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COMPUTER SCIENCE **9618/41**

Paper 4 Practical **October/November 2022**

MARK SCHEME

Maximum Mark: 75

Published

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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.

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Question	Answer	Marks

1(a)	1 mark per point:
	• (global) 1D (Integer) array `DataArray`
	• 100 elements
	
	Example program code:
	
	Python
	`DataArray = [0 for I in range (100)]`
	
	Java
	`public static Integer[] DataArray = new Integer[100];`
	
	VB.NET
	`Dim DataArray(99) As Integer`
		2

1(b)	1 mark per point:
	• Procedure `ReadFile()` header (and end where appropriate)
	• opening file `IntegerData.txt` (for read)
	• looping through the 100 elements // looping to end of file
	• reading each (and all) value from file and storing in array
	• closing file (in appropriate place)
	
	1 mark per point:
	• Exception Handling (for opening the file, or for reading values from the file)…
	• …with appropriate catch and output messages
	
	Example program code:
	
	Python
	`def ReadFile():`
	`  global DataArray`
	
	`  try:`
	`  TextFile = "IntegerData.txt"`
	`  File = open(TextFile, 'r')`
	`  for X in range(0, 100):`
	`  DataArray[X] = File.readline()`
	`  DataArray[X].rstrip('\n')`
	`  DataArray[X] = int(DataArray[X])`
	`  File.close()`
	`  except IOError:`
	`  print("Count not find file")`
		6

Question	Answer	Marks

1(b)	**Java**
	`public static void ReadFile(){`
	`  String Filename = "IntegerData.txt";`
	`  try{`
	`  FileReader F = new FileReader(Filename);`
	`  BufferedReader Reader = new BufferedReader(F);`
	`  for(Integer X = 0; X < 100; X++){`
	`  DataArray[X] =`
	`Integer.parseInt(Reader.readLine());`
	`  }`
	`  Reader.close();`
	`  }`
	`  catch(FileNotFoundException ex){`
	`  System.out.println("No file found");`
	`  }`
	`  catch(IOException ex){`
	`  System.out.println("No file found");`
	`  }`
	`}`
	VB.NET
	`Sub ReadFile()`
	`  try`
	`  Dim TextFile As String = "IntegerData.txt"`
	`  Dim FileReader As New`
	`System.IO.StreamReader(TextFile)`
	`  For X = 0 To 99`
	`  DataArray(X) = FileReader.ReadLine()`
	`  Next`
	`  FileReader.Close()`
	`  Catch ex As Exception`
	`  Console.WriteLine("Invalid file")`
	`  End Try`
	`End Sub`	

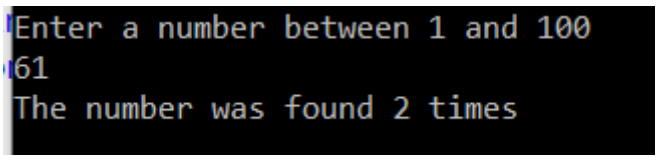
1(c)	1 mark per point: • Function `FindValues()` (and end where appropriate) **and** input of data to search for in the array • …validation/casting(/storing as) of input as integer • …validation of input between 1 and 100 (inclusive) • looping through all 100 array elements… • …comparing input to each array element… • …initialising counter to 0 and then adding 1 each time it is found… • Returning the total	**7**

Question	Answer	Marks

1(c)	Example program code:
	Python
	`def FindValues():`
	`  global DataArray`
	
	`  DataToFind = -1`
	
	`  while(DataToFind < 1 or DataToFind > 100):`
	`  DataToFind = int(input("Enter a number between 1 and 100"))`
	`  Total = 0`
	`  for X in range(0, 99):`
	`  if DataArray[X] == DataToFind:`
	`  Total = Total + 1`
	`  return Total`
	
