

Cambridge International AS & A Level

COMPUTER SCIENCE**9618/42**

Paper 4 Practical

May/June 2024**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.

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This document consists of **50** printed pages.

PUBLISHED**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 descriptions 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.

PUBLISHED**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.

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Question	Answer	Marks
1(a)	1 mark each to max 6 • Procedure declaration (and end where appropriate) taking (string) parameter • Declaration of array to store the data read (type string, suitable number of elements e.g. 150) • Opening file to read... • ... using exception handling with try and catch and output • Reading in the data for each line in that file and storing in array... • ... removing carriage return (Java, Python) • Counting the number of words • Closing the file (might be within the Python opening file statement) e.g. Java <pre>public static void ReadWords(String FileName){ try{ FileReader f = new FileReader(FileName); try{ BufferedReader Reader = new BufferedReader(f); String Line= Reader.readLine(); while (Line != null){ WordArray[NumberWords] = Line.replace("\n",""); NumberWords++; Line = Reader.readLine(); } Reader.close(); }catch(IOException ex){}</pre>	6

Question	Answer	Marks
1(a)	<pre> }catch(FileNotFoundException e){ System.out.println("File not found"); } } VB.NET Sub ReadWords(FileName As String) Try Dim DataReader As StreamReader = New StreamReader(FileName) NumberWords = 0 Do Until DataReader.EndOfStream WordArray(NumberWords) = DataReader.ReadLine() NumberWords = NumberWords + 1 Loop DataReader.Close() Catch ex As Exception Console.WriteLine("Invalid file") End Try End Sub Python def ReadWords(FileName): global WordArray global NumberWords File = open(FileName, 'r') DataRead = File.read().strip() File.close() WordArray = DataRead.split() NumberWords = len(WordArray) </pre>	

Question	Answer	Marks
1(b)	1 mark each • Outputting message to ask user to enter easy, medium, hard • Taking input from user • Conversion of input to filename... • ... calling <code>ReadWords()</code> with correct filename in each case e.g. Java <pre>public static void main(String args[]){ NumberWords = 0; Scanner scanner = new Scanner(System.in); System.out.println("Easy, medium or hard?"); String Choice = scanner.nextLine(); if(Choice.equals("Easy")){ ReadWords("Easy.txt"); }else if(Choice.equals("medium")){ ReadWords("Medium.txt"); }else{ ReadWords("Hard.txt"); } }</pre> VB.NET <pre>Sub Main(args As String()) Console.WriteLine("Easy, medium or hard?") Dim FileName As String Dim Choice As String = Console.ReadLine().ToLower() If Choice = "easy" Then FileName = "Easy.txt" ElseIf Choice = "medium" Then FileName = "Medium.txt" Else</pre>	4

Question	Answer	Marks
1(b)	<pre> FileName = "Hard.txt" End If ReadWords(FileName) End Sub Python WordArray = [] NumberWords = 0 Choice = input("Easy, medium or hard? ").lower() if Choice == "easy": File = "Easy.txt" elif Choice == "medium": File = "Medium.txt" else: File = "Hard.txt" ReadWords(File)</pre>	

Question	Answer	Marks
1(c)(i)	1 mark each • Procedure (and end) taking array and number of answers as parameters and outputting the main word and the number of answers • Loops until user requests to stop (enters "no") • ... takes word as input and compares input to each answer in array but not the main word • ... method of recording answers found e.g. replaces with "" (or appropriate null) • ... outputs if found and not found • Counts the number of answers found (in loop, second array, any method) e.g. Java <pre> public static void Play(){ System.out.println(NumberWords); Scanner scanner = new Scanner(System.in); String WordChosen = WordArray[0]; System.out.println("The word is " + WordChosen); System.out.println("There are " + NumberWords + " words that can be made with 3 or more letters"); WordArray[0] = ""; Boolean Contin = true; Integer QuantityFound = 0; String WordInput; Boolean Found = false; String Answer = "yes"; while(!(Answer.equals("no"))){ System.out.println("Enter your word or no to stop"); Answer = scanner.nextLine(); Found = false; if(!(Answer.equals("no"))){ for(Integer x = 0; x <= NumberWords; x++){ if(Answer.equals(WordArray[x])){ WordArray[x] = ""; </pre>	6

