

Cambridge International AS & A Level

COMPUTER SCIENCE**9618/43**

Paper 4 Practical

May/June 2026**MARK SCHEME**Maximum Mark: 75

Published

This mark scheme contains the instructions and marking guidance that our examiners used to mark candidate responses for this component.

Before they start marking, examiners complete a standardisation process. They review a range of candidate responses and discuss the mark scheme in detail to agree which answers can and cannot be accepted. Examiners award marks where it is clear that candidate responses have met the requirements of the mark scheme. These requirements may vary between different components or different versions of the same component, depending on the exact requirements of the question and the candidate responses seen during the standardisation process.

Sometimes, our mark schemes may allow marks to be awarded to responses which contain elements that are factually incorrect or for content not covered by the syllabus. We do this in response to the demands of a specific question to support candidates and make sure that our assessments are fair. However, these allowances should not be used as a guide for teaching and learning.

We cannot discuss the mark scheme with schools, and we recommend that schools read the mark scheme together with the assessment material and the Principal Examiner Report for Teachers.

This document consists of **46** printed pages.

General marking principles

All examiners must apply these marking principles when marking candidate responses.

1	Examiners must award marks for each response in line with: - the specific content defined in the mark scheme - the specific skills defined in the mark scheme or in the level descriptions - the standard of response required as exemplified by the standardisation scripts.
2	Examiners must award whole marks (not half marks, or other fractions).
3	Examiners must award marks positively . This means that: - marks are not deducted for errors or omissions - marks are awarded for correct/valid answers as defined in the mark scheme and also for other valid answers which go beyond the scope of the syllabus and mark scheme referring to your team leader as appropriate - the quality of spelling, punctuation and grammar are judged only when the mark scheme indicates that these features are specifically assessed in the question. However, the meaning of all responses must be unambiguous.
4	Examiners must consistently apply the requirements of the mark scheme and any rules for what to do when candidates have not followed instructions correctly.
5	Examiners must use the full range of marks defined in the mark scheme, unless limited by the quality of the candidate responses seen.
6	Examiners must award marks according to the mark scheme and must not award marks with grade thresholds or grade descriptions in mind.

Annotations guidance for centres

Examiners use a system of annotations as a shorthand for communicating their marking decisions to one another. Examiners are trained during the standardisation process on how and when to use annotations. The purpose of annotations is to inform the standardisation and monitoring processes and guide the supervising examiners when they are checking the work of examiners within their team. The meaning of annotations and how they are used is specific to each component and is understood by all examiners who mark the component.

We publish annotations in our mark schemes to help centres understand the annotations they may see on copies of scripts. Note that there may not be a direct correlation between the number of annotations on a script and the mark awarded. Similarly, the use of an annotation may not be an indication of the quality of the response.

The annotations listed below were available to examiners marking this component in this series.

Annotations

Annotation	Meaning
	Benefit of the doubt
	To indicate where a key word/phrase/code is missing
	Incorrect
	Follow through
	Indicate a point in an answer
Highlighted text	To draw attention to a particular aspect or to indicate where parts of an answer have been combined
	Ignore
	Not answered question
	No benefit of doubt given
	No examples or not enough

Annotation	Meaning
	Not relevant or used to separate parts of an answer
Off-page comment	Allows comments to be entered at the bottom of the RM marking window and then displayed when the associated question item is navigated to.
	Repetition
	Indicates that work or a page has been seen including blank answer spaces and blank pages.
	Correct
	Too vague

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- **Bold** in mark scheme means that idea is required.
- / in mark scheme means alternative.
- // in mark scheme means alternative solution that gains the same mark point.
- ... at the end of one mark point without a ... at the start of the next just means the sentence follows on. There is no dependency.
- ... at the end of one mark point and ... at the start of the next, this means the second cannot be awarded without the first.
- () means what is in the brackets is not required, or it is not required in some languages but may be required in others.

