Cambridge Assessment International Education

Cambridge International AS & A Level

COMPUTER SCIENCE **9618/42**

Paper 4 Practical **October/November 2021**

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 2021 series for most Cambridge IGCSE™, Cambridge International A and AS Level components and some Cambridge O Level components.

© UCLES 2021

[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.

© UCLES 2021

Question	Answer	Marks

1(a)	1 mark per bullet point
	• function with correct name and parameters
	• correct Div operator (or equivalent) used
	• code matches pseudocode
	
	Example program code:
	
	Python
	`def Unknown(X, Y):`
	`  if X < Y:`
	`  print(str(X + Y))`
	`  return Unknown(X + 1, Y) * 2`
	`  elif X == Y:`
	`  return 1`
	`  else:`
	`  print(str(X + Y))`
	`  return int(Unknown(X - 1, Y) / 2)`
	
	VB.NET
	`Function Unknown(X, Y)`
	`  If X < Y Then`
	`  Console.WriteLine(X + Y)`
	`  Return Unknown(X + 1, Y) * 2`
	`  ElseIf X = Y Then`
	`  Return 1`
	`  Else`
	`  Console.WriteLine(X + Y)`
	`  Return Unknown(X - 1, Y) \ 2`
	`  End If`
	`End Function`
	
	Java
	`public static Integer Unknown(Integer X, Integer Y){`
	`  if(X < Y){`
	`  System.out.println(X+Y);`
	`  return Unknown(X + 1, Y) * 2;`
	`  }else if(X == Y){`
	`  return 1;`
	`  }else{`
	`  System.out.println(X + Y);`
	`  Integer ReturnValue = Unknown(X-1,Y) / 2;`
	`  return ReturnValue;`
	`  }`
	`}`
		3

Question	Answer	Marks

1(b)(i)	1 mark per bullet point
	• Suitable output identifying parameters for each call
	• All three correct function calls …
	• …outputting the return value for each call
	
	Example program code:
	
	Python
	`print("10 and 15")`
	`print(str(Unknown(10, 15)))`
	`print("10 and 10")`
	`print(str(Unknown(10, 10)))`
	`print("15 and 10")`
	`print(str(Unknown(15, 10)))`
	
	VB.NET
	`Console.WriteLine("10 and 15")`
	`Console.WriteLine(Unknown(10, 15))`
	`Console.WriteLine("10, 10")`
	`Console.WriteLine(Unknown(10, 10))`
	`Console.WriteLine("15, 10")`
	`Console.WriteLine(Unknown(15, 10))`
	
	Java
	`public static void main(String[] args){`
	`  System.out.println("10 and 15");`
	`  System.out.println(Unknown(10,15));`
	`  System.out.println("10 and 10");`
	`  System.out.println(Unknown(10, 10));`
	`  System.out.println("15 and 10");`
	`  System.out.println(Unknown(15, 10));`
	`}`
		3

Question	Answer	Marks
1(b)(ii)	1 mark for 1 function with correct output 1 mark for remaining 2 function calls with correct output For example: 10 and 15 25 26 27 28 29 32 10 and 10 1 15 and 10 25 24 23 22 21 0	**2**

Question	Answer	Marks

1(c)	1 mark per bullet point
	• Iterative function, taking 2 parameters
	• Starting with return value (Total) as 1
	• Looping while X <> Y // might be 1 loop or two separate // returning when X = Y // looping until X==Y
	• Within each loop, outputting (X+Y) correctly when X<Y and Y<X
	• **Each time** X < Y, Total * 2 **and** X++
	• **Each time** Y < X Total DIV 2 **and** X--
	• Returning the Total after correct calculations
	
	Example program code:
	
	Python
	`def IterativeUnknown(X,Y):`
	`  Total = 1`
	`  while X != Y:`
	`  print(str(X + Y))`
	`  if X < Y:`
	`  X = X + 1`
	`  Total = Total * 2`
	`  else:`
	`  X = X - 1`
	`  Total = int(Total / 2)`
	`  return Total`
	