Question	Answer	Marks
1(c)(i)	<pre> WordArray(x) = "" QuantityFound = QuantityFound + 1 Console.WriteLine("Correct, you have found " & QuantityFound & " words") Found = True x = NumberWords + 1 End If Next x If Found = False Then Console.WriteLine("Sorry that was incorrect") End If End If End While End Sub Python def Play(): global WordArray global NumberWords Word = WordArray[0] print("The word is: ", Word) print("There are", NumberWords-1,"words that can be made with 3 or more letters") WordArray[0] = "" Answer = "yes" QuantityFound = 0 while Answer != "no": Answer = input("Enter your word or no to stop ").lower() Found = False </pre>	

Question	Answer	Marks
1(c)(i)	<pre>if Answer != "no": for x in range(0, NumberWords): if Answer == WordArray[x]: WordArray[x] = "" QuantityFound = QuantityFound + 1 print("Correct, you have found", QuantityFound, "words") Found = True if Found == False: print("Sorry that was incorrect")</pre>	

Question	Answer	Marks
1(c)(ii)	1 mark each • Calculates and outputs percentage of answers found (when 'no' is entered) • Method of identifying answers not found (e.g. looping array and skipping null values)... • ... and outputting those answers e.g. Java <pre> public static void Play(){ System.out.println(NumberWords); Scanner scanner = new Scanner(System.in); String WordChosen = WordArray[0]; System.out.println("The word is " + WordChosen); System.out.println("There are " + NumberWords + " words that can be made with 3 or more letters"); WordArray[0] = ""; Boolean Contin = true; Integer QuantityFound = 0; String WordInput; Boolean Found = false; String Answer = "yes"; while(!(Answer.equals("no"))){ System.out.println("Enter your word or no to stop"); Answer = scanner.nextLine(); Found = false; if(!(Answer.equals("no"))){ for(Integer x = 0; x <= NumberWords; x++){ if(Answer.equals(WordArray[x])){ WordArray[x] = ""; QuantityFound++; System.out.println("Correct, you have found " + QuantityFound + " words"); } } } } </pre>	3

Question	Answer	Marks
1(c)(ii)	<pre> Found = true; } } if(Found == false){ System.out.println("Sorry that was incorrect"); } } double Correct = ((Double.valueOf(QuantityFound) / Double.valueOf(NumberWords)) * 100.0); System.out.println("You found " + Correct + "%"); if(Correct < 100){ System.out.println("The words you missed are"); for(Integer x = 0; x <= NumberWords; x++){ if(WordArray[x] != ""){ System.out.println(WordArray[x]); } } } } VB.NET Sub Play() Dim Word As String = WordArray(0) Console.WriteLine("The word is: " & Word) Console.WriteLine("There are " & NumberWords & " words that can be made with 3 or more letters") </pre>	

Question	Answer	Marks
1(c)(ii)	<pre> WordArray(0) = "" Dim Contin As Boolean = True Dim QuantityFound As Integer = 0 Dim Found As Boolean Dim Answer As String = "yes" While Answer <> "no" Console.WriteLine("Enter your word or no to stop") Answer = Console.ReadLine().ToLower() Found = False If Answer <> "Not" Then For x = 0 To NumberWords If Answer = WordArray(x) Then WordArray(x) = "" QuantityFound = QuantityFound + 1 Console.WriteLine("Correct, you have found " & QuantityFound & " words") Found = True x = NumberWords + 1 End If Next x If Found = False Then Console.WriteLine("Sorry that was incorrect") End If End If End While Dim Correct As Double Correct = (QuantityFound / NumberWords) * 100 Console.WriteLine("You found " & Correct & "%") If Correct < 100 Then Console.WriteLine("The words you missed are ") For x = 0 To NumberWords If WordArray(x) <> "" Then </pre>	

Question	Answer	Marks
1(c)(ii)	<pre> Console.WriteLine(WordArray(x)) End If Next x End If End Sub Python def Play(): global WordArray global NumberWords Word = WordArray[0] print("The word is: ", Word) print("There are", NumberWords-1,"words that can be made with 3 or more letters") WordArray[0] = "" Answer = "yes" QuantityFound = 0 while Answer != "no": Answer = input("Enter your word or no to stop ").lower() Found = False if Answer != "no": for x in range(0, NumberWords): if Answer == WordArray[x]: WordArray[x] = "" QuantityFound = QuantityFound + 1 print("Correct, you have found", QuantityFound, "words") Found = True if Found == False: print("Sorry that was incorrect") Correct = (QuantityFound / (NumberWords-1)) * 100 print("You found", Correct,"%") </pre>	