Question	Answer	Marks	Guidance
1(a)	1 mark for 1D array (of 15 strings)	1	
Example program code Python <pre>DataArray = [] #15 strings</pre> VB.NET <pre>Dim DataArray(14) As String</pre> Java <pre>public static String[] DataArray = new String[15];</pre>			

Question	Answer	Marks	Guidance
1(b)	1 mark each • Procedure header (and end) • Taking 15 strings as input • ... converting to lower case • ... storing in array	4	
Example program code Python <pre>def CreateArray(): for x in range(15): dataArray.append(input("Enter a word ").lower())</pre> VB.NET <pre>Sub CreateArray() For x = 0 To 14 Console.WriteLine("Enter a word ") dataArray(x) = Console.ReadLine().ToLower() Next End Sub</pre> Java <pre>public static void CreateArray(){ Scanner scanner = new Scanner(System.in); for(Integer x = 0; x < 15; x++){ System.out.println("Enter a word"); dataArray[x] = (scanner.nextLine()).toLowerCase(); } }</pre>			

Question	Answer	Marks	Guidance
1(c)	1 mark each • Procedure header (and end) and outputting all data • ... on one line with a space between each element	2	
Example program code Python <pre>def OutputArray(): StringOutput = "" for x in range(15): StringOutput = StringOutput + " " + DataArray[x] print(StringOutput)</pre> VB.NET <pre>Sub OutputArray() Dim StringOutput As String = "" For x = 0 To 14 StringOutput = StringOutput + " " + DataArray(x) Next Console.WriteLine(StringOutput) End Sub</pre> Java <pre>public static void OutputArray(){ String StringOutput = ""; for(Integer x = 0; x < 15; x++){ StringOutput += " " + DataArray[x]; } System.out.println(StringOutput); }</pre>			

Question	Answer	Marks	Guidance
1(d)(i)	1 mark for calling both procedures in the given order	1	
Example program code Python <pre>CreateArray() OutputArray()</pre> VB.NET <pre>CreateArray() OutputArray()</pre> Java <pre>CreateArray(); OutputArray();</pre>			
1(d)(ii)	1 mark for showing the 15 inputs and all data output on the same line	1	Outputs must be lowercase
e.g. <pre>Enter a word 1 Enter a word One Enter a word 2 Enter a word TWO Enter a word three Enter a word ?? Enter a word house Enter a word 99987 Enter a word popping Enter a word green Enter a word eleven Enter a word 12 Enter a word Twenty Enter a word THIRTY Enter a word 16 1 one 2 two three ?? house 99987 popping green eleven 12 twenty thirty 16</pre>			

Question	Answer	Marks	Guidance
1(e)	1 mark each • Procedure header (and end) taking string as input and converting to lower • Looping through all elements in the array • ... comparing to input • ... counting number of times it occurs • Outputting final count	5	

Question	Answer	Marks	Guidance
Example program code Python <pre>def FindWords(): WordFind = input("Enter the word you want to find ").lower() Counter = 0 for x in range(15): if(DataArray[x] == WordFind): Counter = Counter + 1 print("It was found ", Counter, " times")</pre> VB.NET <pre>Sub FindWords() Console.WriteLine("Enter the word you want to find") Dim WordFind As String = Console.ReadLine().ToLower() Dim Counter As Integer = 0 For x = 0 To 14 If DataArray(x) = WordFind Then Counter = Counter + 1 End If Next Console.WriteLine("It was found " & Counter & " times") End Sub</pre> Java <pre>public static void FindWords(){ Scanner scanner = new Scanner(System.in); System.out.println("Enter the word you want to find"); String WordFind = (scanner.nextLine()).toLowerCase(); Integer Counter = 0; for(Integer x = 0; x < 15; x++){ if(DataArray[x].equals(WordFind)){ Counter++; } } System.out.println("It was found " + Counter + " times"); }</pre>			

Question	Answer	Marks	Guidance
1(f)(i)	1 mark each • Procedure header (and end) and iterating through each element (first loop) • Inner loop • Stopping the loop when in order (any method) • Comparing by length ... • ... and swapping correctly	5	

Question	Answer	Marks	Guidance
	Example program code Python <pre>def SortLength(): Swap = True Count = 0 while(Count < 14 and Swap): Swap = False for y in range(14): if(len(DataArray[y]) > len(DataArray[y+1])): DataArray[y], DataArray[y+1] = DataArray[y+1], DataArray[y] Swap = True Count = Count + 1</pre> VB.NET <pre>Sub SortLength() Dim Temp As String Dim Swap As Boolean = True Dim Count As Integer = 0 While Count < 15 And Swap = True Swap = False For y = 0 To 13 If DataArray(y).Length > DataArray(y + 1).Length Then Temp = DataArray(y) DataArray(y) = DataArray(y + 1) DataArray(y + 1) = Temp Swap = True End If Next Count = Count + 1 End While End Sub</pre>		