	VB.NET
	`Function IterativeUnknown(X, Y)`
	`  Dim Total As Integer = 1`
	`  While X <> Y`
	`  Console.WriteLine(X + Y)`
	`  If X < Y Then`
	`  X = X + 1`
	`  Total = Total * 2`
	`  Else`
	`  X = X - 1`
	`  Total = Total \ 2`
	`  End If`
	`  End While`
	`  Return Total`
	`End Function`
		7

Question	Answer	Marks

1(c)	**Java**
	`public static Integer IterativeUnknown(Integer X, Integer Y){`
	`  Integer Total = 1;`
	`  while (X != Y){`
	`  System.out.println(X+Y);`
	`  if(X<Y){`
	`  X = X + 1;`
	`  Total = Total * 2;`
	`  }else{`
	`  X = X - 1;`
	`  Total = Total / 2;`
	`  }`
	`  }`
	`  return Total;`
	`}`	

1(d)(i)	Calling function 3 times with correct Data and outputting
	
	Example program code:
	
	Python
	`print("10 and 15")`
	`print(str(IterativeUnknown(10, 15)))`
	`print("10 and 10")`
	`print(str(IterativeUnknown(10, 10)))`
	`print("15 and 10")`
	`print(str(IterativeUnknown(15, 10)))`
	
	VB.NET
	`Console.WriteLine("10 and 15")`
	`Console.WriteLine(IterativeUnknown(10, 15))`
	`Console.WriteLine("10, 10")`
	`Console.WriteLine(IterativeUnknown(10, 10))`
	`Console.WriteLine("15, 10")`
	`Console.WriteLine(IterativeUnknown(15, 10))`
	
	Java
	`System.out.println("10 and 15");`
	`System.out.println(IterativeUnknown(10, 15));`
	`System.out.println("10 and 10");`
	`System.out.println(IterativeUnknown(10, 10));`
	`System.out.println("15 and 10");`
	`System.out.println(IterativeUnknown(15, 10));`
		1

Question	Answer	Marks
1(d)(ii)	1 mark for screenshot showing correct output for both functions 10 and 15 25 26 27 28 29 32 10 and 10 1 15 and 10 25 24 23 22 21 0	**1**

Question	Answer	Marks

2(a)	1 mark per bullet point
	• class declared (with appropriate close) with identifier `Picture`
	• correct attribute declarations with Data types (Description, Frame colour = string, Width, Height = integer.)
	• …as private
	• correct constructor (with appropriate close) with four parameters…
	• …parameters assigned to attributes
	
	Example program code:
	
	Python
	`class Picture:`
	`  def __init__(self, DescriptionP, WidthSizeP, HeightSizeP, FrameColourP):`
	`  self.__Description = DescriptionP # string`
	`  self.__Width = int(WidthSizeP) #integer`
	`  self.__Height = int(HeightSizeP) #integer`
	`  self.__FrameColour = FrameColourP #string`
	Java
	`class Picture{`
	`  private String Description;`
	`  private Integer Width;`
	`  private Integer Height;`
	`  private String FrameColour;`
	
	`  public Picture(String DescriptionP, Integer WidthP, Integer HeightP, String FrameColourP){`
	`  Description = DescriptionP;`
	`  Width = WidthP;`
	`  Height = HeightP;`
	`  FrameColour = FrameColourP;`
	`  }`
	`  }`
		5

Question	Answer	Marks

2(a)	**VB.NET**
	`Class Picture`
	`  Private Description As String`
	`  Private Width As Integer`
	`  Private Height As Integer`
	`  Private FrameColour As String`
	
	`  Public Sub New(DescriptionP, WidthP, HeightP,FrameColourP)`
	`  Description = DescriptionP`
	`  Width = WidthP`
	`  Height = HeightP`
	`  FrameColour = FrameColourP`
	`  End Sub`
	`End Class`	

Question	Answer	Marks

2(b)	1 mark per bullet point
	• 1 Get method taking no parameter…
	• …returning correct attribute
	• remaining 3 correct methods
	