	VB.NET
	`Function FindValues()`
	`  Dim DataToFind As Integer`
	`  Do`
	`  Console.WriteLine("Enter a number between 1 and 100")`
	`  DataToFind = Console.ReadLine()`
	`  Loop Until (DataToFind >= 1 And DataToFind <= 100)`
	`  Dim Total As Integer = 0`
	`  For X = 0 To 99`
	`  If DataArray(X) = DataToFind Then`
	`  Total = Total + 1`
	`  End If`
	`  Next`
	`  Return Total`
	`End Function`
	
	Java
	`public static Integer FindValues(){`
	`  Integer DataToFind = -1;`
	`  while(DataToFind < 1 || DataToFind > 100){`
	`  System.out.println("Enter a number between 1 and 100");`
	`  Scanner in = new Scanner(System.in);`
	`  DataToFind = in.nextInt();`
	`  }`
	`  Integer Total = 0;`
	`  for(Integer X = 0; X < 100; X++){`
	`  if(DataArray[X] == DataToFind){`
	`  Total = Total + 1;`
	`  }`
	`  }`
	`  return Total;`
	`}`	

Question	Answer	Marks

1(d)(i)	1 mark per point:
	
	• Calling `ReadFile()` and then `FindValues()` (in the main program)
	• storing/using return value from `FindValues()` …
	• …outputting return value with appropriate message
	
	Example program code:
	
	Python
	`ReadFile()`
	`print("The number appears " + str(FindValues()) + " times")`
	
	Java
	`public static void main(String[] args){`
	`  ReadFile();`
	`  Integer ReturnValue = FindValues();`
	`  System.out.println("The number was found " + ReturnValue + " times");`
	`}`
	
	VB.NET
	`Sub Main()`
	`  ReadFile()`
	`  Dim ReturnValue As Integer = FindValues()`
	`  Console.WriteLine("The number was found " & ReturnValue & " times")`
	`End Sub`
		3

1(d)(ii)	Screenshot showing 61 input and 2 output, e.g.  	**1**

Question	Answer	Marks

1(e)	1 mark per point:
	• procedure declaration (and end where appropriate) **and** outputting array contents at end of procedure **and** calling procedure from main program
	• correct outer loop …
	• … correct inner loop …
	• … swapping **all** elements if in incorrect order
	
	Example program code:
	
	Python
	`def BubbleSort():`
	`  global DataArray`
	
	`    N = 100`
	`    for I in range(N-1):`
	`        for J in range(0, N-I-1):`
	`            if DataArray[J] > DataArray[J+1]:`
	`                DataArray[J], DataArray[J+1] =`
	`DataArray[J+1], DataArray[J]`
	`#main`
	`ReadFile()`
	`print("The number appears " + str(FindValues()) + "`
	`times")`
	`BubbleSort()`
	`print(DataArray)`
	
	Java
	`public static void BubbleSort(){`
	`  Integer Temp = 0;`
	`  for(Integer I = 0; I < 100-1; I++){`
	`    for(Integer J = 0; J < 100-I-1; J++){`
	`      if(DataArray[J] > DataArray[J+1]){`
	`        Temp = DataArray[J];`
	`        DataArray[J] = DataArray[J+1];`
	`        DataArray[J+1] = Temp;`
	`       }`
	`    }`
	`  }`
	
	`  for(Integer X = 0; X < 100; X ++){`
	`    System.out.println(DataArray[X]);`
	`    }`
	`}`
	`public static void main(String[] args){`
	`  ReadFile();`
	`  Integer ReturnValue = FindValues();`
	`  System.out.println("The number was found " +`
	`ReturnValue + " times");`
	`  BubbleSort();`
	`}`
		4

