r')  
    FileData = MyFile.readline()  
    while FileData != "" and not Found :  
        if SearchString + '*' == FileData[0: len(SearchString)+1]:  
            Found = True  
  
    FileData = MyFile.readline()  
  
    MyFile.close  
  
    return(Found)
```

Question 6(d)(ii): Visual Basic

Call ClearArray(Duplicates, 100, "Empty") 'Call optional

Question 6(d)(ii): Pascal

ClearArray(Duplicates, 100, 'Empty');

Question 6(d)(ii): Python

ClearArray(Duplicates, 100, "Empty")