	Example program code:
	
	Python
	`def GetDescription(self):`
	`  return self.__Description`
	`def GetWidth(self):`
	`  return self.__Width`
	`def GetHeight(self):`
	`  return self.__Height`
	`def GetColour(self):`
	`  return self.__FrameColour`
	
	Java
	`public String GetDescription(){`
	`  return Description;`
	`}`
	`public Integer GetWidth(){`
	`  return Width;`
	`}`
	`public Integer GetHeight(){`
	`  return Height;`
	`}`
	`public String GetFrameColour(){`
	`  return FrameColour;`
	`}`
	VB.NET
	`Function GetDescription()`
	`  Return Description`
	`End Function`
	`Function GetWidth()`
	`  Return Width`
	`End Function`
	`Function GetHeight()`
	`  Return Height`
	`End Function`
	`Function GetFrameColour()`
	`  Return FrameColour`
	`End Function`
		3

Question	Answer	Marks

2(c)	1 mark per bullet point
	• Set method (procedure) taking parameter (no return) …
	• …assigning **parameter** to correct attribute
	
	Example program code:
	
	Python
	`def SetDescription(self, DescriptionP):`
	`  self.__Description = DescriptionP`
	Java
	`public void SetDescription(String DescriptionP){`
	`  Description = DescriptionP;`
	`}`
	VB.NET
	`Public Sub SetDescription(DescriptionP)`
	`  Description = DescriptionP`
	`End Sub`
		2

2(d)	1 mark for declaring array of type `Picture` with 100 elements
	
	Example program code:
	
	Python
	`PictureArray = []`
	`for i in range(100):`
	`  PictureArray.append(Picture("",0,0,""))`
	
	Java
	`public static void main(String[] args){`
	`  Picture[] PictureArray = new Picture[100];}`
	VB.NET
	`Dim PictureArray(0 to 99) As Picture`
		1

Question	Answer	Marks

2(e)	1 mark per bullet point:
	• Exception with opening the file inside...
	• ..appropriate catch and output
	
	1 mark per bullet point to Max 7
	• Function/procedure declared with correct name (and close, passing array by reference or global array declared)
	• opening `Pictures.txt` for Read
	• looping until EOF / or equivalent
	• …reading each set of 4 lines from the file within loop
	• creating object of type `Picture`
	• …with Description, Width, Height, Frame colour **from File** as parameters
	• ..adding to next array element/appending
	• closing the File (in an appropriate place)
	• counts and returns number of pictures in array
	
	Example program code:
	
	Python
	`def ReadData(PictureArray):`
	`  Filename = "Pictures.txt"`
	`  Counter = 0`
	`  try:`
	`  File = open(Filename,"r")`
	`  Description = (File.readline()).strip().lower()`
	`  while(Description != ""):`
	
	`  Width = int((File.readline()).strip())`
	`  Height = int((File.readline()).strip())`
	`  Frame = ((File.readline()).strip()).lower()`
	`  PictureArray[Counter] = Picture(Description,`
	`  Width, Height, Frame)`
	`  Description =((File.readline()).strip()).lower()`
	`  Counter = Counter + 1`
	
	`  File.close()`
	`  except IOError:`
	`  print("Could not find File")`
	`  return Counter, PictureArray`
		8

Question	Answer	Marks

2(e)	**VB.NET**
	`Function ReadData(ByRef PictureArray, ByRef NumberPictures) As Integer`
	`  Dim Counter As Integer = 0`
	`  Try`
	`  Dim Filename As String = "Pictures.txt"`
	`  Dim FileReader As New System.IO.StreamReader(Filename)`
	`  Dim Description, FrameColour As String`
	`  Dim Height, Width As Integer`
	
