



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.

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This document consists of **23** printed pages.

Generic Marking Principles

These general marking principles must be applied by all examiners when marking candidate answers. They should be applied alongside the specific content of the mark scheme or generic level descriptors for a question. Each question paper and mark scheme will also comply with these marking principles.

GENERIC MARKING PRINCIPLE 1:

Marks must be awarded in line with:

- the specific content of the mark scheme or the generic level descriptors for the question
- the specific skills defined in the mark scheme or in the generic level descriptors for the question
- the standard of response required by a candidate as exemplified by the standardisation scripts.

GENERIC MARKING PRINCIPLE 2:

Marks awarded are always **whole marks** (not half marks, or other fractions).

GENERIC MARKING PRINCIPLE 3:

Marks must be awarded **positively**:

- marks are awarded for correct/valid answers, as defined in the mark scheme. However, credit is given for valid answers which go beyond the scope of the syllabus and mark scheme, referring to your Team Leader as appropriate
- marks are awarded when candidates clearly demonstrate what they know and can do
- marks are not deducted for errors
- marks are not deducted for omissions
- answers should only be judged on the quality of spelling, punctuation and grammar when these features are specifically assessed by the question as indicated by the mark scheme. The meaning, however, should be unambiguous.

GENERIC MARKING PRINCIPLE 4:

Rules must be applied consistently, e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

GENERIC MARKING PRINCIPLE 5:

Marks should be awarded using the full range of marks defined in the mark scheme for the question (however; the use of the full mark range may be limited according to the quality of the candidate responses seen).

GENERIC MARKING PRINCIPLE 6:

Marks awarded are based solely on the requirements as defined in the mark scheme. Marks should not be awarded with grade thresholds or grade descriptors in mind.

Question	Answer	Marks
1(a)	1 mark per bullet point • function with correct name and parameters • correct Div operator (or equivalent) used • code matches pseudocode Example program code: Python <pre>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)</pre> VB.NET <pre>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</pre> Java <pre>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; } }</pre>	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 <pre>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)))</pre> VB.NET <pre>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))</pre> Java <pre>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)); }</pre>	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 $X \neq Y$ // 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 <pre>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</pre> VB.NET <pre>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</pre>	7

Question	Answer	Marks
1(c)	Java <pre>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; }</pre>	
1(d)(i)	Calling function 3 times with correct Data and outputting Example program code: Python <pre>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)))</pre> VB.NET <pre>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))</pre> Java <pre>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));</pre>	1

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

Question	Answer	Marks
2(a)	1 mark per bullet point • class declared (with appropriate close) with identifier <code>Picture</code> • 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 <pre> 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 </pre> Java <pre> 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; } } </pre>	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 <pre>def GetDescription(self): return self.__Description def GetWidth(self): return self.__Width def GetHeight(self): return self.__Height def GetColour(self): return self.__FrameColour</pre> Java <pre>public String GetDescription(){ return Description; } public Integer GetWidth(){ return Width; } public Integer GetHeight(){ return Height; } public String GetFrameColour(){ return FrameColour; }</pre> VB.NET <pre>Function GetDescription() Return Description End Function Function GetWidth() Return Width End Function Function GetHeight() Return Height End Function Function GetFrameColour() Return FrameColour End Function</pre>	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 <pre>def SetDescription(self, DescriptionP): self.__Description = DescriptionP</pre> Java <pre>public void SetDescription(String DescriptionP){ Description = DescriptionP; }</pre> VB.NET <pre>Public Sub SetDescription(DescriptionP) Description = DescriptionP End Sub</pre>	2
2(d)	1 mark for declaring array of type <code>Picture</code> with 100 elements Example program code: Python <pre>PictureArray = [] for i in range(100): PictureArray.append(Picture("", 0, 0, ""))</pre> Java <pre>public static void main(String[] args){ Picture[] PictureArray = new Picture[100];}</pre> VB.NET <pre>Dim PictureArray(0 to 99) As Picture</pre>	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 <code>Pictures.txt</code> for Read • looping until EOF / or equivalent • ...reading each set of 4 lines from the file within loop • creating object of type <code>Picture</code> • ...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 <pre>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</pre>	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 <pre> 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; } </pre>	
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 <pre>NumberPicturesInArray, PictureArray = ReadData(PictureArray)</pre> Java <pre>Integer NumberPicturesInArray = ReadData(PictureArray);</pre> VB.NET <pre>Dim NumberPicturesInArray As Integer = ReadData()</pre>	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 arrayusing 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 <pre> 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())) </pre> VB.NET <pre> 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 </pre>	7

Question	Answer	Marks
2(g)	<pre> 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()); } } } </pre>	
2(h)	1 mark for screenshot showing output for BLACK, 100, 100 1 mark for showing no outputs for silver, 25, 25 <pre> 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 </pre>	2

Question	Answer	Marks
3(a)	1 mark per bullet point • Declaring array named <code>ArrayNodes</code> of type integer • ...with 20 by 3 elements • <code>RootPointer</code> declared as integer and assigned -1 • <code>FreeNode</code> declared as integer and assigned 0 Example program code: Python <pre>ArrayNodes=[[0 for X in range(3)] for Y in range(20)] RootPointer = -1 FreeNode = 0</pre> VB.NET <pre>Sub Main() Dim ArrayNodes(19, 2) As Integer Dim RootPointer As Integer = -1 Dim FreeNode As Integer = 0 End Sub</pre> Java <pre>public static Integer[] [] ArrayNodes = new Integer[20][3]; public static Integer RootPointer = -1; public static Integer FreeNode = 0;</pre>	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 <pre>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</pre>	8

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 <pre> 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"); } } </pre>	

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 <pre>def PrintAll(ArrayNodes): for X in range(0, 20): print(str(ArrayNodes[X][0]), " ", str(ArrayNodes[X][1]), " ", str(ArrayNodes[X][2]))</pre> VB.NET <pre>Sub PrintAll(ByRef ArrayNodes) For X = 0 To 19 Console.WriteLine(ArrayNodes(X, 0) & " " & ArrayNodes(X, 1) & " " & ArrayNodes(X, 2)) Next End Sub</pre> Java <pre>public static void PrintAll(){ for(int X = 0; X < 20; X++){ System.out.println(ArrayNodes[X][0] + " " + ArrayNodes[X][1] + " " + ArrayNodes[X][2]); } }</pre>	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 <pre>for X in range(0,10): ArrayNodes, RootPointer, FreeNode = AddNode(ArrayNodes,RootPointer,FreeNode) PrintAll(ArrayNodes)</pre> VB.NET <pre>For X = 0 To 9 AddNode(ArrayNodes, RootPointer, FreeNode) Next printall(ArrayNodes)</pre> Java <pre>for (int X = 0; X < 10; X++){ AddNode(); } PrintAll();</pre>	3

Question	Answer	Marks
3(d)(ii)	1 mark for screenshot showing the following output: <pre> 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 </pre>	1
3(e)(i)	1 mark per bullet point • procedure name <code>InOrder</code> taking a parameter (for current node being accessed) • Checking if left Node is empty (-1) •(if not) calling procedure recursively with <code>[Current Node][0]</code> as parameter • outputting the <code>[Current Node][1]</code> • checking if right Node is empty (-1) • ... (if not) calling procedure recursively with <code>[Current Node][2]</code> as a parameter • Order is correct, left, root, right Example program code: Python <pre> 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]) </pre> VB.NET <pre> 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 </pre> Java <pre> 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]); } } </pre>	7

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