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**COMPUTER SCIENCE**

9608/22

Paper 2 Written Paper

May/June 2019

MARK SCHEME

Maximum Mark: 75

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**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 **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)	<ul style="list-style-type: none"> <li>a sequence of steps / stages / instructions</li> <li>to implement a task // solution to a problem</li> </ul> <p>Allow alternatives to sequence providing meaning is clear.</p>	2												
1(a)(ii)	<p><b>Input:</b></p> <ul style="list-style-type: none"> <li>e.g. <code>INPUT MyVar // READFILE MyFile, MyString</code></li> </ul> <p><b>Process:</b></p> <ul style="list-style-type: none"> <li>e.g. <code>NextChar ← 'X' // Count ← Count + 1</code></li> </ul> <p><b>Output:</b></p> <ul style="list-style-type: none"> <li>e.g. <code>OUTPUT "Hello World" // WRITEFILE "LogFile.txt", SomeData</code></li> </ul> <p>Mark as follows:</p> <p>One mark for each stage (<b>Input and Process</b>) One mark for each pseudocode example</p>	5												
1(b)(i)	<table border="1"> <thead> <tr> <th>Expression</th> <th>Evaluates to</th> </tr> </thead> <tbody> <tr> <td><code>STRING_TO_NUM(RIGHT(ID, 3))</code></td> <td><b>234.0 / 234</b></td> </tr> <tr> <td><code>INT(Height * Children)</code></td> <td><b>11</b></td> </tr> <tr> <td><code>IsMarried AND Married &lt; 31/12/1999</code></td> <td><b>TRUE</b></td> </tr> <tr> <td><code>LENGTH(ID &amp; NUM_TO_STRING(Height))</code></td> <td><b>8</b></td> </tr> <tr> <td><code>MID((ID, INT(Height) - Children, 2)</code></td> <td><b>"23"</b></td> </tr> </tbody> </table> <p>No quotes for row 1 Quotes (single or double) for row 5</p>	Expression	Evaluates to	<code>STRING_TO_NUM(RIGHT(ID, 3))</code>	<b>234.0 / 234</b>	<code>INT(Height * Children)</code>	<b>11</b>	<code>IsMarried AND Married &lt; 31/12/1999</code>	<b>TRUE</b>	<code>LENGTH(ID &amp; NUM_TO_STRING(Height))</code>	<b>8</b>	<code>MID((ID, INT(Height) - Children, 2)</code>	<b>"23"</b>	5
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1(b)(ii)	<table border="1"> <thead> <tr> <th>Variable</th> <th>Data type</th> </tr> </thead> <tbody> <tr> <td>Married</td> <td>DATE</td> </tr> <tr> <td>ID</td> <td>STRING</td> </tr> <tr> <td>MiddleInitial</td> <td>CHAR</td> </tr> <tr> <td>Height</td> <td>REAL</td> </tr> <tr> <td>IsMarried</td> <td>BOOLEAN</td> </tr> </tbody> </table> <p>One mark per data type</p>	Variable	Data type	Married	DATE	ID	STRING	MiddleInitial	CHAR	Height	REAL	IsMarried	BOOLEAN	5
Variable	Data type													
Married	DATE													
ID	STRING													
MiddleInitial	CHAR													
Height	REAL													
IsMarried	BOOLEAN													

Question	Answer	Marks
2(a)(i)	<ul style="list-style-type: none"> <li>• To make a more manageable / understandable solution</li> <li>• To support modular design</li> </ul>	<b>1</b>
2(a)(ii)	<ul style="list-style-type: none"> <li>• Allows the subroutine to be called from many / multiple places</li> <li>• Subroutine may be (independently) tested and debugged</li> <li>• If the task changes the change needs to be made only once</li> <li>• Reduces unnecessary duplication / program lines</li> <li>• Allows teams to work on different parts of the solution</li> </ul>	<b>3</b>
2(a)(iii)	<p><b>Type of subroutine:</b> Function  <b>Justification:</b> It returns a value // assigns a value to variable <small>Answer</small></p> <p>One mark for type  One mark for justification</p>	<b>2</b>
2(b)	<ul style="list-style-type: none"> <li>• An editor is used to produce / write / modify the <u>source code / program / high-level language code</u></li> </ul> <p><b>OR by example:</b></p> <p>An editor provides (features such as) context-sensitive prompts / dynamic syntax checking etc.</p> <ul style="list-style-type: none"> <li>• A translator (compiler) is used to translate / convert the source code / program / high-level language code into <u>object code / machine code / an executable file</u>.</li> </ul> <p><b>OR</b></p> <p>A translator (interpreter) is used to translate the source code / program / high-level language code <u>line by line</u></p> <ul style="list-style-type: none"> <li>• A debugger is used to test the program / detect errors (and correct errors) in the program.</li> </ul> <p>One mark per bullet point</p>	<b>3</b>