	`  While FileReader.Peek <> -1`
	`  Description = FileReader.ReadLine()`
	`  Width = FileReader.ReadLine()`
	`  Height = FileReader.ReadLine()`
	`  FrameColour = FileReader.ReadLine()`
	`  PictureArray(NumberPictures) =`
	`  New Picture(Description, Width, Height, FrameColour)`
	`  NumberPictures = NumberPictures + 1`
	`  Counter = Counter + 1`
	`  End While`
	`  FileReader.Close()`
	`  Catch ex As Exception`
	`  Console.WriteLine("Invalid File")`
	`  End Try`
	`  Return Counter`
	`End Function`	

Question	Answer	Marks

2(e)	**Java**
	`public static Integer ReadData(Picture[] PictureArray){`
	`  String Filename = "Pictures.txt";`
	`  String DataRead;`
	`  String Description;`
	`  String Width;`
	`  String Height;`
	`  String FrameColour;`
	`  Integer NumberPictures = 0;`
	`  try{`
	`  FileReader f = new FileReader(Filename);`
	`  BufferedReader Reader = new BufferedReader(f);`
	
	`  DataRead = Reader.readLine();`
	`  while(DataRead != null){`
	`  Description = DataRead;`
	`  Width = Reader.readLine();`
	`  Height = Reader.readLine();`
	`  FrameColour = Reader.readLine();`
	`  PictureArray[NumberPictures] =`
	`  new Picture(Description, Integer.parseInt(Width),`
	`  Integer.parseInt(Height), FrameColour);`
	`  NumberPictures++;`
	`  DataRead = Reader.readLine();`
	`  }`
	`  Reader.close();`
	`  }`
	
	`  catch(FileNotFoundException ex){`
	`  System.out.println("No File found");`
	`  }`
	`  catch(IOException ex){`
	`  System.out.println("No File found");`
	`  }`
	`  return NumberPictures;`
	`}`	

2(f)	1 mark per bullet point
	• calling function `ReadData()` …
	• …store/use the Number of elements returned/by reference based on answer to part 2e
	
	Example program code:
	
	Python
	`NumberPicturesInArray, PictureArray = ReadData(PictureArray)`
	Java
	`Integer NumberPicturesInArray = ReadData(PictureArray);`
	VB.NET
	`Dim NumberPicturesInArray As Integer = ReadData()`
		2

Question	Answer	Marks

2(g)	1 mark per bullet point to Max 7
	• taking as input all three values (colour, width, height)
	• … converting colour to lowercase // uppercase
	• looping through array …
	• …using returned value from part **2(f)** as max index
	
	• …within **loop**, checking if Array[index].FrameColour matches input
	• …**and** checking if Array[index].FrameWidth <= input Width
	• …**and** checking if Array[index].FrameHeight <= input Height
	• …all using Get methods
	
	• outputting the Picture Description, Width and Height for all/any **matching** Pictures
	
	Example program code:
	
	Python
	`FrameColour = input("Input the Frame colour ").lower()`
	`MaxWidth = int(input("Input the Maximum Width "))`
	`MaxHeight = int(input("Input the Maximum Height "))`
	`print("Matches Frames shown")`
	`for Z in range(0, NumberPicturesInArray):`
	
	`    if PictureArray[Z].GetColour() == FrameColour:`
	
	`        if(PictureArray[Z].GetWidth() <= MaxWidth):`
	`            if (PictureArray[Z].GetHeight() <= MaxHeight):`
	`             print(PictureArray[Z].GetDescription(), " " ,`
	`str(PictureArray[Z].GetWidth()), " ",`
	`str(PictureArray[Z].GetHeight()))`
	
	VB.NET
	`Sub Main()`
	`  Dim PictureArray(0 To 99) As Picture`
	`  Dim NumberPictures As Integer = 0`
	`  Dim FrameColour As String`
	`  Dim MaxWidth, MaxHeight As Integer`
	`  ReadData(PictureArray, NumberPictures)`
	
	`  Console.WriteLine("Input the Frame colour")`
	`  FrameColour = (Console.ReadLine()).ToLower()`
	`  Console.WriteLine("Input the Maximum Width")`
	`  MaxWidth = Console.ReadLine()`
	`  Console.WriteLine("Input the Maximum Height")`
	`  MaxHeight = Console.ReadLine()`
	