Question	Answer	Marks	Guidance
Java <pre> public static void SortLength(){ String Temp; Boolean Swap = true; Integer Count = 0; while(Count < 14 && Swap){ Swap = false; for(Integer y = 0; y < 14; y++){ if(DataArray[y].length() > DataArray[y+1].length()){ Temp = DataArray[y]; DataArray[y] = DataArray[y+1]; DataArray[y+1] = Temp; Swap = true; } } Count++; } } </pre>			
1(f)(ii)	1 mark for calling the 3 procedures in order	1	
Example program code Python FindWords() SortLength() OutputArray() VB.NET FindWords() SortLength() OutputArray() Java FindWords(); SortLength(); OutputArray();			

Question	Answer	Marks	Guidance
1(f)(iii)	1 mark for screenshot showing inputs and outputs	1	Ignore output of array content in order first. Allow ordering if correct for the data but not matching screenshot.
e.g. <pre> Enter a word one Enter a word One Enter a word 1 Enter a word three Enter a word three Enter a word One Enter a word house Enter a word 99987 Enter a word popping Enter a word green Enter a word eleven Enter a word One Enter a word Twenty Enter a word THIRTY Enter a word One Enter the word you want to find one It was found 5 times 1 one one one one one three three house 99987 green eleven twenty thirty popping </pre>			

Question	Answer	Marks	Guidance
2(a)(i)	1 mark each • Class header (and end) • Five attributes with the correct data types • Constructor header (and end) taking five parameters • Assigning parameters to each attribute	4	
Example program code Python <pre>class Character(): def __init__(self, pCharacterName, pColour, pSuperStrength, pFly, pInvisible): self.__CharacterName = pCharacterName self.__Colour = pColour self.__SuperStrength = pSuperStrength self.__Fly = pFly self.__Invisible = pInvisible</pre> VB.NET <pre>Class Character Dim CharacterName As String Dim Colour As String Dim SuperStrength As String Dim Fly As String Dim Invisible As String Public Sub New(pCharacterName, pColour, pSuperStrength, pFly, pInvisible) CharacterName = pCharacterName Colour = pColour SuperStrength = pSuperStrength Fly = pFly Invisible = pInvisible End Sub End Class</pre>			

Question	Answer	Marks	Guidance
Java	<pre>public class Character { public String CharacterName; public String Colour; public String SuperStrength; public String Fly; public String Invisible; public Character(String pCharacterName, String pColour, String pSuperStrength, String pFly, String pInvisible){ CharacterName = pCharacterName; Colour = pColour; SuperStrength = pSuperStrength; Fly = pFly; Invisible = pInvisible; } }</pre>		

Question	Answer	Marks	Guidance
2(a)(ii)	1 mark each • 1 get method header (and end) with no parameter ... • ... returning correct attribute • Remaining 4 get methods correct	3	
Example program code Python <pre>def GetCharacterName(self): return self.__CharacterName def GetColour(self): return self.__Colour def GetSuperStrength(self): return self.__SuperStrength def GetFly(self): return self.__Fly def GetInvisible(self): return self.__Invisible</pre> VB.NET <pre>Public Function GetCharacterName() Return CharacterName End Function Public Function GetColour() Return Colour End Function Public Function GetSuperStrength() Return SuperStrength End Function Public Function GetFly() Return Fly End Function Public Function GetInvisible() Return Invisible End Function</pre>			

Question	Answer	Marks	Guidance
	Java <pre>public String GetCharacterName() { return CharacterName; } public String GetColour() { return Colour; } public String GetSuperStrength() { return SuperStrength; } public String GetFly() { return Fly; } public String GetInvisible() { return Invisible; }</pre>		

Question	Answer	Marks	Guidance
2(b)	1 mark each • <code>ReadData()</code> header (and end) returning populated array • Opening file to read and closing file in appropriate place • Exception handling for file handling including appropriate output • Looping through each line in file and reading data... • ... (stripping and) splitting file correctly (as appropriate) • Creating new instance of <code>Character</code> with correct values ... • ... storing in array	7	

Question	Answer	Marks	Guidance
Example program code Python	<pre>def ReadData(): AllCharacters = [] try: with open("Characters.txt") as TheFile: for Line in TheFile: Line = Line.strip() Line = Line.split(",") AllCharacters.append(Character(Line[0],Line[1],Line[2],Line[3],Line[4])) except: print("Cannot open file") return AllCharacters</pre>		
VB.NET	<pre>Public Function ReadData() Dim AllCharacters(14) As Character Dim Line(4) As String Dim Count As Integer = 0 Try Dim FileReader As New System.IO.StreamReader("Characters.txt") While Not FileReader.EndOfStream Line = (FileReader.ReadLine()).Split(",") AllCharacters(Count) = New Character(Line(0), Line(1), Line(2), Line(3), Line(4)) Count = Count + 1 End While FileReader.Close() Catch ex As Exception Console.WriteLine("Cannot open or read from file") End Try Return AllCharacters End Function</pre>		