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Question	Answer	Marks
1(c)(ii)	<pre>if Correct < 100: print("The words you missed are") for x in range(0, NumberWords-1): if WordArray[x] != "": print(WordArray[x])</pre>	

Question	Answer	Marks
1(d)(i)	1 mark for: Calling <code>Play()</code> with array and number of answers after all read in from file e.g. Java <pre> public static void ReadWords(String FileName){ try{ FileReader f = new FileReader(FileName); try{ BufferedReader Reader = new BufferedReader(f); String Line= Reader.readLine(); while (Line != null){ WordArray[NumberWords] = Line.replace("\n",""); NumberWords++; Line = Reader.readLine(); } Reader.close(); Play(); }catch(IOException ex){} }catch(FileNotFoundException e){ System.out.println("File not found"); } } </pre>	1

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Question	Answer	Marks
1(d)(i)	VB.NET <pre> Sub ReadWords(FileName As String) Try Dim DataReader As StreamReader = New StreamReader(FileName) NumberWords = 0 Do Until DataReader.EndOfStream WordArray(NumberWords) = DataReader.ReadLine() NumberWords = NumberWords + 1 Loop DataReader.Close() Play() Catch ex As Exception Console.WriteLine("Invalid file") End Try End Sub </pre> Python <pre> def ReadWords(FileName): global WordArray global NumberWords File = open(FileName, 'r') DataRead = File.read().strip() File.close() WordArray = DataRead.split() NumberWords = len(WordArray) Play() </pre>	

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Question	Answer	Marks
1(d)(ii)	1 mark for screenshot showing the inputs "easy", "she", "out", "no" e.g. <pre> Easy, medium or hard?easy The word is: house There are 14 words that can be made with 3 or more letters Enter your wordshe Correct, you have found 1 words Enter your wordout Sorry that was incorrect Enter your wordno You found 7.142857142857142 % The words you missed are hues hose hoes shoe sou ohs ose oes sue use hue hoe hes </pre>	1

Question	Answer	Marks
1(d)(iii)	1 mark for screenshot showing the inputs 'hard', 'fine', 'fined', 'idea', 'no' e.g. <pre> Easy, medium or hard?hard The word is: fainted There are 97 words that can be made with 3 or more letters Enter your wordfine Correct, you have found 1 words Enter your wordfined Correct, you have found 2 words Enter your wordidea Correct, you have found 3 words Enter your wordno You found 3.0927835051546393 % The words you missed are defiant detain fadein nideate anted fated tined fan fet fit fad flat ted ain an def din end fat fid nae tae ten ait ant den dit eta fed fie net tan </pre>	1

Question	Answer	Marks
2(a)(i)	1 mark each to max 4 • Class declaration (and end where appropriate) with identifier <code>Node</code> • <code>LeftPointer</code>, <code>Data</code> and <code>RightPointer</code>, integer • Constructor taking 1 parameter (within class) ... • ... assigning parameter to <code>Data</code> initialising <code>LeftPointer</code> and <code>RightPointer</code> to <code>-1</code> e.g. Java <pre>public class Node{ private Integer LeftPointer; private Integer Data; private Integer RightPointer; public Node(Integer PData){ LeftPointer = -1; Data = PData; RightPointer = -1; } }</pre> VB.NET <pre>Class Node Private LeftPointer As Integer Private Data As Integer Private RightPointer As Integer Sub New(PData) LeftPointer = -1 Data = PData RightPointer = -1 End Sub End Class</pre>	4

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Question	Answer	Marks
2(a)(i)	Python <pre>class Node(): def __init__(self, PData): self._LeftPointer = -1 #int self._Data = PData #int self._RightPointer = -1 #int</pre>	