Question	Answer	Marks
2(c)	<p><b>Control structure:</b> A (pre-) <u>conditional</u> loop</p> <p><b>Function of code:</b></p> <ul style="list-style-type: none"> <li>• Check if <code>Result</code> is less than 20 and If true, calls <code>ResetSensor</code> with parameter value 3...</li> <li>• ... and assign the value returned by <code>GetSensor</code> with parameter value 3 to <code>Result</code></li> <li>• Loop until <code>Result &gt;= 20</code></li> </ul> <p><b>OR</b></p> <p><b>Control structure:</b> A selection // conditional statement</p> <p><b>Function of code:</b></p> <ul style="list-style-type: none"> <li>• Check if <code>Result</code> is less than 20 and If true, calls <code>ResetSensor</code> with parameter value 3...</li> <li>• ... and assign the value returned by <code>GetSensor</code> with parameter value 3 to <code>Result</code></li> </ul> <p>One mark for control structure, maximum two for function</p> <p>Function of code marks independent of answer to control structure</p>	3

Question	Answer	Marks
3(a)(i)	<p><u>PROCEDURE SubA (A : STRING, B : INTEGER, BYREF C : CHAR)</u></p> <p>One mark for each underlined part Ignore <code>BYVAL</code> for parameter A and/or parameter B Parameter order / names not important but must be correct data types</p>	3
3(a)(ii)	<p><u>Function SubB (D : STRING, E : INTEGER) RETURNS BOOLEAN</u></p> <p>One mark for each underlined part Ignore <code>BYVAL</code> for parameter D and/or parameter E Parameter order / names not important but must be correct data types</p>	3
3(b)	<ul style="list-style-type: none"> <li>• Selection</li> <li>• Iteration</li> <li>• Sequence</li> </ul> <p>One mark per bullet to max. 2</p>	2

Question	Answer					Marks
4(a)(i)	Index	NextChar	Selected	NewValue	NewString	5
			0		"0"	
	1	'1'			"01"	
	2	'2'			"012"	
	3	'∇'		12		
			12			
					"0"	
	4	'3'			"03"	
	5	'4'			"034"	
	6	'∇'		34		
			34			
					"0"	
	7	'5'			"05"	
	8	'∇'		5		
					"0"	
	9	'∇'		0		
					"0"	
	10	'3'			"03"	
11	'9'			"039"		
<p>One mark for each column.</p> <p>If no mark for columns, award one mark for initialisation of <code>Selected</code> to 0 and <code>Newstring</code> to '0' (single or double quotes).</p>						
4(a)(ii)	34					1

Question	Answer	Marks
4(b)(i)	<ul style="list-style-type: none"> <li>• The final value (in the string) is the largest value (39) and is not considered // the final comparison with variable <code>Selected</code> is not made</li> <li>• The loop terminates at the end of the string (the character 9) // there wasn't a final space / non-numeric digit</li> </ul> <p>One mark per bullet.</p>	<b>2</b>
4(b)(ii)	<ul style="list-style-type: none"> <li>• Check the (final) value of <code>NewString</code> <b>after</b> the loop...</li> <li>• ...and see if it is greater than <code>Selected</code> (repeat the existing conditional clause)</li> </ul> <p><b>OR</b></p> <ul style="list-style-type: none"> <li>• Amend the algorithm to add a space character / non-numeric character to the end of the string...</li> <li>• ...before the <code>FOR</code> loop / at the start of the function</li> </ul> <p>One mark per bullet point Accept alternative workable solution</p>	<b>2</b>