Question	Answer	Marks

1(e)	**VB.NET**
	`Sub Bubblesort()`
	`  Dim Outer As Integer = 100 - 1`
	`  Dim Swap As Boolean`
	`  Dim Inner As Integer`
	`  Dim Temp As Integer`
	`  Do`
	`   Inner = 0`
	`   Swap = False`
	`   Do`
	`     If DataArray(Inner) > DataArray(Inner + 1) Then`
	`       Temp = DataArray(Inner)`
	`       DataArray(Inner) = DataArray(Inner + 1)`
	`       DataArray(Inner + 1) = Temp`
	`       Swap = True`
	`     End If`
	`     Inner = Inner + 1`
	`     Loop Until Inner = Outer`
	`     Outer = Outer - 1`
	`  Loop Until Swap = False Or Outer = 0`
	`  For X = 0 To 99`
	`    Console.WriteLine(DataArray(X))`
	`  Next`
	`End Sub`
	`Sub Main()`
	`    ReadFile()`
	`    Dim ReturnValue As Integer = FindValues()`
	`    Console.WriteLine("The number was found " &`
	`ReturnValue & " times")`
	`    Bubblesort()`
	`End Sub`	

Question	Answer	Marks

2(a)(i)	1 mark per point:
	
	• class `Card` declaration (and end where appropriate)
	• Private attributes declared `Number` as integer and `Colour` as string
	• constructor header (and end where appropriate)…
	• …taking 2 parameters
	• assigning parameters to attributes
	
	Example program code:
	
	Python
	`class Card:`
	`    #Number as integer`
	`    #Colour as string`
	`    def __init__(self, Number1, Colour1):`
	`        self.__Number = Number1;`
	`        self.__Colour = Colour1;`
		5

Question	Answer	Marks

2(a)(i)	**Java**
	`class Card{`
	`  private Integer Number;`
	`  private String Colour;`
	`  public Card(Integer Number1, String Colourp){`
	`  Number = Number1;`
	`  Colour = Colourp;`
	`  }}`
	
	VB.NET
	`Class Card`
	`  Private Number As Integer`
	`  Private Colour As String`
	`  Sub New(Number1, Colourp)`
	`  Number = Number1`
	`  Colour = Colourp`
	`  End Sub`
	`End Class`	

2(a)(ii)	1 mark per point:
	
	• 1 get method as function (and end where appropriate) with no parameters…
	• …returning the value
	• 2nd correct get method
	
	Example program code:
	
	Python
	`def GetNumber(self):`
	`  return self.__Number`
	
	`def GetColour(self):`
	`  return self.__Colour`
	
	Java
	`public Integer GetNumber(){`
	`  return Number;`
	`}`
	
	`public String GetColour(){`
	`  return Colour;`
	`}`
	
	VB.NET
	`Function GetNumber()`
	`  Return Number`
	`End Function`
	
	`Function GetColour()`
	`  Return Colour`
	`End Function`
		3

Question	Answer	Marks

2(a)(iii)	1 mark per point:
	
	• one card initialised as type `Card` …
	• … all 15 cards initialised correctly as type `Card`
	
	Example program code:
	
	Python
	`OneRed = Card(1, "red")`
	`TwoRed = Card(2, "red")`
	`ThreeRed = Card(3, "red")`
	`FourRed = Card(4, "red")`
	`FiveRed = Card(5, "red")`
	
	`OneBlue = Card(1, "blue")`
	`TwoBlue = Card(2, "blue")`
	`ThreeBlue = Card(3, "blue")`
	`FourBlue = Card(4, "blue")`
	`FiveBlue = Card(5, "blue")`
	
	`OneYellow = Card(1, "yellow")`
	`TwoYellow = Card(2, "yellow")`
	`ThreeYellow = Card(3, "yellow")`
	`FourYellow = Card(4, "yellow")`
	`FiveYellow = Card(5, "yellow")`
	
	Java
	`CARD oneRed = new Card(1, "red");`
	`CARD twoRed = new Card(2, "red");`
	`CARD threeRed = new Card(3, "red");`
	`CARD fourRed = new Card(4, "red");`
	`CARD fiveRed = new Card(5, "red");`
	`CARD oneBlue = new Card(1, "blue");`
	`CARD twoBlue = new Card(2, "blue");`
	`CARD threeBlue = new Card(3, "blue");`
	`CARD fourBlue = new Card(4, "blue");`
	`CARD fiveBlue = new Card(5, "blue");`
	`CARD oneYellow = new Card(1, "yellow");`
	`CARD twoYellow = new Card(2, "yellow");`
	`CARD threeYellow = new Card(3, "yellow");`
	`CARD fourYellow = new Card(4, "yellow");`
	`CARD fiveYellow = new Card(5, "yellow");`
		2