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Question	Answer	Marks
2(a)(ii)	1 mark each • 1 get method with no parameter... • ...returning correct attribute • Remaining 2 correct (FT minor errors) e.g. Java <pre>public Integer GetLeft(){ return LeftPointer; } public Integer GetRight(){ return RightPointer; } public Integer GetData(){ return Data; }</pre> VB.NET <pre>Function GetLeft() Return LeftPointer End Function Function GetRight() Return RightPointer End Function Function GetData() Return Data End Function</pre> Python <pre>def GetLeft(self): return self._LeftPointer</pre>	3

Question	Answer	Marks
2(a)(ii)	<pre>def GetRight(self): return self._RightPointer def GetData(self): return self.__Data</pre>	

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Question	Answer	Marks
2(a)(iii)	1 mark each • 1 set method with parameter ... • ... assigning to attribute • Remaining 2 correct (FT minor errors) e.g. Java <pre>public void SetLeft(Integer NewLeft){ LeftPointer = NewLeft; } public void SetRight(Integer NewRight){ RightPointer = NewRight; } public void SetData(Integer NewData){ Data = NewData; }</pre> VB.NET <pre>Sub SetLeft(NewLeft) LeftPointer = NewLeft End Sub Sub SetRight(NewRight) RightPointer = NewRight End Sub Sub SetData(NewData) Data = NewData End Sub</pre> Python <pre>def SetLeft(self, NewLeft): self._LeftPointer = NewLeft def SetRight(self, NewRight):</pre>	3

Question	Answer	Marks
2(a)(iii)	<pre>self._RightPointer = NewRight def SetData(self, NewData): self.__Data = NewData</pre>	

Question	Answer	Marks
2(b)(i)	1 mark each • Class header (and end) • Private array <code>Tree</code> of type <code>Node</code> with 20 elements, private <code>FirstNode</code> and private <code>NumberNodes</code> • Constructor assigns <code>-1</code> to <code>FirstNode</code> and <code>0</code> to <code>NumberNodes</code> • ... initialises all <code>Tree</code> (20) elements to <code>Node</code> object with data value <code>-1</code> e.g. Java <pre>class TreeClass{ private static Node[] Tree = new Node[20]; private static Integer FirstNode; private static Integer NumberNodes; public TreeClass(){ FirstNode = -1; NumberNodes = 0; Integer MinusOne = -1; for(Integer x = 0; x < 20; x++){ Tree[x] = new Node(MinusOne); } } }</pre> VB.NET <pre>Class TreeClass Private Tree(20) As Node Private FirstNode As Integer Private NumberNodes As Integer Sub New() FirstNode = -1 NumberNodes = 0 End Sub End Class</pre>	4

Question	Answer	Marks
2(b)(i)	<pre> For x = 0 To 19 Tree(x) = New Node(-1) Next End Sub End Class Python class TreeClass(): def __init__(self): self.__Tree = [] #type node 20 spaces self._FirstNode = -1 #int self._NumberNodes = 0 #int for x in range(20): self.__Tree.append(Node(-1)) </pre>	

Question	Answer	Marks
2(b)(ii)	1 mark each: - Method header and end, taking node as parameter and checking if empty and inserting in first position, updating FirstNode ... otherwise inserting node in tree - Accessing first node and comparing data checking whether to go left or right repeatedly until data found - Updating left and right pointer for parent node e.g. Java <pre> public void InsertNode(Node NewNode) { Integer NodeAccess; Integer Previous = -1; String Direction; if (NumberNodes == 0) { Tree[0] = NewNode; FirstNode = 0; NumberNodes++; } else { Tree[NumberNodes] = NewNode; NodeAccess = FirstNode; Direction = ""; System.out.println(Tree[0].GetData()); while (NodeAccess != -1) { Previous = NodeAccess; if (NewNode.GetData() < Tree[NodeAccess].GetData()) { NodeAccess = Tree[NodeAccess].GetLeft(); Direction = "left"; } } } } </pre>	6

Question	Answer	Marks
2(b)(ii)	<pre> }else if(NewNode.GetData() > Tree[NodeAccess].GetData()){ NodeAccess = Tree[NodeAccess].GetRight(); Direction = "right"; } } if(Direction.equals("left")){ Tree[Previous].SetLeft(NumberNodes); }else{ Tree[Previous].SetRight(NumberNodes); } NumberNodes++; } } VB.NET Sub InsertNode(NewNode) Dim NodeAccess As Integer Dim Direction As String Dim Previous As Integer If NumberNodes = 0 Then Tree(0) = NewNode FirstNode = 0 NumberNodes += 1 Else Tree(NumberNodes) = NewNode NodeAccess = FirstNode Direction = "" While NodeAccess <> -1 Previous = NodeAccess </pre>	

