COMPUTER SCIENCE **9608/22**

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.

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This document consists of **13** 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.
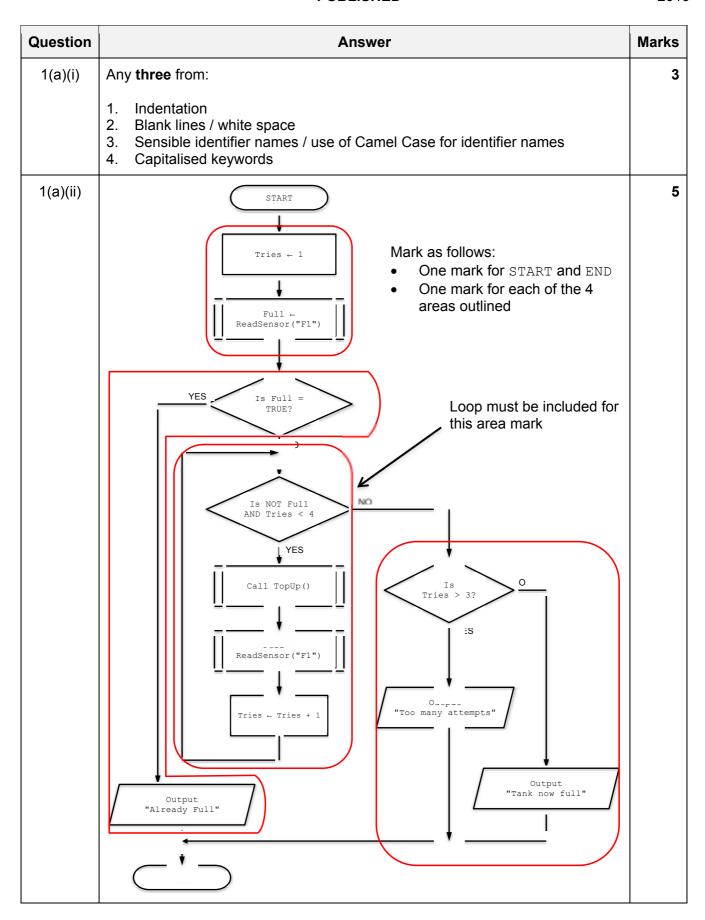

GENERIC MARKING PRINCIPLE 5:

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)	Any **three** from: 1. Indentation 2. Blank lines / white space 3. Sensible identifier names / use of Camel Case for identifier names 4. Capitalised keywords	**3**
1(a)(ii)		**5**

Question	Answer	Marks
1(b)(i)	One mark per row	**4**

Example value	Data type
43	INTEGER
TRUE	BOOLEAN
−273.16	REAL
"−273.16"	STRING

Question	Answer	Marks
1(b)(ii)	One mark per row	**4**

Expression	Evaluates to
RIGHT("Stop", 3) & LEFT("ich",2)	**"topic"**
MID(NUM_TO_STRING(2019), 3, 1)	**"1"**
INT(NUM_TO_STRING(-273.16))	**ERROR**
INT(13/2)	**6**

Question	Answer	Marks
2(a)	One mark per point: 1. The source code represents a solution / design / algorithm expressed in a high-level language 2. The Object code is produced (by the compiler) during the translation stage // The Object code is produced by translating the source code (NOT produced by Interpreter) 3. Corrective maintenance occurs when testing reveals a fault (or error) in the program **and** this is corrected // Corrective maintenance is when errors are found and fixed // Corrective maintenance is when a program is debugged Accept alternative answers provided they relate to the **program development cycle**	**3**
2(b)	Any **three** from: 1. Dynamic syntax checking // Identification of syntax errors 2. Highlighting undeclared variables // incorrect variable usage... 3. Parameter checking 4. Type checking 5. Auto-indentation 6. PrettyPrint	**3**