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Question	Answer	Marks

2(a)(iii)	**VB.NET**
	`Dim OneRed As New Card (1, "red")`
	`Dim TwoRed As New Card(2, "red")`
	`Dim ThreeRed As New Card(3, "red")`
	`Dim FourRed As New Card(4, "red")`
	`Dim FiveRed As New Card(5, "red")`
	`Dim OneBlue As New Card(1, "blue")`
	`Dim TwoBlue As New Card(2, "blue")`
	`Dim ThreeBlue As New Card(3, "blue")`
	`Dim FourBlue As New Card(4, "blue")`
	`Dim FiveBlue As New Card(5, "blue")`
	`Dim OneYellow As New Card(1, "yellow")`
	`Dim TwoYellow As New Card(2, "yellow")`
	`Dim ThreeYellow As New Card(3, "yellow")`
	`Dim FourYellow As New Card(4, "yellow")`
	`Dim FiveYellow As New Card(5, "yellow")`	

2(b)(i)	1 mark per point:
	• class `Hand` declaration (and end where appropriate)
	• private attribute declarations; `FirstCard` as integer, `NumberCards` as integer
	• private attribute array named `Cards` of type `Card` with 10 elements
	• constructor with 5 `Card` objects as parameters
	• assigning each `Card` parameter to the array (in constructor)
	• initialising `FirstCard` to 0 and `NumberCards` to 5 (in constructor)
	Example program code:
	Python
	`class Hand:`
	`    #Cards[10] as Card`
	`    #FirstCard as integer`
	`    #NumberCards as integer`
	`    def __init__(self, Card1, Card2, Card3, Card4, Card5):`
	`        self.__Cards = []`
	`        self.__Cards.append(Card1)`
	`        self.__Cards.append(Card2)`
	`        self.__Cards.append(Card3)`
	`        self.__Cards.append(Card4)`
	`        self.__Cards.append(Card5)`
	`        self.__FirstCard = 0`
	`        self.__NumberCards = 5`
		6

Question	Answer	Marks

2(b)(i)	**Java**
	`class Hand{`
	`  private Card[] Cards = new Card[10];`
	`  private Integer FirstCard;`
	`  private Integer NumberCards;`
	
	`  public Hand(CARD Card1, CARD Card2, CARD Card3, CARD Card4, CARD Card5){`
	`  Cards[0] = Card1;`
	`  Cards[1] = Card2;`
	`  Cards[2] = Card3;`
	`  Cards[3] = Card4;`
	`  Cards[4] = Card5;`
	`  FirstCard = 0;`
	`  NumberCards = 5;`
	`  }`
	`}`
	
	VB.NET
	`class Hand`
	`  Private Cards(9) As Card`
	`  Private FirstCard As Integer`
	`  Private NumberCards As Integer`
	
	`  Sub New(Card1, Card2, Card3, Card4, Card5)`
	`  Cards(0) = Card1`
	`  Cards(1) = Card2`
	`  Cards(2) = Card3`
	`  Cards(3) = Card4`
	`  Cards(4) = Card5`
	`  FirstCard = 0`
	`  NumberCards = 5`
	`  End Sub`
	`End Class`	

2(b)(ii)	1 mark per point:
	• function `GetCard()` header (and end where appropriate) taking (integer) parameter
	• returning the card at parameter index in array
	
	Example program code:
	Python
	`def GetCard(self, Position):`
	`  return self.__Cards[Position]`
	
	Java
	`public Card GetCard(Integer Position){`
	`  return Cards[Position];`
	`}`
	
	VB.NET
	`Function GetCard(Position)`
	`  Return Cards(Position)`
	`End Function`
		2

Question	Answer	Marks

2(b)(iii)	1 mark per point:
	