Question	Answer	Marks	Guidance
Java	<pre> public static Character[] ReadData(){ Character[] AllCharacters = new Character[15]; try{ Scanner Scanner1 = new Scanner(new File("Characters.txt")); String[] Line = new String[5]; Integer Count = 0; while(Scanner1.hasNextLine()){ Line = Scanner1.nextLine().split(","); AllCharacters[Count] = new Character(Line[0],Line[1],Line[2],Line[3], Line[4]); Count++; } Scanner1.close(); } catch(FileNotFoundException ex){ System.out.println("No file found"); } return AllCharacters; } </pre>		

Question	Answer	Marks	Guidance
2(c)	1 mark each • Procedure header (and end) taking array parameter and outputting character data using get methods • Looping through all characters and outputting data on same line ... • ... in correct format	3	

Question	Answer	Marks	Guidance
	Example program code Python <pre>def OutputCharacters(CharacterArray): for Item in CharacterArray: print("Name: ", Item.GetCharacterName(), " Colour: ", Item.GetColour(), " Super Strength: ", Item.GetSuperStrength(), " Fly: ", Item.GetFly(), " Invisible: ", Item.GetInvisible())</pre> VB.NET <pre>Public Sub OutputCharacters(CharacterArray() As Character) Dim Count As Integer = 0 While (Not (CharacterArray(Count) Is Nothing)) Console.WriteLine("Name: " & CharacterArray(Count).GetCharacterName() & " Colour: " & CharacterArray(Count).GetColour() & " Super strength: " & CharacterArray(Count).GetSuperStrength() & " Fly: " & CharacterArray(Count).GetFly() & " Invisible: " & CharacterArray(Count).GetInvisible()) Count = Count + 1 End While End Sub</pre> Java <pre>public static void OutputCharacters(Character[] CharacterArray){ System.out.println("Remaining characters: "); Integer Count = 0; while(CharacterArray[Count] != null){ System.out.println("Name: " + CharacterArray[Count].GetCharacterName() + " Colour: " + CharacterArray[Count].GetColour() + " Super strength: " + CharacterArray[Count].GetSuperStrength() + " Fly: " + CharacterArray[Count].GetFly() + " Invisible: " + CharacterArray[Count].GetInvisible()); Count++; } }</pre>		

Question	Answer	Marks	Guidance
2(d)(i)	1 mark each - Calling <code>ReadData()</code> and storing returned array - Calling <code>OutputCharacters()</code> with returned array	2	
Example program code Python <pre>CharacterOptions = ReadData() OutputCharacters(CharacterOptions)</pre> VB.NET <pre>Dim CharacterOptions(19) As Character CharacterOptions = ReadData() OutputCharacters(CharacterOptions)</pre> Java <pre>Character[] CharacterOptions = ReadData(); OutputCharacters(CharacterOptions);</pre>			
2(d)(ii)	1 mark for screenshot showing all characters output (in correct format)	1	
e.g. <pre>Name: Jet Colour: Black Super Strength: Yes Fly: No Invisible: No Name: Chewie Colour: Grey Super Strength: No Fly: Yes Invisible: No Name: Nymph Colour: Brown Super Strength: No Fly: No Invisible: Yes Name: Copper Colour: Brown Super Strength: Yes Fly: Yes Invisible: No Name: Seti Colour: White Super Strength: Yes Fly: No Invisible: Yes Name: Epie Colour: Black Super Strength: No Fly: Yes Invisible: Yes Name: Silk Colour: Yellow Super Strength: No Fly: Yes Invisible: No Name: Menth Colour: Green Super Strength: No Fly: No Invisible: Yes Name: Thet Colour: Black Super Strength: Yes Fly: Yes Invisible: Yes Name: Vaze Colour: White Super Strength: Yes Fly: Yes Invisible: No Name: Lithe Colour: Grey Super Strength: Yes Fly: Yes Invisible: No Name: Benny Colour: Grey Super Strength: Yes Fly: Yes Invisible: No Name: Meryl Colour: Yellow Super Strength: No Fly: No Invisible: Yes Name: Cookie Colour: Brown Super Strength: Yes Fly: No Invisible: No Name: Robin Colour: Red Super Strength: Yes Fly: No Invisible: Yes</pre>			