Question	Answer	Marks
2(b)(ii)	<pre> If NewNode.GetData() < Tree(NodeAccess).GetData() Then NodeAccess = Tree(NodeAccess).GetLeft() Direction = "left" ElseIf NewNode.GetData() > Tree(NodeAccess).GetData() Then NodeAccess = Tree(NodeAccess).GetRight() Direction = "right" End If End While If Direction = "left" Then Tree(Previous).SetLeft(NumberNodes) Else Tree(Previous).SetRight(NumberNodes) End If NumberNodes += 1 End If End Sub Python def InsertNode(self, NewNode): if(self.__NumberNodes == 0): self.__Tree[0] = NewNode self.__FirstNode = 0 self.__NumberNodes = self.__NumberNodes + 1 else: self.__Tree[self.__NumberNodes] = NewNode NodeAccess = self.__FirstNode Direction = "" while(NodeAccess != -1): Previous = NodeAccess if NewNode.GetData() < self.__Tree[NodeAccess].GetData(): </pre>	

Question	Answer	Marks
2(b)(ii)	<pre> NodeAccess = self._Tree[NodeAccess].GetLeft() Direction = "left" elif NewNode.GetData() > self.__Tree[NodeAccess].GetData(): NodeAccess = self._Tree[NodeAccess].GetRight() Direction = "right" if(Direction == "left"): self._Tree[Previous].SetLeft(self._NumberNodes) else: self._Tree[Previous].SetRight(self._NumberNodes) self._NumberNodes = self._NumberNodes + 1 </pre>	

Question	Answer	Marks
2(b)(iii)	1 mark each • Procedure header (and end) with no parameter and if no nodes output 'No nodes' • (otherwise) Loop from index 0 to NumberNodes (or equivalent) ... • ... Outputting LeftPointer, Data then RightPointer • ... using get methods e.g. Java <pre>public void OutputTree(){ if(NumberNodes == 0){ System.out.println("No nodes"); }else{ for(Integer x = 0; x < NumberNodes; x++){ System.out.println(Tree[x].GetLeft() + " " + Tree[x].GetData() + " " + Tree[x].GetRight()); } } }</pre> VB.NET <pre>Sub OutputTree() If NumberNodes = 0 Then Console.WriteLine("No nodes") Else For x = 0 To NumberNodes - 1 Console.WriteLine(Tree(x).GetLeft() & " " & Tree(x).GetData() & " " & Tree(x).GetRight()) Next End If End Sub</pre>	4

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Question	Answer	Marks
2(b)(iii)	Python <pre>def OutputTree(self): if self._NumberNodes == 0: print("No nodes") else: for x in range(0, self.__NumberNodes): print(self.__Tree[x].GetLeft(), " ", self.__Tree[x].GetData(), " ", self. Tree[x].GetRight())</pre>	
2(c)(i)	1 mark for • Instance of TreeClass created with identifier TheTree e.g. Java <pre>public static void main(String args[]){ TreeClass TheTree = new TreeClass(); }</pre> VB.NET <pre>Sub Main(args As String()) Dim TheTree As TreeClass = New TreeClass() End Sub</pre> Python <pre>TheTree = TreeClass()</pre>	1

Question	Answer	Marks
2(c)(ii)	1 mark each • Creating one node with one correct value (e.g. 10) • Calling <code>InsertNode</code> for <code>TheTree</code> with each new <code>Node</code> • All nodes correctly assigned in order • Calling <code>OutputTree</code> e.g. Java <pre>public static void main(String args[]){ TreeClass TheTree = new TreeClass(); TheTree.InsertNode(new Node(10)); TheTree.InsertNode(new Node(11)); TheTree.InsertNode(new Node(5)); TheTree.InsertNode(new Node(1)); TheTree.InsertNode(new Node(20)); TheTree.InsertNode(new Node(7)); TheTree.InsertNode(new Node(15)); TheTree.OutputTree(); }</pre> VB.NET <pre>Sub Main(args As String()) Dim TheTree As TreeClass = New TreeClass() TheTree.InsertNode(New Node(10)) TheTree.InsertNode(New Node(11)) TheTree.InsertNode(New Node(5)) TheTree.InsertNode(New Node(1)) TheTree.InsertNode(New Node(20)) TheTree.InsertNode(New Node(7)) TheTree.InsertNode(New Node(15)) TheTree.OutputTree() End Sub</pre>	4