	• 2 variables (player 1 and player 2) of type `Hand`
	• using constructor and sending the correct variables as parameters
	
	Example program code:
	
	Python
	`Player1 = Hand(OneRed, TwoRed, ThreeRed, FourRed, OneYellow)`
	`Player2 = Hand(TwoYellow, ThreeYellow, FourYellow, FiveYellow, OneBlue)`
	
	Java
	`Hand Player1 = new Hand(OneRed, TwoRed, ThreeRed, FourRed, OneYellow);`
	`Hand Player2 = new Hand(TwoYellow, ThreeYellow, FourYellow, FiveYellow, OneBlue);`
	
	VB.NET
	`Dim Player1 As New Hand(OneRed, TwoRed, ThreeRed, FourRed, OneYellow)`
	`Dim Player2 As New Hand(TwoYellow, ThreeYellow, FourYellow, FiveYellow, OneBlue)`
		2

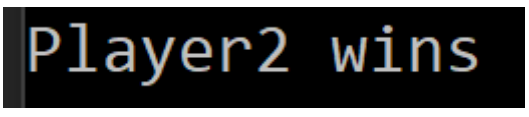
2(c)(i)	1 mark per point:
	
	• function `CalculateValue()` header (and end where appropriate) taking one parameter **and** initialising score to 0
	• looping through all 5 `Card` objects in parameter array…
	• … adding 5 to score for red, 10 to score for blue, 15 to score if yellow
	• … adding **each** card number to score
	• Using `GetCard()`, `GetColour()` and `GetNumber()` correctly
	• Returning calculated score
	
	Example program code:
	
	Python
	`def CalculateValue(Player):`
	`  Score = 0`
	`  for Count in range(0, 4):`
	`  CardGot = Player.GetCard(Count)`
	`  Score = Score + CardGot.GetNumber()`
	`  Colour = CardGot.GetColour()`
	`  if Colour == "red":`
	`  Score = Score + 5`
	`  elif Colour == "blue":`
	`  Score = Score + 10`
	`  else:`
	`  Score = Score + 15`
	`  return Score`
		6

Question	Answer	Marks

2(c)(i)	**Java**
	
	`public static Integer CalculateValue(Hand Player){`
	`  Integer Score = 0;`
	`  String Colour;`
	`  Card CardGot;`
	`  for(Integer X = 0; X<5; X++){`
	`  CardGot = Player.GetCard(X);`
	`  Score = Score + CardGot.GetNumber();`
	`  Colour = CardGot.GetColour();`
	`  if(Colour == "red"){`
	`  Score = Score + 5;`
	`  }else if(Colour == "blue"){`
	`  Score = Score + 10;`
	`  } else {`
	`  Score = Score + 15;`
	`  }}return Score;}`
	
	VB.NET
	
	`Function CalculateValue(Player As Hand)`
	`  Dim Score As Integer = 0`
	`  Dim Colour As String`
	`  Dim CardGot As Card`
	`  For Count = 0 To 4`
	`  CardGot = Player.GetCard(Count)`
	`  Score = Score + CardGot.GetNumber()`
	`  Colour = CardGot.GetColour()`
	`  If Colour = "red" Then`
	`  Score = Score + 5`
	`  ElseIf Colour = "blue" Then`
	`  Score = Score + 10`
	`  Else`
	`  Score = Score + 15`
	`  End If`
	`  Next`
	`  Return Score`
	`End Function`	

Question	Answer	Marks

2(c)(ii)	1 mark per point:
	
	• One function call of `CalculateValue( )` for each player …
	• …sending the player's hand as parameter
	• Comparing **return values and** outputting the player with the highest score in an appropriate message …
	• … or if there was a draw in appropriate message
	
	Example program code:
	
	Python
	
	`Player1score = CalculateValue(Player1)`
	`Player2score = CalculateValue(Player2)`
	`if Player1score > Player2score:`
	`  print("Player 1 wins")`
	`elif Player1score < Player2score:`
	`  print("Player 2 wins")`
	`else:`
	`  print("It's a draw")`
	