Question	Answer	Marks	Guidance
2(e)(i)	1 mark each • Prompt and input for two criteria ... • ... taking input as two separate inputs // each in one input and splitting appropriately • Looping through each character and comparing attribute to one choice... • ... repeating for a second choice ... (could be AND in if statement) • ... storing matching characters in new array // removing characters from the list // other appropriate method of limiting/identifying • Counting and outputting the number of characters • Calling <code>OutputCharacters()</code> with updated array • Using get methods correctly throughout	8	

Question	Answer	Marks	Guidance
	Example program code Python <pre> print("You can use 2 choices to limit the characters available") for x in range(2): TempArray = [] print("Choice ", x+1) TheOption = int(input("Enter 1 to select a colour, 2 for strength, 3 for fly and 4 for invisibility ")) if(TheOption == 1): Choice = input("Which colour would you like to select a character ") for Item in CharacterOptions: if Item.GetColour() == Choice: TempArray.append(Item) CharacterOptions = TempArray elif TheOption == 2: Choice = input("Enter 1 to select characters with super strength, anything else for those without select super strength ") if Choice == "1": Choice = "Yes" else: Choice = "No" for Item in CharacterOptions: if Item.GetSuperStrength() == Choice: TempArray.append(Item) CharacterOptions = TempArray elif TheOption == 3: Choice = input("Enter 1 to select characters that fly, anything else for those that cannot fly ") if Choice == "1": Choice = "Yes" </pre>		

Question	Answer	Marks	Guidance
	<pre> else: Choice = "No" for Item in CharacterOptions: if Item.GetFly() == Choice: TempArray.append(Item) CharacterOptions = TempArray else: Choice = int(input("Enter 1 to select characters with invisibility, anything else for those without invisibility ")) if Choice == "1": Choice = "Yes" else: Choice = "No" for Item in CharacterOptions: if Item.GetInvisible() == Choice: TempArray.append(Item) CharacterOptions = TempArray NumberCharacters = len(CharacterOptions) print("There are", NumberCharacters, "characters that match your choice") OutputCharacters(CharacterOptions) VB.NET Console.WriteLine("You can use 2 choices to limit the characters available") Dim TheOption As String Dim Choice As String Dim Count As Integer Dim TempCount As Integer </pre>		

Question	Answer	Marks	Guidance
	<pre> For x = 1 To 2 Dim TempArray(20) As Character TempCount = 0 Console.WriteLine("Choice " & x) Console.WriteLine("Enter 1 to select a colour, 2 for strength, 3 for fly and 4 for invisibility ") TheOption = Console.ReadLine() If TheOption = "1" Then Console.WriteLine("Which colour would you like to select a character ") Choice = Console.ReadLine() Count = 0 While (Not (CharacterOptions(Count) Is Nothing)) If (CharacterOptions(Count).GetColour() = Choice) Then TempArray(TempCount) = CharacterOptions(Count) TempCount = TempCount + 1 End If Count = Count + 1 End While CharacterOptions = TempArray ElseIf TheOption = "2" Then Console.WriteLine("Enter 1 to select characters with super strength, anything else for those without select super strength ") Choice = Console.ReadLine() Count = 0 If Choice = "1" Then Choice = "Yes" Else Choice = "No" End If </pre>		

Question	Answer	Marks	Guidance
	<pre> While (Not (CharacterOptions(Count) Is Nothing)) If (CharacterOptions(Count).GetSuperStrength() = Choice) Then TempArray(TempCount) = CharacterOptions(Count) TempCount = TempCount + 1 End If Count = Count + 1 End While CharacterOptions = TempArray ElseIf TheOption = "3" Then Console.WriteLine("Enter 1 to select characters that fly, anything else for those that cannot fly ") Choice = Console.ReadLine() Count = 0 If Choice = "1" Then Choice = "Yes" Else Choice = "No" End If While (Not (CharacterOptions(Count) Is Nothing)) If (CharacterOptions(Count).GetFly() = Choice) Then TempArray(TempCount) = CharacterOptions(Count) TempCount = TempCount + 1 End If Count = Count + 1 End While CharacterOptions = TempArray Else Console.WriteLine("Enter 1 to select characters with invisibility, anything else for those without invisibility ") Choice = Console.ReadLine() Count = 0 </pre>		