Question	Answer	Marks
2(c)(ii)	Python <pre> TheTree = TreeClass() TheTree.InsertNode(Node(10)) TheTree.InsertNode(Node(11)) TheTree.InsertNode(Node(5)) TheTree.InsertNode(Node(1)) TheTree.InsertNode(Node(20)) TheTree.InsertNode(Node(7)) TheTree.InsertNode(Node(15)) TheTree.OutputTree()</pre>	
2(c)(iii)	1 mark for correct output e.g. <pre> 2 10 1 -1 11 4 3 5 5 -1 1 -1 6 20 -1 -1 7 -1 -1 15 -1</pre>	1

Question	Answer	Marks
3(a)	1 mark each • <code>NumberArray</code> declared (in main) with the 7 correct values in order (integer) 100 85 644 22 15 8 1 e.g. Java <pre>public static void main(String args[]){ Integer[] NumberArray = new Integer[7]; NumberArray[0] = 100; NumberArray[1] = 85; NumberArray[2] = 644; NumberArray[3] = 22; NumberArray[4] = 15; NumberArray[5] = 8; NumberArray[6] = 1; }</pre> VB.NET <pre>Sub Main(args As String()) Dim NumberArray(7) As Integer NumberArray(0) = 100 NumberArray(1) = 85 NumberArray(2) = 644 NumberArray(3) = 22 NumberArray(4) = 15 NumberArray(5) = 8 NumberArray(6) = 1 EndSub</pre> Python <pre>NumberArray = [100, 85, 644, 22, 15, 8, 1]</pre>	1

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Question	Answer	Marks
3(b)(i)	1 mark each • Recursive function written with recursive call • Correct base case and return • Correct while loop control and internal • All correct and structure followed e.g. Java <pre> public static Integer[] RecursiveInsertion(Integer[] IntegerArray, Integer NumberElements){ Integer LastItem; Integer CheckItem; if(NumberElements <= 1){ return IntegerArray; }else{ RecursiveInsertion(IntegerArray, NumberElements - 1); LastItem = IntegerArray[NumberElements - 1]; CheckItem = NumberElements - 2; } Boolean LoopAgain = true; if(CheckItem < 0){ LoopAgain = false; }else if(IntegerArray[CheckItem] < LastItem){ LoopAgain = false; } while(LoopAgain){ IntegerArray[CheckItem + 1] = IntegerArray[CheckItem]; CheckItem = CheckItem - 1; if(CheckItem < 0){ LoopAgain = false; } } } </pre>	4

Question	Answer	Marks
3(b)(i)	<pre> }else if(IntegerArray[CheckItem] <= LastItem){ LoopAgain = false; } } IntegerArray[CheckItem + 1] = LastItem; return IntegerArray; } VB.NET Function RecursiveInsertion(IntegerArray, NumberElements) Dim LastItem, CheckItem As Integer If NumberElements <= 1 Then Return IntegerArray Else RecursiveInsertion(IntegerArray, NumberElements - 1) LastItem = IntegerArray(NumberElements - 1) CheckItem = NumberElements - 2 End If Dim LoopAgain As Boolean = True If CheckItem < 0 Then LoopAgain = False ElseIf IntegerArray(CheckItem) <= LastItem Then LoopAgain = False End If While LoopAgain IntegerArray(CheckItem + 1) = IntegerArray(CheckItem) CheckItem = CheckItem - 1 If CheckItem < 0 Then LoopAgain = False ElseIf IntegerArray(CheckItem) <= LastItem Then </pre>	