	Java
	
	`Integer Player1score = CalculateValue(Player1);`
	`Integer Player2score = CalculateValue(Player2);`
	`if(Player1score > Player2score){`
	`  System.out.println("Player 1 wins");`
	`}else if(Player2score > Player1score){`
	`  System.out.println("Player2 wins");`
	`} else {`
	`  System.out.println("It's a draw");`
	`}`
	
	VB.NET
	
	`Dim Player1score As Integer`
	`Dim Player2score As Integer`
	`Player1score = CalculateValue(Player1)`
	`Player2score = CalculateValue(Player2)`
	`If Player1score > Player2score Then`
	`  Console.WriteLine("Player 1 wins")`
	`ElseIf Player1score < Player2score Then`
	`  Console.WriteLine("Player 2 wins")`
	`Else`
	`  Console.WriteLine("It's a draw")`
	`End If`
		4

2(c)(iii)	Output showing player 2 wins, for example: 	**1**

Question	Answer	Marks

3(a)	1 mark per point:
	
	• Declaring (global) 2D array `ArrayNodes`
	• looping through all 20 × 3 elements of array …
	• …. storing −1 in each element
	
	Example program code:
	
	Java
	
	`public static Integer[][] ArrayNodes = new Integer[20][3];`
	`for(Integer X = 0; X<20; X++){`
	`  for(Integer Y = 0; Y<3; Y++){`
	`  ArrayNodes[X][Y] = -1`
	`}}`
	
	Python
	
	`ArrayNodes = []`
	`for x in range(0, 20):`
	`  ArrayNodes.append([-1, -1, -1])`
	
	VB.NET
	
	`Dim ArrayNodes(19, 2) As Integer`
	`Sub main()`
	`  For X = 0 To 19`
	`  For Y = 0 To 2`
	`  ArrayNodes(X, Y) = -1`
	`  Next`
	`  Next`
	`End Sub`
		3

Question	Answer	Marks

3(b)	1 mark per point:
	
	• initialising each of the first 6 array elements correctly
	• declaring and initialising `FreeNode` to 6 and `RootPointer` to 0
	
	Example program code:
	
	Python
	
	`ArrayNodes = [[1,20,5],[2,15,-1],[-1,3,3],[-1,9,4],[-1,10,-1],[-1,58,-1]]`
	`FreeNodes = 6`
	`RootPointer = 0`
	
	Java
	
	`ArrayNodes[0][0] = 1;`
	`ArrayNodes[0][1] = 20;`
	`ArrayNodes[0][2] = 5;`
	
	`ArrayNodes[1][0] = 2;`
	`ArrayNodes[1][1] = 15;`
	`ArrayNodes[1][2] = -1;`
	
	`ArrayNodes[2][0] = -1;`
	`ArrayNodes[2][1] = 3;`
	`ArrayNodes[2][2] = 3;`
	
	`ArrayNodes[3][0] = -1;`
	`ArrayNodes[3][1] = 9;`
	`ArrayNodes[3][2] = 4;`
	
	`ArrayNodes[4][0] = -1;`
	`ArrayNodes[4][1] = 10;`
	`ArrayNodes[4][2] = -1;`
	`ArrayNodes[5][0] = -1;`
	`ArrayNodes[5][1] = 58;`
	`ArrayNodes[5][2] = -1;`
	
	`Integer FreeNode = 6;`
	`Integer RootPointer = 0;`
		2

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Question	Answer	Marks

3(b)	**VB.NET**
	`ArrayNodes(0, 0) = 1`
	`ArrayNodes(0, 1) = 20`
	`ArrayNodes(0, 2) = 5`
	
