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COMPUTER SCIENCE **9608/42**

Paper 4 Further Problem-solving and Programming Skills **October/November 2021**

MARK SCHEME

Maximum Mark: 75

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[Turn over

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.

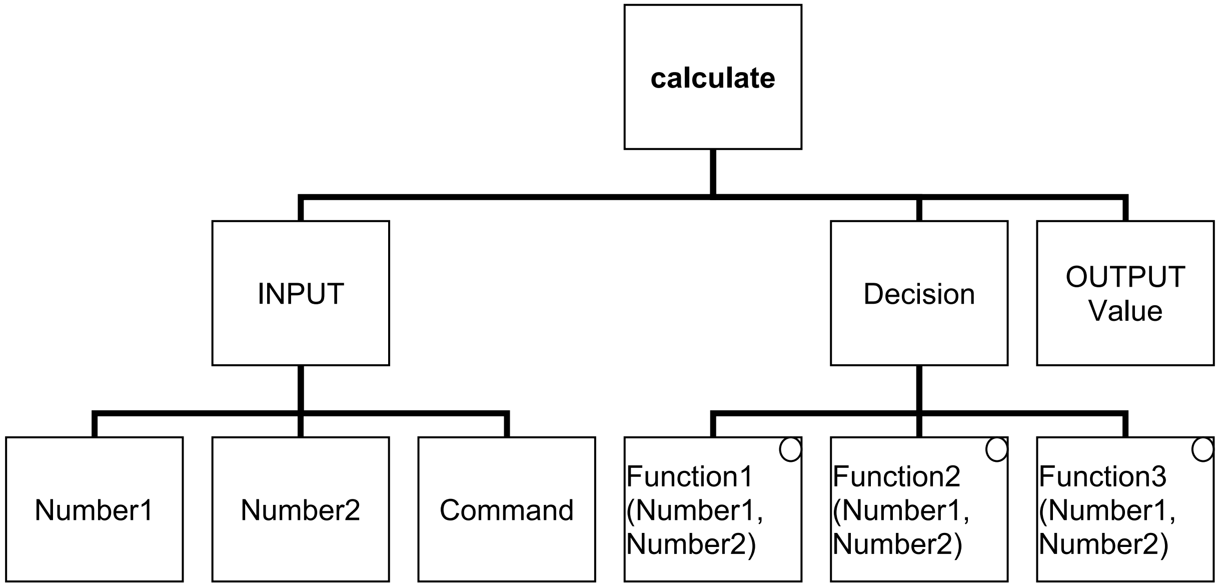
GENERIC MARKING PRINCIPLE 1: Marks must be awarded in line with: • the specific content of the mark scheme or the generic level descriptors for the question • the specific skills defined in the mark scheme or in the generic level descriptors for the question • the standard of response required by a candidate 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)	1 mark per bullet point to max 4 • Set the first element to be the sorted list • Store the next element in a temporary variable // store the value to be sorted in a temporary variable • … compare this next element to each element in the sorted list • Move the elements that are greater than it one space to the right and insert the temporary variable // swap the element down until in the correct positions • Loop through all items from 2nd to end of array/100	**4**
1(b)	1 mark for each completed statement	**5**

```
PROCEDURE Bubble(ByRef NumberArray : ARRAY[0:99] OF INTEGER)
  DECLARE Outer : INTEGER
  DECLARE Swap : BOOLEAN
  DECLARE Inner : INTEGER
  DECLARE Temp : INTEGER

  Outer ← LENGTH(NumberArray)-1
  REPEAT
    Inner ← 0
    Swap ← FALSE
    REPEAT
      IF NumberArray[Inner] > NumberArray[Inner + 1]
        THEN
          Temp ← NumberArray[Inner]
          NumberArray[Inner] ← NumberArray[Inner + 1]
          NumberArray[Inner + 1] ← Temp
          Swap ← TRUE
      ENDIF
      Inner ← Inner + 1
    UNTIL Inner = Outer
    Outer ← Outer - 1
  UNTIL Swap = FALSE OR Outer = 0
ENDPROCEDURE
```