	`  Console.WriteLine("Matching Frames shown")`
	
	`  For X = 0 To NumberPictures - 1`
	`  If PictureArray(X).GetFrameColour() = FrameColour And`
	`     PictureArray(X).GetWidth <= MaxWidth And`
	`     PictureArray(X).GetHeight <= MaxHeight Then`
		7

Question	Answer	Marks

2(g)	Console.WriteLine(PictureArray(X).GetDescription() & " " & PictureArray(X).GetWidth() & " " & PictureArray(X).GetHeight)
	End If
	Next
	Console.ReadLine()
	End Sub
	
	Java
	public static void main(String[] args){
	Picture[] PictureArray = new Picture[100];
	Integer NumberPicturesInArray = ReadData(PictureArray);
	
	Scanner scanner = new Scanner(System.in);
	System.out.println("Enter the Frame colour");
	String FrameColour = scanner.nextLine();
	System.out.println("Enter the Maximum Width");
	Integer MaxWidth = Integer.parseInt(scanner.nextLine());
	System.out.println("Enter the Maximum Height");
	Integer MaxHeight = Integer.parseInt(scanner.nextLine());
	FrameColour = FrameColour.toLowerCase();
	
	for(int X = 0; X < NumberPicturesInArray; X++){
	
	if(PictureArray[X].GetFrameColour().equals(FrameColour) &&
	PictureArray[X].GetWidth() <= MaxWidth &&
	PictureArray[X].GetHeight() <= MaxHeight){
	
	System.out.println(PictureArray[X].GetDescription() +
	" " + PictureArray[X].GetWidth() + " " +
	PictureArray[X].GetHeight());
	}
	}
	}	

2(h)	1 mark for screenshot showing output for BLACK, 100, 100 1 mark for showing no outputs for silver, 25, 25 Input the Frame colour BLACK Input the Maximum Width 100 Input the Maximum Height 100 Matches Frames shown flowers 45 50 people 20 20 landscape 30 45 landscape 25 37 people 50 40 Input the Frame colour silver Input the Maximum Width 25 Input the Maximum Height 25 Matches Frames shown	**2**

Question	Answer	Marks

3(a)	1 mark per bullet point
	• Declaring array named `ArrayNodes` of type integer
	• …with 20 by 3 elements
	• `RootPointer` declared as integer and assigned -1
	• `FreeNode` declared as integer and assigned 0
	
	Example program code:
	
	Python
	`ArrayNodes=[[0 for X in range(3)] for Y in range(20)]`
	`RootPointer = -1`
	`FreeNode = 0`
	
	VB.NET
	`Sub Main()`
	`  Dim ArrayNodes(19, 2) As Integer`
	`  Dim RootPointer As Integer = -1`
	`  Dim FreeNode As Integer = 0`
	`End Sub`
	
	Java
	`public static Integer[][] ArrayNodes = new Integer[20][3];`
	`public static Integer RootPointer = -1;`
	`public static Integer FreeNode = 0;`
		4

Question	Answer	Marks
3(b)	1 mark for each completed statement to Max 6 1 mark per bullet point • Function/procedure declaration either : taking parameters by reference returning the three amended values (Python) using global instead • remainder of function/procedure matches the pseudocode Example program code: **Python**	**8**

```
def AddNode(ArrayNodes, RootPointer, FreeNode):
   NodeData = int(input("Enter the Data"))
   if FreeNode <= 19:
      ArrayNodes[FreeNode][0] = -1
      ArrayNodes[FreeNode][1] = NodeData
      ArrayNodes[FreeNode][2] = -1

      if RootPointer == -1:  # Add to start
          RootPointer = 0
      else:
          Placed = False
          CurrentNode = RootPointer
          while Placed == False:

              if NodeData < ArrayNodes[CurrentNode][1]:
                  if ArrayNodes[CurrentNode][0] == -1:
                    ArrayNodes[CurrentNode][0] = FreeNode
                    Placed = True
                  else:
                    CurrentNode = ArrayNodes[CurrentNode][0]
              else:
                  if ArrayNodes[CurrentNode][2] == -1:
                     ArrayNodes[CurrentNode][2] = FreeNode
                     Placed = True
                  else:
                    CurrentNode = ArrayNodes[CurrentNode][2]
     FreeNode = FreeNode + 1
  else:
      print("Tree is full")
  return ArrayNodes, RootPointer, FreeNode
```