Question	Answer	Marks
3(b)(i)	<pre> LoopAgain = False End If End While IntegerArray(CheckItem + 1) = LastItem Return IntegerArray End Function Python def RecursiveInsertion(IntegerArray, NumberElements): if NumberElements <= 1: return IntegerArray RecursiveInsertion(IntegerArray, NumberElements - 1) LastItem = IntegerArray[NumberElements - 1] CheckItem = NumberElements - 2 LoopAgain = True if CheckItem < 0: LoopAgain = False elif IntegerArray[CheckItem] <= LastItem: LoopAgain = False while (LoopAgain): IntegerArray[CheckItem + 1] = IntegerArray[CheckItem] CheckItem = CheckItem - 1 if CheckItem < 0: LoopAgain = False elif IntegerArray[CheckItem] <= LastItem: LoopAgain = False IntegerArray[CheckItem + 1] = LastItem return IntegerArray </pre>	

Question	Answer	Marks
3(b)(ii)	1 mark each • Calling <code>RecursiveInsertion()</code> with array and number of elements (7 or length) • Outputting 'recursive' and then each element in returned array e.g. Java <pre>Integer[] SortedArray = new Integer[7]; SortedArray = RecursiveInsertion(NumberArray, 7); System.out.println("Recursive"); for(Integer x = 0; x < 7; x++){ System.out.println(SortedArray[x]); }</pre> VB.NET <pre>SortedArray = RecursiveInsertion(NumberArray, 7) Console.WriteLine("Recursive") For x = 0 To 6 Console.WriteLine(SortedArray(x)) Next x</pre> Python <pre>SortedArray = RecursiveInsertion(NumberArray, len(NumberArray)) print("Recursive", SortedArray)</pre>	2

Question	Answer	Marks
3(b)(iii)	1 mark for screenshot with: Recursive 1 8 15 22 85 100 644	1

Question	Answer	Marks
3(c)(i)	1 mark each • Insertion algorithm written with correct identifier – no recursion • External loop while there are still elements left (e.g. NumberElements > 0) • Internal loop and selection accurate • Nothing additional added / logic changed e.g. Java <pre> public static Integer[] IterativeInsertion(Integer[] IntegerArray, Integer NumberElements){ Integer LastItem; Integer CheckItem; while(NumberElements > 0){ LastItem = IntegerArray[NumberElements - 1]; CheckItem = NumberElements - 2; Boolean LoopAgain = true; if(CheckItem < 0){ LoopAgain = false; }else if(IntegerArray[CheckItem] < LastItem){ LoopAgain = false; } while(LoopAgain){ IntegerArray[CheckItem+ 1] = IntegerArray[CheckItem]; CheckItem = CheckItem - 1; if(CheckItem < 0){ LoopAgain = false; }else if(IntegerArray[CheckItem] <= LastItem){ LoopAgain = false; } } } } </pre>	4

Question	Answer	Marks
3(c)(i)	<pre> IntegerArray[CheckItem + 1] = LastItem; NumberElements = NumberElements - 1; } return IntegerArray; } VB.NET Function IterativeInsertion(IntegerArray, NumberElements) Dim LastItem, CheckItem As Integer While NumberElements > 0 LastItem = IntegerArray(NumberElements - 1) CheckItem = NumberElements - 2 Dim LoopAgain As Boolean = True If CheckItem < 0 Then LoopAgain = False ElseIf IntegerArray(CheckItem) <= LastItem Then LoopAgain = False End If While LoopAgain IntegerArray(CheckItem + 1) = IntegerArray(CheckItem) CheckItem = CheckItem - 1 If CheckItem < 0 Then LoopAgain = False ElseIf IntegerArray(CheckItem) <= LastItem Then LoopAgain = False End If End While IntegerArray(CheckItem + 1) = LastItem NumberElements = NumberElements - 1 End While Return IntegerArray End Function </pre>	

Question	Answer	Marks
3(c)(i)	Python <pre> def IterativeInsertion(IntegerArray, NumberElements): while NumberElements > 0: LastItem = IntegerArray[NumberElements - 1] CheckItem = NumberElements - 2 LoopAgain = True if CheckItem < 0: LoopAgain = False elif IntegerArray[CheckItem] <= LastItem: LoopAgain = False while(LoopAgain): IntegerArray[CheckItem + 1] = IntegerArray[CheckItem] CheckItem = CheckItem - 1 if CheckItem < 0: LoopAgain = False elif IntegerArray[CheckItem] <= LastItem: LoopAgain = False IntegerArray[CheckItem + 1] = LastItem NumberElements = NumberElements - 1 return IntegerArray </pre>	