Question	Answer	Marks	Guidance
	<pre> If Choice = "1" Then Choice = "Yes" Else Choice = "No" End If While (Not (CharacterOptions(Count) Is Nothing)) If (CharacterOptions(Count).GetInvisible() = Choice) Then TempArray(TempCount) = CharacterOptions(Count) TempCount = TempCount + 1 End If Count = Count + 1 End While CharacterOptions = TempArray End If Next Console.WriteLine("There are " & TempCount & " characters") OutputCharacters(CharacterOptions) Java System.out.println("You can use 2 choices to limit the characters available"); String TheOption; String Choice; Integer Count; Integer TempCount = 0; for(Integer x = 1; x < 3; x++){ Character[] TempArray = new Character[20]; TempCount = 0; System.out.println("Choice" + x); System.out.println("Enter 1 to select a colour, 2 for strength, 3 for fly and 4 for invisibility "); TheOption = Scanner1.nextLine(); if(TheOption.equals("1")){ System.out.println("Which colour would you like to select a character "); Choice = Scanner1.nextLine(); Count = 0; </pre>		

Question	Answer	Marks	Guidance
	<pre> while(CharacterOptions[Count] != null){ if ((CharacterOptions[Count].GetColour()).equals(Choice)){ TempArray[TempCount] = CharacterOptions[Count]; TempCount++; } Count++; } CharacterOptions = TempArray; }else if(TheOption.equals("2")){ System.out.println("Enter 1 to select characters with super strength, anything else for those without select super strength "); Choice = Scanner1.nextLine(); if(Choice.equals("1")){ Choice = "Yes"; }else{ Choice = "No"; } Count = 0; while(CharacterOptions[Count] != null){ if ((CharacterOptions[Count].GetSuperStrength()).equals(Choice)){ TempArray[TempCount] = CharacterOptions[Count]; TempCount++; } Count++; } CharacterOptions = TempArray; }else if(TheOption.equals("3")){ System.out.println("Enter 1 to select characters that fly, anything else for those that cannot fly "); Choice = Scanner1.nextLine(); if(Choice.equals("1")){ Choice = "Yes"; }else{ Choice = "No"; } Count = 0; </pre>		

Question	Answer	Marks	Guidance
	<pre> while(CharacterOptions[Count] != null){ if ((CharacterOptions[Count].GetFly()).equals(Choice)){ TempArray[TempCount] = CharacterOptions[Count]; TempCount++; } Count++; } CharacterOptions = TempArray; }else{ System.out.println("Enter 1 to select characters with invisibility, anything else for those without invisibility "); Choice = Scanner1.nextLine(); if(Choice.equals("1")){ Choice = "Yes"; }else{ Choice = "No"; } Count = 0; while(CharacterOptions[Count] != null){ if ((CharacterOptions[Count].GetInvisible()).equals(Choice)){ TempArray[TempCount] = CharacterOptions[Count]; TempCount++; } Count++; } CharacterOptions = TempArray; } } System.out.println("Number of characters " + TempCount); OutputCharacters(CharacterOptions); </pre>		

Question	Answer	Marks	Guidance
2(e)(ii)	1 mark for screenshot showing correct inputs and outputs	1	
e.g. <pre> You can use 2 choices to limit the characters available Choice 1 Enter 1 to select a colour, 2 for strength, 3 for fly and 4 for invisibility 1 Which colour would you like to select a character Black Choice 2 Enter 1 to select a colour, 2 for strength, 3 for fly and 4 for invisibility 3 Enter 1 to select characters that fly, anything else for those that cannot fly 1 There are 2 characters that match your choice Remaining characters: Name: Epie Colour: Black Super Strength: No Fly: Yes Invisible: Yes Name: Thet Colour: Black Super Strength: Yes Fly: Yes Invisible: Yes </pre>			