Question	Answer	Marks
5(a)	<p>One mark for each of:</p> <ul style="list-style-type: none"> <li>• Open the file</li> <li>• Set a count to zero</li> <li>• Loop until end of file // no more lines to read</li> <li>• Increment the count each time a line is read in a loop</li> </ul> <p>Maximum 3 marks</p>	<b>3</b>
5(b)	<pre>PROCEDURE CountLines(FileName : STRING)    DECLARE NumLines : INTEGER   DECLARE Dummy : STRING    NumLines ← 0    OPENFILE FileName FOR READ    WHILE NOT EOF(FileName)     READFILE FileName, Dummy     NumLines ← NumLines + 1   ENDWHILE    CLOSEFILE FileName    OUTPUT "Number of lines in the file : ", NumLines  ENDPROCEDURE</pre> <p>One mark for each of the following:</p> <ol style="list-style-type: none"> <li>1. Procedure header and end, including parameter</li> <li>2. Declaration <b>and</b> initialisation of a local INTEGER to count lines (e.g. NumLines)</li> <li>3. OPEN file in read mode <b>and</b> CLOSE file</li> <li>4. WHILE loop stopping when EOF(FileName)</li> <li>5. Read a line from the file <b>and</b> increment NumLines <b>in a loop</b></li> <li>6. Output a message plus the NumLines <b>outside a loop</b></li> </ol>	<b>6</b>



Question	Answer	Marks
6(a)	<p>'Pseudocode' solution included here for development and clarification of mark scheme.</p> <p>Programming language example solutions appear in the Appendix.</p> <pre> FUNCTION GetInfo() RETURNS STRING    DECLARE ID : STRING   DECLARE PreferredName : STRING   DECLARE Valid : BOOLEAN    Valid ← FALSE    WHILE Valid = FALSE     OUTPUT "Please Enter a valid ID"     INPUT ID      IF LENGTH(ID) = 5 AND LEFT(ID, 1) &gt;= 'A'       AND LEFT(ID, 1) &lt;= 'Z'       AND ISNUM(RIGHT(ID, 4))        THEN         Valid ← TRUE       ENDIF    ENDWHILE    OUTPUT "Please enter preferred name"   INPUT PreferredName   RETURN ID &amp; '*' &amp; PreferredName  ENDFUNCTION </pre> <p>One mark for each of the following:</p> <ol style="list-style-type: none"> <li>1. Function header and end (where appropriate)</li> <li>2. Local variables used are declared (commented in python)</li> <li>3. Prompt <b>and</b> input for ID (until valid) <b>and</b> preferred name</li> <li>4. Conditional loop repeating while ID is invalid</li> <li>5. test length <b>in a loop</b></li> <li>6. test first character <b>in a loop</b></li> <li>7. test last four characters <b>in a loop</b></li> <li>8. Concatenate using correct separator character <b>and</b> return resulting string</li> </ol>	8

Question	Answer	Marks
6(b)	<p>'Pseudocode' solution included here for development and clarification of mark scheme.</p> <p>Programming language example solutions appear in the Appendix.</p> <pre> PROCEDURE TopLevel ()      DECLARE Response : CHAR     DECLARE InputData : STRING     DECLARE Success : BOOLEAN      Response ← 'Y'      WHILE Response = 'Y'         InputData ← GetInfo ()         IF LEFT (InputData,1) &lt; 'N'             THEN                 Success ← WriteInfo (InputData, "File1.txt")             ELSE                 Success ← WriteInfo (InputData, "File2.txt")         ENDIF         IF NOT Success             THEN                 Response ← 'N'             ELSE                 OUTPUT "Enter details for another student? (Y/N)"                 INPUT Response         ENDIF     ENDWHILE  ENDPROCEDURE </pre> <p>One mark for each of the following:</p> <ol style="list-style-type: none"> <li>1. Procedure header and end</li> <li>2. Conditional loop terminated with user input</li> <li>3. call to <code>GetInfo()</code> <b>in a loop</b></li> <li>4. check first character of returned <code>UserID</code> value <b>in a loop</b></li> <li>5. call(s) to <code>WriteInfo()</code> in both cases ...</li> <li>6. ... with two <code>STRING</code> parameters <b>in a loop</b></li> <li>7. exit procedure if <code>WriteInfo()</code> unsuccessful <b>in a loop</b></li> <li>8. if <code>WriteInfo()</code> successful, prompt and check input to repeat / exit <b>in a loop</b></li> </ol>	8
6(c)	<pre> <u>FUNCTION WriteInfo (FileData : STRING, Filename : STRING)</u> <u>RETURNS BOOLEAN</u> </pre> <p>One mark per underlined section</p>	3

\*\*\* End of Mark Scheme – example program code solutions follow \*\*\*

**Program Code Example Solutions****Q6 (a): Visual Basic**

```

Function GetInfo() As String
    Dim ID As String = ""
    Dim PreferredName As String = ""
    Dim Valid As Boolean = False
    While Valid = False
        Console.WriteLine("Please enter a valid ID : ")
        ID = Console.ReadLine()
        If Len(ID) = 5 And Left(ID, 1) >= "A" And Left(ID, 1) <= "Z"
            And IsNumeric(Right(ID, 4)) Then
            Valid = True
        End If
    End While
    Console.WriteLine("Please enter preferred name : ")
    PreferredName = Console.ReadLine()
    Return ID & "*" & PreferredName
End Function

