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**COMPUTER SCIENCE**

**9608/21**

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 **11** 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)	<p><b>Construct:</b> Assignment <b>Pseudocode example:</b> Answer ← "YES"</p> <p><b>Construct:</b> Selection <b>Pseudocode example:</b> IF X = 3 THEN OUTPUT "HELLO"</p> <p><b>Construct:</b> Repetition / Iteration <b>Pseudocode example:</b> FOR N ← 1 to 100</p> <p>One mark for construct One mark for pseudocode example Maximum 4 marks</p>	4																				
1(a)(ii)	<table><tr><th>Pseudocode statement</th><th>Input</th><th>Process</th><th>Output</th></tr><tr><td>Temp ← SensorValue * Factor</td><td></td><td>✓</td><td></td></tr><tr><td>WRITEFILE "LogFile.txt", TextLine</td><td></td><td></td><td>✓</td></tr><tr><td>WRITEFILE "LogFile.txt", MyName &amp; MyIDNumber</td><td></td><td>✓</td><td>✓</td></tr><tr><td>READFILE "AddressBook.txt", NextLine</td><td>✓</td><td>(✓)</td><td></td></tr></table> <p>One mark per correct row</p>	Pseudocode statement	Input	Process	Output	Temp ← SensorValue * Factor		✓		WRITEFILE "LogFile.txt", TextLine			✓	WRITEFILE "LogFile.txt", MyName & MyIDNumber		✓	✓	READFILE "AddressBook.txt", NextLine	✓	(✓)		4
Pseudocode statement	Input	Process	Output																			
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WRITEFILE "LogFile.txt", TextLine			✓																			
WRITEFILE "LogFile.txt", MyName & MyIDNumber		✓	✓																			
READFILE "AddressBook.txt", NextLine	✓	(✓)																				
1(b)(i)	<table><tr><th>Expression</th><th>Evaluates to</th></tr><tr><td>MID(Title, 5, 3) &amp; RIGHT(Author, 3)</td><td>"tripod"</td></tr><tr><td>INT(WeightEach * PackSize)</td><td>24</td></tr><tr><td>PackSize &gt;= 4 AND WeightEach &lt; 6.2</td><td>FALSE</td></tr><tr><td>LEFT(Author, ASC(Version) - 65)</td><td>"Er"</td></tr><tr><td>RIGHT(Title, (LEN(Author) - 6))</td><td>"hetti"</td></tr></table> <p>Quotes must be present Must be capital E in row 4</p>	Expression	Evaluates to	MID(Title, 5, 3) & RIGHT(Author, 3)	"tripod"	INT(WeightEach * PackSize)	24	PackSize >= 4 AND WeightEach < 6.2	FALSE	LEFT(Author, ASC(Version) - 65)	"Er"	RIGHT(Title, (LEN(Author) - 6))	"hetti"	5								
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1(b)(ii)	<table><tr><th>Variable</th><th>Data type</th></tr><tr><td>Tile</td><td>STRING</td></tr><tr><td>Version</td><td>CHAR</td></tr><tr><td>PackSize</td><td>INTEGER</td></tr><tr><td>WeightEach</td><td>REAL</td></tr><tr><td>Paperback</td><td>BOOLEAN</td></tr></table> <p>One mark per data type</p>	Variable	Data type	Tile	STRING	Version	CHAR	PackSize	INTEGER	WeightEach	REAL	Paperback	BOOLEAN	5
Variable	Data type													
Tile	STRING													
Version	CHAR													
PackSize	INTEGER													
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Paperback	BOOLEAN													
1(c)	<p>Data is chosen:</p> <ul style="list-style-type: none"><li>to test that the program does what it is supposed to do / to check that the results are as expected</li><li>to use known valid, boundary and erroneous values</li></ul>	2												

Question	Answer	Marks
2(a)	<p>Type: <u>Conditional</u></p> <p>Explanation: The number of iterations is not known / dependent on a condition</p>	2
2(b)	<p>One mark per bullet point to max 3</p> <ul style="list-style-type: none"> <li>Functions / Procedures / Modules / subtasks</li> <li>Parameters</li> <li>Variable / constant declaration / assignment / Data types</li> <li>Input / Output</li> <li>Arithmetic / logic operations</li> <li>Classes / Objects</li> </ul>	3
2(c)	<p>One mark for:</p> <ul style="list-style-type: none"> <li>A CASE structure</li> </ul> <p>Max 2 for remaining points:</p> <ul style="list-style-type: none"> <li>Selecting on / using variable X</li> <li>Calling ProcA if X = 15</li> <li>Assigning a value of 0 to Y if X = 20 <b>and</b> assign 99 to Y if X = 25</li> <li>Calling ProcError if no match (previous conditions not satisfied) // Call ProcError if x = NONE</li> </ul>	3