Question	Answer	Marks	Guidance
3(a)	1 mark each - Global array with space for 100×3 elements all initialised to -1 - TreeRootPointer to -1 and FirstFreeNodePointer initialised to 0	3	
Example program code Python <pre>for x in range(100): BinaryTree.append([-1,-1,-1]) TreeRootPointer = -1 FirstFreeNodePointer = 0</pre> VB.NET <pre>Dim BinaryTree(100, 3) As Integer Dim FirstFreeNodePointer As Integer Dim TreeRootPointer As Integer Sub Main() For x = 0 To 99 BinaryTree(x, 0) = -1 BinaryTree(x, 1) = -1 BinaryTree(x, 2) = -1 Next TreeRootPointer = -1 FirstFreeNodePointer = 0 End Sub</pre> Java <pre>for(Integer x = 0; x < 100; x++){ BinaryTree[x][0] = -1; BinaryTree[x][1] = -1; BinaryTree[x][2] = -1; } TreeRootPointer = -1; FirstFreeNodePointer = 0;</pre>			

Question	Answer	Marks	Guidance
3(b)	1 mark each to max 7 • Procedure header (and end) take integer parameter and incrementing <code>FirstFreeNodePointer</code> • Checking if tree is empty, storing in first element and updating root pointer • Checking if the tree is full and outputting message • (if not full) stores the data in <code>FirstFreeNodePointer</code> with parameter (and pointers -1) • Comparing to root pointer ... • ... repeating with left pointer if less than • ... repeating with right pointer if greater than • ... repeating until leaf node found ... • ... updating correct parent node pointer to new node	7	

Question	Answer	Marks	Guidance
Example program code Python	<pre>def AddNode(NodeData): global FirstFreeNodePointer global TreeRootPointer if FirstFreeNodePointer <= 99: BinaryTree[FirstFreeNodePointer][0] = -1 BinaryTree[FirstFreeNodePointer][1] = NodeData BinaryTree[FirstFreeNodePointer][2] = -1 if TreeRootPointer == -1: TreeRootPointer = 0 else: Placed = False CurrentNode = TreeRootPointer while Placed == False: if NodeData < BinaryTree[CurrentNode][1]: if BinaryTree[CurrentNode][0] == -1: BinaryTree[CurrentNode][0] = FirstFreeNodePointer Placed = True else: CurrentNode = BinaryTree[CurrentNode][0] else: if BinaryTree[CurrentNode][2] == -1: BinaryTree[CurrentNode][2] = FirstFreeNodePointer Placed = True else: CurrentNode = BinaryTree[CurrentNode][2] FirstFreeNodePointer = FirstFreeNodePointer + 1 else: print("The tree is full")</pre>		

Question	Answer	Marks	Guidance
VB.NET	<pre> Sub AddNode(NodeData) If FirstFreeNodePointer <= 99 Then BinaryTree(FirstFreeNodePointer, 0) = -1 BinaryTree(FirstFreeNodePointer, 1) = NodeData BinaryTree(FirstFreeNodePointer, 2) = -1 If (TreeRootPointer = -1) Then TreeRootPointer = 0 Else Dim Placed As Boolean = False Dim CurrentNode As Integer = TreeRootPointer While (Placed = False) If (NodeData < BinaryTree(CurrentNode, 1)) Then If (BinaryTree(CurrentNode, 0) = -1) Then BinaryTree(CurrentNode, 0) = FirstFreeNodePointer Placed = True Else CurrentNode = BinaryTree(CurrentNode, 0) End If Else If (BinaryTree(CurrentNode, 2) = -1) Then BinaryTree(CurrentNode, 2) = FirstFreeNodePointer Placed = True Else CurrentNode = BinaryTree(CurrentNode, 2) End If End If End While End If FirstFreeNodePointer = FirstFreeNodePointer + 1 Else Console.WriteLine("The tree is full") End If End Sub </pre>		

Question	Answer	Marks	Guidance
Java	<pre> public static void AddNode(Integer NodeData){ if(FirstFreeNodePointer <= 99){ BinaryTree[FirstFreeNodePointer][0] = -1; BinaryTree[FirstFreeNodePointer][1] = NodeData; BinaryTree[FirstFreeNodePointer][2] = -1; if(TreeRootPointer == -1){ TreeRootPointer = 0; }else{ boolean Placed = false; Integer CurrentNode = TreeRootPointer; while(Placed == false){ if(NodeData < BinaryTree[CurrentNode][1]){ if(BinaryTree[CurrentNode][0] == -1){ BinaryTree[CurrentNode][0] = FirstFreeNodePointer; Placed = true; }else{ CurrentNode = BinaryTree[CurrentNode][0]; } }else{ if(BinaryTree[CurrentNode][2] == -1){ BinaryTree[CurrentNode][2] = FirstFreeNodePointer; Placed = true; }else{ CurrentNode = BinaryTree[CurrentNode][2]; } } } } } FirstFreeNodePointer= FirstFreeNodePointer + 1; </pre>		