```

**Alternative:**

```

Function GetInfo() As String

    Dim ID As String
    Dim PreferredName As String
    Dim Valid As Boolean
    Dim Number As String
    Dim Size As Integer
    Dim i As Integer

    Valid = False

    While Valid = False
        Console.WriteLine("Please Enter a valid ID")
        ID = Console.ReadLine()
        Size = Len(ID)

        If (Size = 5) And ((Left(ID, 1) >= "A") And (Left(ID, 1) <= "Z"))
Then
            Valid = True
            For i = 2 To 5
                Number = Mid(ID, i, 1)
                If (Number < "0") Or (Number > "9") Then
                    Valid = False
                End If
            Next
        End If
    End While

    Console.WriteLine("Please enter preferred name")
    PreferredName = Console.ReadLine()
    Return (ID & "*" & PreferredName)
End Function

```

**Q6 (a): Pascal**

```
function GetInfo() : String;
var
  ID : String;
  PreferredName : String;
  Valid : Boolean;
  Value, Code : Integer;
begin
  Valid := false;
  while not Valid do
  begin
    Write('Please enter a valid ID : ');
    Readln(ID);
    if (Length(ID) = 5) and (ID[1] >= 'A') and (ID[1] <= 'Z') then
      Valid := true;
      Val(Copy(ID, 2, 4), Value, Code);
      if Code <> 0 then
        Valid := false;
    end;
    Write('Please enter preferred name : ');
    Readln(PreferredName);
    GetInfo := ID + '*' + PreferredName;
  end;
end;
```

**Free Pascal**

```
function GetInfo() : String;
var
  ID : String;
  PreferredName : String;
  Valid : Boolean;
  Value, Code : Integer;
begin
  Valid := false;
  while not Valid do
  begin
    Write('Please enter a valid ID : ');
    Readln(ID);
    if (Length(ID) = 5) and (ID[1] >= 'A') and (ID[1] <= 'Z') ___
      and (IsNumber(SubStr(ID, 2, 4))) then
      Valid := true;
    end;
    Write('Please enter preferred name : ');
    Readln(PreferredName);
    result := ID + '*' + PreferredName;
  end;
end;
```

**Q6 (a): Python**

```
def GetInfo() :
    ID = ""                # string variable
    PreferredName = ""    # string variable
    Valid = False         # Boolean variable
    while not Valid :
        ID = input("Please enter a valid ID : ")
        if len(ID) == 5 and ID[0] >= "A" and ID[0] <= "Z" and
ID[1:].isnumeric() :
            Valid = True
        PreferredName = input("Please enter preferred name : ")
    return ID + "*" + PreferredName
```

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**Q6 (b): Visual Basic**

```

Sub TopLevel()
    Dim Response As String = "Y"
    Dim InputData As String = ""
    Dim Success As Boolean = True
    While Response = "Y"
        InputData = GetInfo()
        If Left(InputData, 1) < "N" Then
            Success = WriteInfo(InputData, "File1.txt")
        Else
            Success = WriteInfo(InputData, "file2.txt")
        End If
        If Not Success Then
            Response = "N"
        Else
            Console.Write("Enter details for another student? Y/N ")
            Response = Console.ReadLine()
        End If
    End While
End Sub

```

**Q6 (b): Pascal**

```

procedure TopLevel();
var
    Response : Char;
    InputData : String;
    Success : Boolean;
begin
    Response := 'Y';
    while Response = 'Y' do
        begin
            InputData := GetInfo();
            if InputData[1] < 'N' then
                Success := WriteInfo(InputData, 'File1.txt')
            else
                Success := WriteInfo(InputData, 'File2.txt');
            if not Success then
                Response := 'N'
            else
                begin
                    Write('Enter details for another student? (Y/N) ');
                    Readln(Response);
                end;
            end;
        end;
    end;
end;

```

**Q6 (b): Python**

```
def TopLevel() :
    Response = "Y"           # string/character variable
    InputData = ""          # string variable
    Success = True          # Boolean variable
    while Response == "Y" :
        InputData = GetInfo()
        if InputData[0] < "N" :
            Success = WriteInfo(InputData, "File1.txt")
        else :
            Success = WriteInfo(InputData, "File2.txt")
        if not Success :
            Response = "Y"
        else :
            Response = input("Enter details for another student? (Y/N) ")
```