Question	Answer	Marks
3(a)	<pre> TotalValue ← 0 ZeroCount ← 0  FOR Index ← 1 TO 100     TotalValue ← TotalValue + Result[Index]     IF Result[Index] = 0.0         THEN             ZeroCount ← ZeroCount + 1         ENDIF     ENDFOR  OUTPUT "The average is ", (TotalValue / 100) OUTPUT "The number of elements with a zero value is ",     ZeroCount  One mark for each of the following:  1 Both initialisations 2 Loop 100 times 3 Adding individual element to TotalValue <b>in a loop</b> 4 Check if element value is zero <b>in a loop</b> 5 If so increment ZeroCount <b>in a loop</b> 6 Average is calculated after the loop 7 Both OUTPUT statements, including message and variables </pre>	7
3(b)	<pre> <u>PROCEDURE ScanArray (BYREF AverageValue: REAL, _</u> <u>BYREF ZeroCount: INTEGER, ArrayName : ARRAY)</u> </pre> <p>One mark for each underlined part</p> <p>Names unimportant but first two parameters must be BYREF</p>	4

Question	Answer	Marks																																																																																																
4(a)(i)	<table><tr><th>Index</th><th>AfterSpace</th><th>NextChar</th><th>NewString</th></tr><tr><td></td><td>FALSE</td><td></td><td>""</td></tr><tr><td>1</td><td></td><td>'X'</td><td>"X"</td></tr><tr><td>2</td><td>TRUE</td><td>'∇ '</td><td>"X∇"</td></tr><tr><td>3</td><td></td><td>'∇ '</td><td></td></tr><tr><td>4</td><td></td><td>'∇ '</td><td></td></tr><tr><td>5</td><td>FALSE</td><td>'Y'</td><td>"X∇Y"</td></tr><tr><td>6</td><td>TRUE</td><td>'∇ '</td><td>"X∇Y∇"</td></tr><tr><td>7</td><td>FALSE</td><td>'a'</td><td>"X∇Y∇a "</td></tr><tr><td>8</td><td></td><td>'n '</td><td>"X∇Y∇an "</td></tr><tr><td>9</td><td></td><td>'d'</td><td>"X∇Y∇and "</td></tr><tr><td>10</td><td>TRUE</td><td>'∇ '</td><td>"X∇Y∇and∇ "</td></tr><tr><td>11</td><td></td><td>'∇ '</td><td></td></tr><tr><td>12</td><td>FALSE</td><td>'Z'</td><td>"X∇Y∇and∇Z "</td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td></tr></table> <p>One mark for each area as outlined. If no row marks then mark by column for columns 2, 3 and 4</p>	Index	AfterSpace	NextChar	NewString		FALSE		""	1		'X'	"X"	2	TRUE	'∇ '	"X∇"	3		'∇ '		4		'∇ '		5	FALSE	'Y'	"X∇Y"	6	TRUE	'∇ '	"X∇Y∇"	7	FALSE	'a'	"X∇Y∇a "	8		'n '	"X∇Y∇an "	9		'd'	"X∇Y∇and "	10	TRUE	'∇ '	"X∇Y∇and∇ "	11		'∇ '		12	FALSE	'Z'	"X∇Y∇and∇Z "																																									6
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4(a)(ii)	To remove repeated space characters	1																																																																																																
4(a)(iii)	<ul style="list-style-type: none"><li>All leading spaces / spaces at the beginning</li><li>will be removed (from the input string)</li></ul>	2																																																																																																

Question	Answer	Marks
4(b)	<pre> DECLARE Code : ARRAY[1:500, 1:4] OF STRING DECLARE RowIndex : INTEGER DECLARE ColIndex : INTEGER  FOR RowIndex ← 1 TO 500     FOR ColIndex ← 1 TO 4         Code[RowIndex, ColIndex] ← "Empty"     ENDFOR ENDFOR </pre> <p>One mark for each of the following:</p> <ol style="list-style-type: none"> <li>1 Array declaration</li> <li>2 Additional local variable</li> <li>3 Nested loops</li> <li>4 Array element assignment <b>within the inner loop</b></li> </ol> <p>RowIndex and ColIndex can be interchangeable</p>	<b>4</b>
4(c)	Adaptive Maintenance	<b>1</b>