Question	Answer	Marks
2	1 mark per bullet point: • input of `Number1 Number2 Command` on same level under an input box • three functions (1, 2, 3) below e.g. decision box … • …with selection on each • output value at end in box below calculate  calculate INPUT Decision OUTPUT Value Number1 Number2 Command Function1 (Number1, Number2) Function2 (Number1, Number2) Function3 (Number1, Number2)	**4**

Question	Answer	Marks
3	1 mark for each row	**3**

		Rules							
Conditions	One or more upper-case letters	N	Y	N	Y	N	Y	N	Y
	One or more numeric characters	N	N	Y	Y	N	N	Y	Y
	One or more symbols	N	N	N	N	Y	Y	Y	Y
Actions	Strong				Y		Y	Y	Y
	Medium		Y	Y		Y			
	Weak	Y							

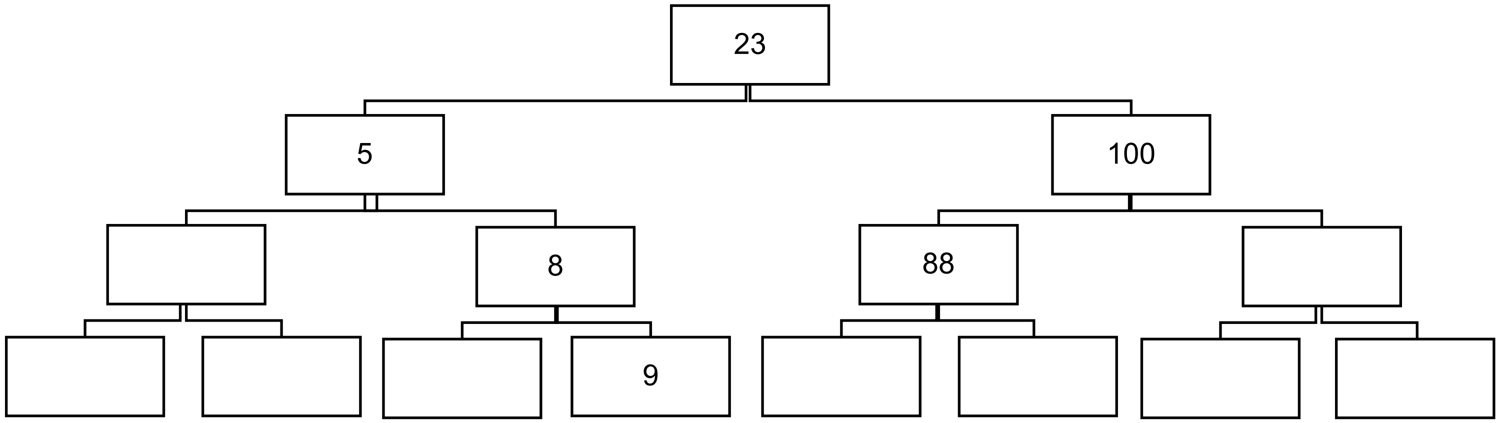
Question	Answer	Marks

4(a)	1 mark per bullet point
	• Record declaration with identifier Node …
	• … all three fields declared with type integer
	
	Example:
	`TYPE Node`
	`  DECLARE LeftPointer : INTEGER`
	`  DECLARE Data : INTEGER`
	`  DECLARE RightPointer : INTEGER`
	`ENDTYPE`
		2

Question	Answer	Marks

4(b)	1 mark per bullet point:
	• Declaration with correct identifier (Node100) of type Node
	• Assigning `LeftPointer` to 1 and `RightPointer` to 4
	• Assigning 100 to the Data
	
	Example pseudocode
	
	`DECLARE Node100 : Node`
	`Node100.LeftPointer ← 1`
	`Node100.Data ← 100`
	`Node100.RightPointer ← 4`
		3

4(c)(i)	To point to the start/first of the empty node/nodes	**1**
4(c)(ii)	–1 or below // 101 or above	**1**