Question	Answer	Marks
3(c)(ii)	1 mark each Calling <code>IterativeInsertion()</code> with original unsorted array and outputting 'iterative' and the content of the returned array e.g. Java <pre>Integer[] Sorted2Array = new Integer[7]; Sorted2Array = IterativeInsertion(NumberArray, 7); System.out.println("iterative"); for(Integer x = 0; x < 7; x++){ System.out.println(Sorted2Array[x]); }</pre> VB.NET <pre>Sorted2Array = IterativeInsertion(NumberArray, 7) Console.WriteLine("iterative") For x = 0 To 6 Console.WriteLine(Sorted2Array(x)) Next x</pre> Python <pre>Sorted2Array = IterativeInsertion(NumberArray, len(NumberArray)) print("iterative", Sorted2Array)</pre>	1
3(c)(iii)	1 mark for Recursive 1 8 15 22 85 100 644 Iterative 1 8 15 22 85 100 644	1

Question	Answer	Marks
3(d)(i)	1 mark each to max 6 • Recursive function <code>BinarySearch</code> taking the 4 indicated parameters • Suitable base case (e.g. <code>First > Last</code>) ... • ... returning <code>-1</code> • Calculating middle element • Comparing <code>ToFind</code> with middle and returning <code>Middle</code> if found • If <code>ToFind</code> less than middle, recursive call with <code>Last</code> as <code>Middle - 1</code> • If <code>ToFind</code> more than middle, recursive call with <code>First</code> as <code>Middle + 1</code> e.g. Java <pre>public static Integer BinarySearch(Integer[] IntegerArray, Integer First, Integer Last, Integer ToFind){ Integer Middle; if(First > Last){; return -1; }else{ Middle = (Last + First) / 2; if(IntegerArray[Middle].equals(ToFind)){ return Middle; }else if(IntegerArray[Middle] > ToFind){ return BinarySearch(IntegerArray, First, Middle - 1, ToFind); }else{ return BinarySearch(IntegerArray, Middle + 1, Last, ToFind); } } }</pre> VB.NET <pre>Function BinarySearch(IntegerArray, First, Last, ToFind) Dim Middle As Integer If First > Last Then</pre>	6

Question	Answer	Marks
3(d)(i)	<pre> Return -1 Else Middle = (Last + First) \ 2 If IntegerArray(Middle) = ToFind Then Return Middle ElseIf IntegerArray(Middle) > ToFind Then Return BinarySearch(IntegerArray, First, Middle - 1, ToFind) Else Return BinarySearch(IntegerArray, Middle + 1, Last, ToFind) End If End If End Function </pre> Python <pre> def BinarySearch(IntegerArray, First, Last, ToFind): if First > Last: return -1 else: Middle = int((Last + First) / 2) if IntegerArray[Middle] == ToFind: return Middle elif IntegerArray[Middle] > ToFind: return BinarySearch(IntegerArray, First, Middle - 1, ToFind) else: return BinarySearch(IntegerArray, Middle + 1, Last, ToFind) </pre>	

Question	Answer	Marks
3(d)(ii)	1 mark each • Calling <code>BinarySearch</code> function with sorted array, 0, 6/len(array)-1, 644 as parameters • Checking return value and outputting 'Not found' if -1 and index otherwise e.g. Java <pre>Position = BinarySearch(Sorted2Array, 0, 6, 644); if(Position == -1){ System.out.println("Not found"); }else{ System.out.println(Position); }</pre> VB.NET <pre>Position = BinarySearch(Sorted2Array, 0, 6, 644) If Position = -1 Then Console.WriteLine("Not found") Else Console.WriteLine(Position) End If</pre> Python <pre>Position = BinarySearch(Sorted2Array, 0, len(NumberArray)-1, 644) if Position == -1: print("Not found") else: print(Position)</pre>	2

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Question	Answer	Marks
3(d)(iii)	1 mark for screenshot showing found in index 6 e.g. Recursive [1, 8, 15, 22, 85, 100, 644] Iterative [1, 8, 15, 22, 85, 100, 644] 6	1