Question	Answer	Marks
5(a)	<ul style="list-style-type: none"> <li>Saves development time / no need to write it / can't write it...</li> <li>Pre-compiled and tested / Increased reliability / reduces chance of error</li> <li>Is available to all programs</li> </ul>	3
5(b)	<pre> PROCEDURE TestRand()      DECLARE MyArray : ARRAY [1:50] OF BOOLEAN     DECLARE Attempts : INTEGER     DECLARE NumFound : INTEGER     DECLARE ThisRndNumber : INTEGER     DECLARE Index : INTEGER      FOR Index ← 1 TO 50         Myarray[Index] ← FALSE     ENDFOR      NumFound ← 0     Attempts ← 0      WHILE NumFound &lt; 50         ThisRndNumber ← 1 + INT(RAND(50))         Attempts ← Attempts + 1         IF MyArray[ThisRndNumber] = FALSE             THEN                 MyArray[ThisRndNumber] ← TRUE                 NumFound ← NumFound + 1             ENDIF     ENDWHILE      OUTPUT "Number of calls to RAND() was ", Attempts  ENDPROCEDURE </pre> <p>1 mark for each of the following:</p> <ol style="list-style-type: none"> <li>Declaration of array of 50 elements</li> <li>Loop to initialise array</li> <li>Conditional loop stopping when all numbers generated</li> <li>Generate a random integer in the range 1 to 50 <b>in a loop</b></li> <li>Count each call to <code>RND()</code> <b>in a loop</b></li> <li>check if the number has already been generated <b>in a loop</b></li> <li>if true, record as generated <b>in a loop</b></li> <li>Output a message plus the <code>Attempts</code> <b>outside a loop</b></li> </ol>	8



Question	Answer	Marks
6(a)	<p>One mark for each of:</p> <ol style="list-style-type: none"> <li>1 To make a more manageable / understandable solution</li> <li>2 Subroutine may be (independently) tested and debugged</li> <li>3 Program is easier to maintain</li> </ol>	<b>3</b>
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 FindCD(SearchCDArtist : STRING,                 SearchCDTitle :  STRING) RETURNS STRING      DECLARE CDTitle : STRING     DECLARE CDArtist : STRING     DECLARE CDLocation : STRING     DECLARE Location : STRING      Location ← ""      OPENFILE "MyCDs.txt" FOR READ      WHILE NOT EOF ("MyCDs.txt") AND Location = ""          READFILE "MyCDs.txt", CDArtist         READFILE "MyCDs.txt", CDTitle         READFILE "MyCDs.txt", CDLocation          IF SearchCDArtist = CDArtist AND             SearchCDTitle = CDTitle             THEN                 Location ← CDLocation             ENDIF      ENDWHILE      CLOSEFILE ("MyCDs.txt")     RETURN Location  ENDFUNCTION </pre> <p>One mark for each of the following:</p> <ol style="list-style-type: none"> <li>1 Function header and close (where appropriate), including parameters</li> <li>2 Declaration of local <code>STRING</code> variables for <code>CDArtist</code> and <code>CDTitle</code></li> <li>3 <code>OPEN</code> and <code>CLOSE</code> file for reading (Allow <code>MyCDs</code> or <code>MyCDs.txt</code>)</li> <li>4 (<code>WHILE</code>) loop checking for <code>EOF</code></li> <li>5 read three lines from file <b>in a loop</b></li> <li>6 compare search values with file values <b>in a loop...</b></li> <li>7 ...If true, set <code>Location</code> and exit loop <b>in a loop</b></li> <li>8 Return <code>Location</code></li> </ol>	<b>8</b>

**Program Code Example Solutions****Q6 (b) (i): Visual Basic**

```
Function FindCD(SearchCDArtist As String, SearchCDTitle As String) As String

    Dim CDTitle As String
    Dim CDArtist As String
    Dim CDLocation As String
    Dim Location As String

    Location = ""
    FileOpen(1, "MyCDs.txt", OpenMode.Input)

    Do While Not EOF(1) And Location = ""
        CDArtist = LineInput(1)
        CDTitle = LineInput(1)
        CDLocation = LineInput(1)

        If SearchCDArtist = CDArtist And SearchCDTitle = CDTitle Then
            Location = CDLocation
        End If

    Loop
    FileClose(1)

EndFunction
```

**Q6 (b) (i): Python**

```
def FindCD(SearchCDArtist, SearchCDTitle):

    # CDTitle, CDArtist, CDLocation, Location : string

    Location = ""
    myFile = open("MyCDs.txt", 'r')
    while True:
        # or Location == "":
        CDArtist = myFile.readline()

        if CDArtist == "":
            break
        else:
            CDTitle = myFile.readline()
            CDLocation = myFile.readline()

            if SearchCDArtist == CDArtist.strip() and SearchCDTitle == CDTitle.strip():

                Location = CDLocation

    myFile.close
    return (Location)
```

**Q6 (b) (i): Pascal**

```
function FindCD(SearchCDArtist, SearchCDTitle:string): string;

var
  CDTitle, CDArtist, CDLocation, Location : string;
  FileHandle : TextFile;

begin
  Location := '';
  AssignFile(FileHandle, 'MyCDs.txt');
  Reset (FileHandle);

  while not eof(FileHandle) and (Location = '') do
    begin
      readln(FileHandle, CDArtist);
      readln(FileHandle, CDTitle);
      readln(FileHandle, CDLocation);
      if (SearchCDArtist = CDArtist) and (SearchCDTitle = CDTitle)
then
        Location := CDLocation;
      end;

      Close (FileHandle);
      FindCD := Location;

    end;
```