Question	Answer	Marks
4(c)(iii)	1 mark for 23 at top, with 5 below left, 100 below right 1 mark for remaining in correct places below 5 and 100 	2

Question	Answer	Marks

4(c)(iv)	1 mark for each completed statement
	`PROCEDURE AddData(NewNode)`
	`  BinaryTree[FreePointer] ← ` **`NewNode`**
	`  BinaryTree[FreePointer].LeftPointer ← -1`
	`  BinaryTree[FreePointer].RightPointer ← -1`
	
	`  DECLARE PositionFound : BOOLEAN`
	`  DECLARE PointerCounter : INTEGER`
	`  PositionFound ← ` **`FALSE`**
	`  PointerCounter ← RootNode`
	
	`  WHILE NOT ` **`PositionFound`**
	`    IF ` **`NewNode.Data`** ` < BinaryTree[PointerCounter].Data`
	`      THEN`
	`        IF BinaryTree[PointerCounter].LeftPointer = -1`
	`          THEN`
	`            BinaryTree[PointerCounter].LeftPointer ← FreePointer`
	`            PositionFound ← TRUE`
	`          ELSE`
	`            PointerCounter ← BinaryTree[PointerCounter].LeftPointer`
	`        ENDIF`
	`      ELSE`
	`        IF BinaryTree[PointerCounter].RightPointer = -1`
	`          THEN`
	`            BinaryTree[PointerCounter].RightPointer ← FreePointer`
	`            PostionFound ← True`
	`          ELSE`
	`            PointerCounter ← BinaryTree[PointerCounter].RightPointer`
	`        ENDIF`
	`    ENDIF`
	`  ENDWHILE`
	`  FreePointer ← FreePointer ` **`+ 1`**
	`ENDPROCEDURE`
		5

Question	Answer	Marks
5(a)	1 mark per bullet point • Return value of 25 (in space or if space left empty look at tracing) • Calling with 1 and 15, then 2 and 15 • Calling with 4, then 8, then 16 • Showing the unwinding of the return values	**4**

Function Call	**Num1**	**Num2**	**Return value**

`Recursive(1, 15)`	`1`	`15`	`1 + Recursive(2, 15)`
			`1 + 24 = 25`

`Recursive(2, 15)`	`2`	`15`	`2 + Recursive(4, 15)`
			`2 + 22 = 24`

`Recursive(4, 15)`	`4`	`15`	`4 + Recursive(8, 15)`
			`4 + 18 = 22`

`Recursive(8, 15)`	`8`	`15`	`8 + Recursive(16, 15)`
			`8 + 10 = 18`

`Recursive(16, 15)`	`16`	`15`	`10`

Question	Answer	Marks

5(b)	1 mark per bullet point to max 7
	
	• function declaration (and end) taking two parameters **and** the function returns the final totalling value outside of loop and in all cases
	• Initialising totalling value to 0 outside of loop
	
	• Loop until Num1 >= Num2 // loop while Num1 < Num2 …
	• … adding Num1 to totalling value inside the loop
	• … and multiplying Num1 by 2 inside a loop and storing back in Num1
	
	After loop
	• Checking if Num1 > Num2 …
	• … adding 10 to totalling value when true
	• check Num1 = Num2 …
	• … adding Num1 to totalling value when true
	
	Example pseudocode:
	
	`FUNCTION NonRecursive(Num1, Num2 : INTEGER) RETURNS INTEGER`
	`  Value ← 0`
	
	`  WHILE Num1 < Num2`
	`    Value ← Value + Num1`
	`    Num1 ← Num1 * 2`
	`  ENDWHILE`
	
	`  IF Num1 > Num2`
	`    THEN`
	`      Value ← Value + 10`
	`    ELSE`
	`      Value ← Value + Num1`
	`  ENDIF`
	`  RETURN Value`
	`ENDFUNCTION`
		7