	`ArrayNodes(1, 0) = 2`
	`ArrayNodes(1, 1) = 15`
	`ArrayNodes(1, 2) = -1`
	
	`ArrayNodes(2, 0) = -1`
	`ArrayNodes(2, 1) = 3`
	`ArrayNodes(2, 2) = 3`
	
	`ArrayNodes(3, 0) = -1`
	`ArrayNodes(3, 1) = 9`
	`ArrayNodes(3, 2) = 4`
	
	`ArrayNodes(4, 0) = -1`
	`ArrayNodes(4, 1) = 10`
	`ArrayNodes(4, 2) = -1`
	
	`ArrayNodes(5, 0) = -1`
	`ArrayNodes(5, 1) = 58`
	`ArrayNodes(5, 2) = -1`
	
	`Dim FreeNode As Integer = 6`
	`Dim RootPointer As Integer = 0`	

Question	Answer	Marks

3(c)	1 mark for each completed statement (4)
	1 mark for remainder of function correct
	
	Pseudocode:
	`FUNCTION SearchValue(BYVAL Root : INTEGER, ValueToFind : INTEGER)`
	
	`  IF Root = -1 THEN`
	`  RETURN -1`
	`  ELSE`
	`  IF ArrayNodes[Root,1] = ValueToFind THEN`
	`  RETURN Root`
	`  ELSE`
	`  IF ArrayNodes[Root, 1] = -1 THEN`
	`  RETURN -1`
	`  ENDIF`
	`  ENDIF`
	`  ENDIF`
	`  IF ArrayNodes[Root,1] > ValueToFind THEN`
	`  RETURN SearchValue(ArrayNodes[Root,0], ValueToFind)`
	`  ENDIF`
	
	`  IF ArrayNodes[Root,1] < ValueToFind THEN`
	`  RETURN SearchValue(ArrayNodes[Root,2], ValueToFind)`
	`  ENDIF`
	
	`ENDFUNCTION`
	
	Example program code:
	
	Python
	
	`def SearchValue(Root, ValueToFind):`
	`  global ArrayNodes`
	`  if Root == -1:`
	`  return -1`
	`  elif ArrayNodes[Root][1] == ValueToFind:`
	`  return Root`
	`  elif ArrayNodes[Root][1] == -1:`
	`  return -1`
	`  if(ArrayNodes[Root][1] > ValueToFind):`
	`  return SearchValue(ArrayNodes[Root][0], ValueToFind)`
	`  if(ArrayNodes[Root][1] < ValueToFind):`
	`  return SearchValue(ArrayNodes[Root][2], ValueToFind)`
		5

Question	Answer	Marks

3(c)	**Java**
	`public static Integer SearchValue(Integer Root, Integer ValueToFind){`
	`  if(Root == -1){`
	`  return -1;`
	`  }else if(ArrayNodes[Root][1] == ValueToFind){;`
	`  return **Root;**`
	`  }else if(ArrayNodes[Root][1] == -1){`
	`  return -1;`
	`  }`
	`  if(ArrayNodes[Root][1] **>** ValueToFind){`
	`  return(SearchValue(ArrayNodes[**Root**][0], ValueToFind));`
	`  }`
	`  if(ArrayNodes[Root][**1**] < ValueToFind){`
	`  return(SearchValue(ArrayNodes[Root][2], ValueToFind));`
	`  }`
	`  return -1;`
	`}`
	
	VB.NET
	`Function SearchValue(ByVal Root, ByVal ValueToFind)`
	
	`  If ArrayNodes(Root, 1) = ValueToFind Then`
	`  Return **Root**`
	`  ElseIf ArrayNodes(Root, 1) = -1 Then`
	`  Return -1`
	`  End If`
	`  If ArrayNodes(Root, 1) **>** ValueToFind Then`
	`  Return SearchValue(ArrayNodes(**Root**, 0), ValueToFind)`
	`  End If`
	`  If ArrayNodes(Root, **1**) < ValueToFind Then`
	`  Return SearchValue(ArrayNodes(Root, 2), ValueToFind)`
	`  End If`
	`  Return -1`
	`End Function`	

Question	Answer	Marks

3(d)	1 mark per point (**Max 7**):
	