Question	Answer	Marks	Guidance
	<pre> }else{ System.out.println("The tree is full"); } } </pre>		
3(c)	1 mark each • Procedure header (and end) looping 10 times • Outputting array data in correct format	2	
Example program code Python <pre> def OutputArray(): for x in range(10): print(BinaryTree[x][0], " ", BinaryTree[x][1], " ", BinaryTree[x][2]) </pre> VB.NET <pre> Sub OutputArray() For x = 0 To 9 Console.WriteLine(BinaryTree(x, 0) & " " & BinaryTree(x, 1) & " " & BinaryTree(x, 2)) Next End Sub </pre> Java <pre> public static void OutputArray(){ for(Integer x = 0; x < 10; x++){ System.out.println(BinaryTree[x][0] + " " + BinaryTree[x][1] + " " + BinaryTree[x][2]); } } </pre>			

Question	Answer	Marks	Guidance
3(d)(i)	1 mark each • Taking 10 numbers as input ... • ... calling <code>AddNode()</code> with each value • Calling <code>OutputArray()</code>	3	
Example program code Python <pre>for x in range(10): AddNode(int(input("Enter a number "))) OutputArray()</pre> VB.NET <pre>For x = 0 To 9 Console.WriteLine("Enter a number") AddNode(Console.ReadLine()) Next OutputArray()</pre> Java <pre>for(Integer x = 0; x < 10; x++){ System.out.println("Enter a number "); AddNode(Integer.parseInt(scanner.nextLine())); } OutputArray();</pre>			

Question	Answer	Marks	Guidance
3(d)(ii)	1 mark for screenshot show array contents	1	
e.g. <pre>Enter a number 50 Enter a number 26 Enter a number 120 Enter a number 236 Enter a number 2 Enter a number 16 Enter a number 67 Enter a number 49 Enter a number 165 Enter a number 15 1 50 2 4 26 7 6 120 3 8 236 -1 -1 2 5 9 16 -1 -1 67 -1 -1 49 -1 -1 165 -1 -1 15 -1</pre>			

Question	Answer	Marks	Guidance
3(e)(i)	1 mark each • Recursive procedure <code>InOrder()</code> header and end with parameter • Checking if left pointer is null ... • ... if not, recursive call with left pointer • Outputting data at parameter • Checking if right pointer is null ... • ... if not, recursive call with right pointer • Correct order	7	

Question	Answer	Marks	Guidance
	Example program code Python <pre>def InOrder(TheRoot): if(BinaryTree[TheRoot][0] != -1): InOrder(BinaryTree[TheRoot][0]) print(BinaryTree[TheRoot][1]) if(BinaryTree[TheRoot][2] != -1): InOrder(BinaryTree[TheRoot][2])</pre> VB.NET <pre>Sub InOrder(TheRoot) If (BinaryTree(TheRoot, 0) <> -1) Then InOrder(BinaryTree(TheRoot, 0)) End If Console.WriteLine(BinaryTree(TheRoot, 1)) If (BinaryTree(TheRoot, 2) <> -1) Then InOrder(BinaryTree(TheRoot, 2)) End If End Sub</pre> Java <pre>public static void InOrder(Integer TheRoot){ if(BinaryTree[TheRoot][0] != -1){ InOrder(BinaryTree[TheRoot][0]); } System.out.println(BinaryTree[TheRoot][1]); if(BinaryTree[TheRoot][2] != -1){ InOrder(BinaryTree[TheRoot][2]); } }</pre>		

Question	Answer	Marks	Guidance
3(e)(ii)	1 mark for calling <code>InOrder()</code> with root pointer	1	
Example program code Python <pre>InOrder(TreeRootPointer)</pre> VB.NET <pre>InOrder(TreeRootPointer)</pre> Java <pre>InOrder(TreeRootPointer);</pre>			

Question	Answer	Marks	Guidance
3(e)(iii)	1 mark for screenshot showing data input and output in correct order	1	
e.g. <pre> Enter a number 50 Enter a number 26 Enter a number 120 Enter a number 236 Enter a number 2 Enter a number 16 Enter a number 67 Enter a number 49 Enter a number 165 Enter a number 15 1 50 2 4 26 7 6 120 3 8 236 -1 -1 2 5 9 16 -1 -1 67 -1 -1 49 -1 -1 165 -1 -1 15 -1 2 15 16 26 49 50 67 120 165 236 </pre>			