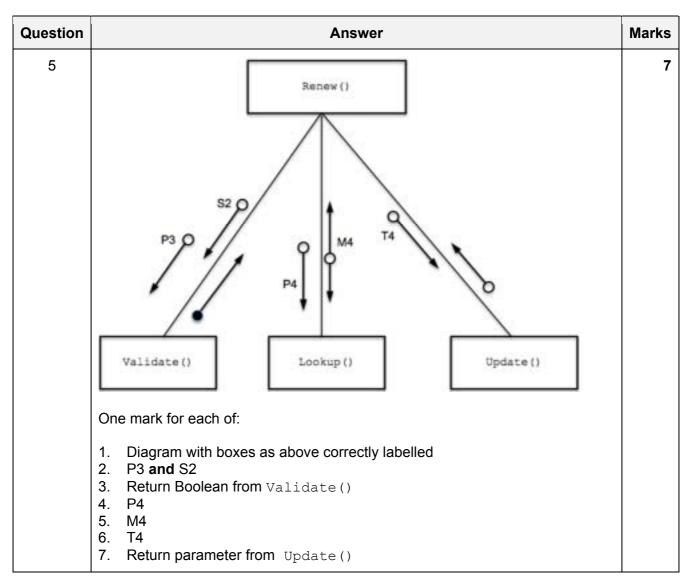| Question	Answer	Marks
| 3(a) | ```
DECLARE Result : ARRAY [0:9] OF INTEGER
DECLARE Index : INTEGER

FOR Index ← 0 TO 9
    Result[Index] ← 0
ENDFOR
```<br><br>One mark for each of the following:<br><br>1. Declaration of RESULT array (10 elements of type INTEGER)<br>2. Loop<br>3. Assignment **within a** loop | **3** |
| 3(b) | ```
DECLARE Index : INTEGER
DECLARE NextChar : CHAR
DECLARE NextCharValue : INTEGER

FOR Index ← 1 TO LENGTH(InString)
    NextChar ← MID(InString, Index, 1)
    NextCharValue ← STRING_TO_NUM(NextChar)
    Result[NextCharValue] ← Result[NextCharValue] + 1
ENDFOR

FOR Index ← 0 TO 9
    OUTPUT "Count of digit " & NUM_TO_STRING(Index) & " : "
                            & NUM_TO_STRING(Result[Index])
ENDFOR
```<br><br>One mark for each of the following:<br><br>1. Declaration of INTEGER variable for Index (or equivalent) to index Result array<br>2. **First** loop from 1 to length of InString:<br>3. Select each character (e.g MID) **in first loop**<br>4. Apply type conversion to obtain integer value for index **in first loop**<br>5. Increment element of Result array **in a loop**<br>6. Separate second loop to repeat 10 times:<br>7. Attempt to OUTPUT two items (digit 0 to 9 plus corresponding count) **in any loop**<br>8. OUTPUT statement including index and count **in any loop** including type conversion of element from array if required **in a loop** | **8** |

Question	Answer	Marks
| 4(a) | ```
PROCEDURE Button(ButtonNum : INTEGER)
    DECLARE Limit : INTEGER