	• (procedure) header (and end where appropriate) with one parameter (root node or index of root node) and at least one recursive call
	• checking if left node is −1 …
	• … if not recursive call with parameter as `ArrayNodes[RootNode[0]]`
	• checking if right node is −1 …
	• …if not recursive call with parameter as `ArrayNodes[RootNode[2]]`
	• outputting the element at the parameter `RootNode[]`
	• all 3 in the correct order
	
	Example program code:
	
	Python
	`def PostOrder(RootNode):`
	`  if RootNode[0] != -1:`
	`  PostOrder(ArrayNodes[RootNode[0]])`
	`  if RootNode[2] != -1:`
	`  PostOrder(ArrayNodes[RootNode[2]])`
	`  print(str(RootNode[1]))`
	
	Java
	`public static void PostOrder(Integer[] RootNode){`
	`  if(RootNode[0] != -1){`
	`  PostOrder(ArrayNodes[RootNode[0]]);`
	`  }`
	`  if(RootNode[2] != -1){`
	`  PostOrder(ArrayNodes[RootNode[2]]);`
	`  }`
	`  System.out.println(RootNode[1]);`
	`  }`
	
	VB.NET
	`Sub PostOrder(RootNode() As Integer)`
	`  Dim TempArray(2) As Integer`
	`  If RootNode(0) <> -1 Then`
	`  TempArray(0) = ArrayNodes(RootNode(0), 0)`
	`  TempArray(1) = ArrayNodes(RootNode(0), 1)`
	`  TempArray(2) = ArrayNodes(RootNode(0), 2)`
	`  PostOrder(TempArray)`
	`  End If`
	`  If RootNode(2) <> -1 Then`
	`  TempArray(0) = ArrayNodes(RootNode(2), 0)`
	`  TempArray(1) = ArrayNodes(RootNode(2), 1)`
	`  TempArray(2) = ArrayNodes(RootNode(2), 2)`
	`  PostOrder(TempArray)`
	`  End If`
	`  Console.WriteLine(RootNode(1))`
	`End Sub`
		7

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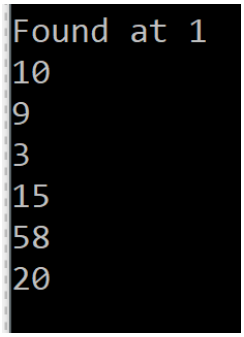
Question	Answer	Marks

3(e)(i)	1 mark per point:
	
	• calling `SearchValue()` with 15 and `rootPointer` as a parameter …
	• … if **return value** > -1 output returned index **and**
	if **return value** = -1 output not found
	Both as appropriate messages
	• Calling `PostOrder()` with `ArrayNodes[RootPointer]` as a parameter
	
	Example program code:
	
	Python
	`ReturnValue = SearchValue(RootPointer, 15)`
	`if ReturnValue == -1:`
	`  print("Not found")`
	`else:`
	`  print("Found at " + str(ReturnValue))`
	`PostOrder(ArrayNodes[RootPointer])`
	
	Java
	`Integer ReturnValue = SearchValue(RootPointer, 15);`
	`if(ReturnValue == -1){`
	`  System.out.println("Not found");`
	`} else {`
	`  System.out.println("Found at " + ReturnValue);`
	`}`
	`PostOrder(ArrayNodes[RootPointer]);`
	
	VB.NET
	`Dim returnvalue As Integer = SearchValue(RootPointer, 15)`
	`If returnvalue = -1 Then`
	`  Console.WriteLine("Not found")`
	`Else`
	`  Console.WriteLine("Found at " & returnvalue)`
	`End If`
	`Console.WriteLine("Post order")`
	`Dim TempArray(2) As Integer`
	`TempArray(0) = ArrayNodes(RootPointer, 0)`
	`TempArray(1) = ArrayNodes(RootPointer, 1)`
	`TempArray(2) = ArrayNodes(RootPointer, 2)`
	`PostOrder(TempArray)`
		3

Question	Answer	Marks
3(e)(ii)	Screenshot with result as shown, for example:  	**1**