Question	Answer	Marks

3(b)	**VB.NET**
	`Sub AddNode(ByRef ArrayNodes, ByRef RootPointer,`
	`  ByRef FreeNode)`
	`  Console.WriteLine("Enter the Data")`
	`  Dim NodeData As Integer = Console.ReadLine`
	`  If FreeNode <= 19 Then`
	`  ArrayNodes(FreeNode, 0) = -1`
	`  ArrayNodes(FreeNode, 1) = **NodeData**`
	`  ArrayNodes(FreeNode, 2) = -1`
	
	`  If RootPointer = **-1** Then`
	`  RootPointer = 0`
	`  Else`
	`  Dim Placed As Boolean = False`
	`  Dim CurrentNode As Integer = RootPointer`
	`  While Placed = False`
	`  If NodeData < ArrayNodes(CurrentNode, 1) Then`
	`  If ArrayNodes(CurrentNode, 0) = -1 Then`
	`  ArrayNodes(CurrentNode, 0) = **FreeNode**`
	`  Placed = True`
	`  Else`
	`  **CurrentNode** = ArrayNodes(CurrentNode, 0)`
	`  End If`
	`  Else`
	`  If ArrayNodes(CurrentNode, 2) = -1 Then`
	`  ArrayNodes(CurrentNode, 2) = FreeNode`
	`  Placed = **True**`
	`  Else`
	`  CurrentNode = ArrayNodes(CurrentNode, 2)`
	`  End If`
	`  End If`
	`  End While`
	`  Endif`
	`  FreeNode = **FreeNode** + 1`
	`  Else`
	`  Console.WriteLine("Tree is full")`
	`  End If`
	`End Sub`	

Question	Answer	Marks

3(b)	**Java**
	`public static void AddNode(){`
	`  System.out.println("Enter the Data");`
	`  Integer NodeData;`
	`  Scanner in = new Scanner(System.in);`
	`  NodeData = in.nextInt();`
	`  if(FreeNode <= 19){`
	`  ArrayNodes[FreeNode][0] = -1;`
	`  ArrayNodes[FreeNode][1] = NodeData;`
	`  ArrayNodes[FreeNode][2] = -1;`
	
	`  if (RootPointer == -1){`
	`  RootPointer = 0;`
	`  }else{`
	`  Boolean Placed = false;`
	`  Integer CurrentNode = RootPointer;`
	`  while(Placed == false){`
	`  if (NodeData < ArrayNodes[CurrentNode][1]){`
	`  if (ArrayNodes[CurrentNode][0] == -1){`
	`  ArrayNodes[CurrentNode][0] = FreeNode;`
	`  Placed = true;`
	`  }else{`
	`  CurrentNode = ArrayNodes[CurrentNode][0];`
	`  }`
	`  }else{`
	`  if (ArrayNodes[CurrentNode][2] == -1){`
	`  ArrayNodes[CurrentNode][2] = FreeNode;`
	`  Placed = true;`
	`  }else{`
	`  CurrentNode = ArrayNodes[CurrentNode][2];`
	`  }`
	`  }`
	`  }`
	`  }`
	
	`  FreeNode = FreeNode + 1;`
	`  }else{`
	`  System.out.println("Tree is full");`
	`  }`
	`  }`	

Question	Answer	Marks

3(c)	1 mark per bullet point
	• procedure header (and end, take array as parameter)
	• Loops through all array elements // loops 20 times
	• Prints data in index 0, 1, 2 in each array element…
	• … in the correct order and format (spaces between)
	