Question	Answer	Marks
6(a)	The last one in // most recent	**1**

6(b)(i)	1 mark for True and False in the correct place
	1 for each other completed statement
	
	`FUNCTION AddItemToStack(BYREF ErrorArray : ARRAY[0:99] OF Error,`
	`              BYREF LastItem : INTEGER, BYVALUE Error1 : Error) RETURNS BOOLEAN`
	`  IF LastItem = `**`99 // ErrorArray.Length - 1`**
	`    THEN`
	`      RETURN `**`FALSE`**
	`  ELSE`
	`    ErrorArray(LastItem + 1) ← `**`Error1`**
	`    LastItem ← `**`LastItem + 1`**
	`    RETURN `**`TRUE`**
	`  ENDIF`
	`ENDFUNCTION`
		4

6(b)(ii)	1 mark per bullet point to max 3 • The function needs to change the values in `ErrorArray` and/or `LastItem` in main/where called • … otherwise they would not be changed outside of the function // otherwise changes would only stay in the function • `Error1`'s value does not change in the function // no changes to `Error1`'s value need reflecting where it was called / to the original • `BYVALUE` stops the value being changed outside the function but `BYREF` changes the value where called from	**3**

Question	Answer	Marks

6(b)(iii)	1 mark for **both** return statements
	1 mark for each other completed statement
	
	`FUNCTION RemoveItem(ByRef ErrorArray : ARRAY[0:99] OF Error,`
	`                    ByRef LastItem : INTEGER) RETURNS Error`
	`  DECLARE ItemToRemove : Error`
	`  IF LastItem  < 0 / = -1`
	`    THEN`
	`       RETURN NullError`
	`    ELSE`
	`       ItemToRemove ← ErrorArray[LastItem]`
	`       LastItem ← LastItem - 1`
	`       RETURN ItemToRemove`
	`ENDFUNCTION`
		3

Question	Answer	Marks

6(b)(iv)	1 mark per bullet point to max 5
	• Using `RemoveItem(ErrorArray, LastItem)` **and** storing return value …
	• …checking if return value is `NullError` **and** outputting "stack empty" message if it is null
	• … (if not `NullError`), calling `Enqueue` with return value …
	• … if return value is TRUE, output "added to queue" message …
	• … if return value is FALSE output "not added to queue" message
	
	`PROCEDURE RunError(BYREF ErrorComplete : ARRAY[0:99] OF Error,`
	`                   BYREF ErrorArray : ARRAY[0:99] OF Error)`
	`  DECLARE DataItem : error`
	`  DataItem ← RemoveItem(ErrorArray, LastItem)`
	`  IF DataItem = NullError`
	`    THEN`
	`      OUTPUT "Stack empty"`
	`    ELSE`
	`      IF Enqueue(DataItem) = True`
	`        THEN`
	`          OUTPUT "Item added to queue"`
	`        ELSE`
	`          OUTPUT "Item not added to queue"`
	`     ENDIF`
	`ENDPROCEDURE`
		5

Question	Answer	Marks

7(a)	1 mark per bullet point to max 5
	• class header (and end where appropriate)
	• contents array declared of type `FieldObject` with 10 elements
	• size, lock and strength all private (size & lock – string, strength – integer)
	• constructor taking 3 parameters …
	• … setting Size, Lock and Contents at index 0/1 to parameters
	• … setting strength to 100
	
	Example program code
	
	VB.NET
	`Public Class Box`
	`   Private Size As String`
	`   Private Contents(9) As FieldObject`
	`   Private Lock As String`
	`   Private Strength As Integer`
	`   Sub New(sizep, firstContent, lockNumber)`
	`       Size = sizep`
	`       Lock = lockNumber`
	`       Strength = 100`
	`       Contents(0) = firstContent`
	`   End Sub`
	`End Class`
	
	Python
	`class Box:`
	`     def __init__(self, Sizep, FirstContent, LockNumber):`
	`     self.__Size = Sizep #string`
	`     self.__Lock = LockNumber #string`
	`     self.__Strength = 100 #integer`
	`     self.__Contents[0] = FirstContent #array 10 elements of FieldObject`
		5