    IF ButtonNum = 10 // increase volume
        THEN
            IF MaxVol = 0
                THEN
                    Limit ← 49
                ELSE
                    Limit ← MaxVol
            ENDIF
            IF VolLevel < Limit
                THEN
                    VolLevel ← VolLevel + 1
            ENDIF
        ELSE // otherwise must be ButtonNum 20 - decrease
            IF VolLevel > 0
                THEN
                    VolLevel ← VolLevel - 1
            ENDIF
    ENDIF
ENDPROCEDURE
```<br><br>Mark as follows:<br><br>1.  Check if parameter value = 10<br>2.  Check if parameter value = 20<br>3.  Check if `MaxVol = 0`<br>4.  Decrement `VolLevel` **and** ensure still in range<br><br>If attempting to increase volume (parameter value was 10):<br><br>5.  Increment `VolLevel`<br>6.  Ensure `VolLevel` still in range: for both cases. i.e:<br>   `VolLevel <= 49` (for `MaxVol = 0`)<br>   `VolLevel <= MaxVol` (for `MaxVol <> 0`) | **6** |
| 4(b) | 2 independent marks for each test:

Test 1
`MaxVol`: **0/49**
`VolLevel` expected: **49**

Test 2
`VolLevel` before: **34**
`VolLevel` expected: **34**

Test 3
`Parameter`: **20**
`VolLevel` expected: **0** | **6** |

Question	Answer	Marks
4(c)(i)	One mark for type, one for description: • Type: Logical Error • Description: Program does not perform as expected • Type: Run-time error • Description: Program executes an invalid instruction / out of bounds error / attempts to divide by zero // program crashes	**2**
4(c)(ii)	One mark per bullet point: • Tests carried out before all the modules / subroutines have been written • Simple / dummy module written to simulate / model / replace the actual module / subroutine / object • Contains an output statement // returns a fixed value to indicate that the call has been made	**3**

Question	Answer	Marks
5	 One mark for each of: 1. Diagram with boxes as above correctly labelled 2. P3 **and** S2 3. Return Boolean from `Validate()` 4. P4 5. M4 6. T4 7. Return parameter from `Update()`	**7**

Question	Answer	Marks

6(a)	'Pseudocode' solution included here for development and clarification of mark scheme.
	Programming language example solutions appear in the Appendix.
	
	``
	FUNCTION SearchLeavers(Reference : STRING) RETURNS BOOLEAN
	
	    DECLARE Index : INTEGER
	    DECLARE Found : BOOLEAN
	
	    Found ← FALSE
	    Index ← 0
	
	    WHILE Index < 500 AND NOT Found
	
	        IF Reference = Leavers[Index]
	          THEN
	              Found ← TRUE
	        ENDIF
	
	        Index ← Index + 1
	
	    ENDWHILE
	
	    RETURN Found
	
	ENDFUNCTION
	``
	
	One mark for each of the following:
	
	1. Function heading (and ending) as above
	2. Initialisation **and** increment of `Index` used to index `Leavers` array **in a loop**
	3. Conditional loop repeating while `Index < 500` **and** exit loop if `Reference` is found:
	4. Compare indexed array element value with `Reference` **in a loop**
	5. Set termination logic if found **in a loop**
	6. Return Boolean value
		6

Question	Answer	Marks
6(b)	```
FUNCTION ProcessStudentList() RETURNS INTEGER

    DECLARE NotCopied : INTEGER
    DECLARE FileData : STRING
    DECLARE Reference : STRING

    NotCopied ← 0

    OPENFILE "StudentList.txt" FOR READ
    OPENFILE "UpdatedList.txt" FOR WRITE

    WHILE NOT EOF("StudentList.txt")

        READFILE "StudentList.txt", FileData

        IF MID(FileData, 6, 1) = '*'
            THEN
                Reference ← MID(FileData, 1, 5) // five char
                    reference
            ELSE
                Reference ← MID(FileData, 1, 8) // eight char
                    reference
        ENDIF

        IF SearchLeavers(Reference) = FALSE
            THEN
                WriteFile "UpdatedList.txt", FileData
            ELSE
                NotCopied ← NotCopied + 1
        ENDIF

    ENDWHILE

    CLOSEFILE "StudentList.txt"
    CLOSEFILE "UpdatedList.txt"

    RETURN NotCopied

ENDFUNCTION
```

One mark for each of the following:

1. Function heading **and** ending as above
2. Declaration and use of three local variables **and** initialisation of count to 0
3. `OPEN` both files in correct mode **and** `CLOSE`
4. Pre-Condition loop to go through the file `StudentList.txt` until `EOF()`
5. Read line from `StudentList.txt` **and** extract correct `Reference` (either 5 or 8 characters) **in a loop**
6. Call `SearchLeavers()` with `Reference` (after attempted extraction) **in a loop**
7. If result is `FALSE` then write `FileData` to `UpdatedList.txt` **in a loop**
8. Otherwise increment `NotCopied` **in a loop**
9. Return `NotCopied` count | 9 |

Question	Answer	Marks
6(c)	'Pseudocode' solution included here for development and clarification of mark scheme. Programming language example solutions appear in the Appendix. One mark per underlined section: Result ← CountTimes (Leavers, "") (Space before open bracket to highlight underlined section only)	**3**

Program Code Example Solutions

Q6 (a): Visual Basic

```
Function SearchLeavers(ByVal Reference As String) As Boolean

    Dim Index As Integer
    Dim Found As Boolean

    Found = FALSE
    Index = 0

    Do While Index < 500 And Not Found

        If Reference = Leavers(Index) Then
            Found = TRUE
        End If

        Index = Index + 1

    Loop

    Return Found

End Function
```

Q6 (a): Pascal

```
function SearchLeavers(Reference : String) : boolean;

   var Index : integer;
   var Found : boolean;

   begin
   Found := FALSE;
   Index := 0;

      While Index < 500 And Not Found
      begin
         if Reference = Leavers[Index] Then
            Found := TRUE;

         Index := Index + 1;

      end;

   result := Found; // SearchLeavers := Found

end;
```

Q6 (a): Python

```
def SearchLeavers(Reference):

   ## Index : Integer
   ## Found : Boolean

   Found = False
   Index = 0

   while Index < 500 and not Found:
      if Reference == Leavers[Index]:
         Found = True

      Index = Index + 1

   return Found
```

Q6 (c): Visual Basic

```
Result = CountTimes(Leavers, "")
```

Q6 (c): Pascal

```
Result := CountTimes(Leavers, "");
```

Q6 (c): Python

```
Result = CountTimes(Leavers, "")
```

Q6 (c): Visual Basic