	Example program code:
	Python
	`def PrintAll(ArrayNodes):`
	`  for X in range(0, 20):`
	`  print(str(ArrayNodes[X][0]), " ", str(ArrayNodes[X][1]),`
	`  " ", str(ArrayNodes[X][2]))`
	
	VB.NET
	`Sub PrintAll(ByRef ArrayNodes)`
	`  For X = 0 To 19`
	`  Console.WriteLine(ArrayNodes(X, 0) & " " & ArrayNodes(X,`
	`  1) & " " & ArrayNodes(X, 2))`
	`  Next`
	`End Sub`
	
	Java
	`public static void PrintAll(){`
	`  for(int X = 0; X < 20; X++){`
	`  System.out.println(ArrayNodes[X][0] + " " +`
	`  ArrayNodes[X][1] + " " + ArrayNodes[X][2]);`
	`  }`
	`}`
		4

3(d)(i)	1 mark per bullet point
	• looping 10 times
	• calling `AddNode` 10 times (check parameters in 3b)
	• calling `PrintAll` outside of loop (check parameters in 3c)
	
	Example program code:
	Python
	`for X in range(0,10):`
	`  ArrayNodes, RootPointer, FreeNode =`
	`  AddNode(ArrayNodes,RootPointer,FreeNode)`
	
	`PrintAll(ArrayNodes)`
	
	VB.NET
	`For X = 0 To 9`
	`  AddNode(ArrayNodes, RootPointer, FreeNode)`
	`Next`
	`printall(ArrayNodes)`
	
	Java
	`for (int X = 0; X < 10; X++){`
	`  AddNode();`
	`  }`
	`PrintAll();`
		3

Question	Answer	Marks
3(d)(ii)	1 mark for screenshot showing the following output: 1 10 2 9 5 3 4 15 6 5 8 8 7 12 −1 −1 6 −1 −1 20 −1 −1 11 −1 −1 9 −1 −1 4 −1	**1**

3(e)(i)	1 mark per bullet point
	• procedure name `InOrder` taking a parameter (for current node being accessed)
	• Checking if left Node is empty (−1)
	• ….(if not) calling procedure recursively with [Current Node][0] as parameter
	• outputting the [Current Node][1]
	• checking if right Node is empty (−1)
	• …(if not) calling procedure recursively with [Current Node][2] as a parameter
	• Order is correct, left, root, right
	
	Example program code:
	
	Python
	`def InOrder(ArrayNodes, RootNode):`
	`  if ArrayNodes[RootNode][0] != -1:`
	`  InOrder(ArrayNodes, ArrayNodes[RootNode][0])`
	`  print(str(ArrayNodes[RootNode][1]))`
	`  if ArrayNodes[RootNode][2] != -1:`
	`  InOrder(ArrayNodes, ArrayNodes[RootNode][2])`
	
	VB.NET
	`Sub InOrder(ArrayNodes, RootNode)`
	`  If ArrayNodes(RootNode, 0) <> -1 Then`
	`  InOrder(ArrayNodes, ArrayNodes(RootNode, 0))`
	`  End If`
	`  Console.WriteLine(ArrayNodes(RootNode, 1))`
	`  If ArrayNodes(RootNode, 2) <> -1 Then`
	`  InOrder(ArrayNodes, ArrayNodes(RootNode, 2))`
	`  End If`
	`End Sub`
	
	Java
	`public static void InOrder(Integer Root){`
	`  if (ArrayNodes[Root][0] != -1){`
	`  InOrder(ArrayNodes[Root][0]);`
	`  }`
	`  System.out.println(ArrayNodes[Root][1]);`
	`  if(ArrayNodes[Root][2] != -1){`
	`  InOrder(ArrayNodes[Root][2]);`
	`  }`
	`}`
		7

Question	Answer	Marks
3(e)(ii)	1 mark showing output: 4 5 6 8 9 10 11 12 15 20	**1**

© UCLES 2021