Question	Answer	Marks

7(a)	**Pascal**
	`type`
	`   Box = class`
	
	`   private`
	`      Size : String;`
	`      Contents : array[0 .. 9] of String;`
	`      Lock : String;`
	`      Strength : integer;`
	
	`   public`
	`      constructor create(Sizep : String; FirstContent : String; LockNumber : string);`
	
	`end;`
	
	`constructor Box.create(Sizep : String; FirstContent : String; LockNumber : string);`
	`   begin`
	`      Size := Sizep;`
	`      Lock := LockNumber;`
	`      Strength := 100;`
	`      Contents[0] := FirstContent;`
	`end;`	

Question	Answer	Marks

7(b)	1 mark per bullet point to max 5
	• Function declaration (and end) taking (string) parameter (and return Boolean)
	• Check if **parameter** matches `Lock` **and** returning true if it does
	• (otherwise) decrementing `Strength` …
	• … If `Strength` is < 1 / = 0, return true
	• … otherwise if `Strength` is >= 1, return false
	
	Example program code:
	
	V.B.NET
	`Function Unlock(Key)`
	`   If Lock = Key Then`
	`      Return True`
	`   Else`
	`      Strength = Strength - 1`
	`      If Strength <= 0 Then`
	`         Return True`
	`      Else`
	`         Return False`
	`      End If`
	`   End If`
	`End Function`
	
	Python
	`def Unlock(self, Key):`
	`    if self.__Lock == Key:`
	`        return True`
	`    else:`
	`        self.__Strength = self.__Strength - 1`
	`        if self.__Strength <= 0:`
	`            return True`
	`        else:`
	`            return False`
		5

Question	Answer	Marks

7(b)	**Pascal**
	`function Box.Unlock(Key : String) : Boolean;`
	`begin`
	`  if Lock = Key then`
	`    begin`
	`      Unlock := true;`
	`    end`
	`  else`
	`    begin`
	`      Strength := Strength - 1;`
	`      if Strength <= 0 then`
	`         begin`
	`           Unlock := true;`
	`         end`
	`      else`
	`         begin`
	`           Unlock := false;`
	`         end;`
	`    end;`
	`end;`	

Question	Answer	Marks

7(c)	1 mark per bullet point to max 6
	• procedure heading (and end where applicable)
	• opening progress.txt to read
	• read all data from file into `GameData`
	• closing file
	• Exception check when trying to open the file …
	• … appropriate message/other
	
	Example program code
	
	VB.NET
	`Sub LoadGame()`
	`   Dim Filename As String = "progress.txt"`
	`   Dim GameData As String`
	`   Try`
	`      Dim ObjRead As New System.IO.StreamReader(Filename)`
	`      GameData = ObjRead.ReadToEnd`
	`      Console.WriteLine(GameData)`
	`      ObjRead.Close()`
	`   Catch`
	`      Console.WriteLine("File not found")`
	`   End Try`
	`End Sub`
		6

Question	Answer	Marks

7(c)	**Python**
	`def LoadGame():`
	`    Filename = "progress.txt"`
	`    try:`
	`        F = open(Filename, "r")`
	`        GameData = F.read()`
	`        F.close()`
	
	`    except:`
	`        print("File not found")`
	
	Pascal
	`procedure LoadGame();`
	`   var`
	`      Myfile : Text;`
	`      GameData : String;`
	`   begin`
	
	`      try`
	`         assign(Myfile, 'progress.txt');`
	`         reset(Myfile);`
	`         read(Myfile, GameData);`
	`         close(Myfile);`
	`      except`
	`         writeln('File not found');`
	`  end;`
	`end;`	

Question	Answer	Marks
8	1 mark per bullet point • `person(X) AND has(X, black)` • `AND (has(X, moustache) OR has(X, beard))` Example: `person(X) AND has(X, black) AND (has(X, moustache) OR has(X, beard))`	**2**