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**COMPUTER SCIENCE**

**9608/42**

Paper 4 Written Paper

**May/June 2019**

MARK SCHEME

Maximum Mark: 75

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**Published**

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge International will not enter into discussions about these mark schemes.

Cambridge International is publishing the mark schemes for the May/June 2019 series for most Cambridge IGCSE™, Cambridge International A and AS Level and Cambridge Pre-U components, and some Cambridge O Level components.

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This document consists of **21** 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 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:**

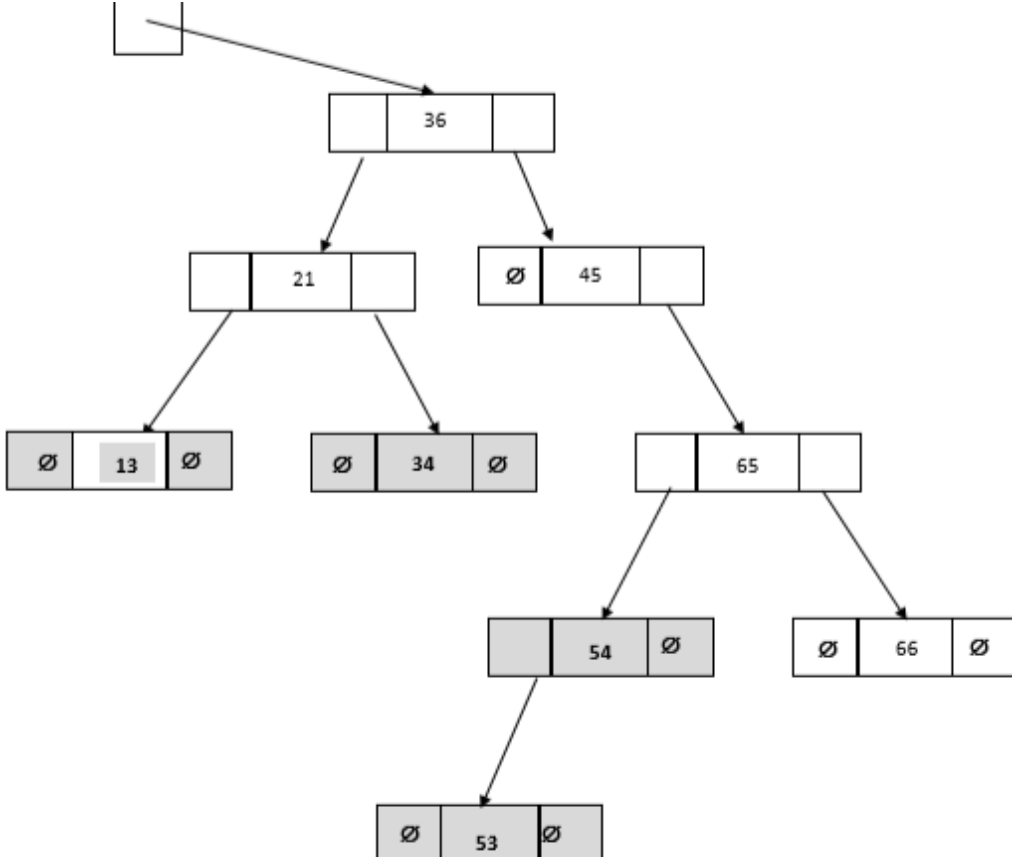
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

**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
<p>1(a)(i)</p>	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• 13 to left of 21</li> <li>• 34 to right of 21</li> <li>• 54 to left of 65</li> <li>• 53 to left of 54</li> <li>• Null and other pointers on all boxes written <b>and</b> no other pointers filled in</li> </ul> 	<p><b>5</b></p>

Question	Answer	Marks																																																
<p>1(a)(ii)</p>	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• FreePointer</li> <li>• 36</li> <li>• 45</li> <li>• 21 and 65</li> <li>• 66 and 13</li> <li>• 54, 53 and 34</li> </ul> <table border="1" data-bbox="322 531 546 627"> <tr><td>RootPointer</td></tr> <tr><td>0</td></tr> </table> <table border="1" data-bbox="322 667 546 751"> <tr><td>FreePointer</td></tr> <tr><td>9</td></tr> </table> <table border="1" data-bbox="703 531 1464 1002"> <thead> <tr> <th>Index</th> <th>LeftPointer</th> <th>Data</th> <th>RightPointer</th> </tr> </thead> <tbody> <tr><td>[0]</td><td>2</td><td>36</td><td>1</td></tr> <tr><td>[1]</td><td>null</td><td>45</td><td>3</td></tr> <tr><td>[2]</td><td>5</td><td>21</td><td>8</td></tr> <tr><td>[3]</td><td>6</td><td>65</td><td>4</td></tr> <tr><td>[4]</td><td>null</td><td>66</td><td>null</td></tr> <tr><td>[5]</td><td>null</td><td>13</td><td>null</td></tr> <tr><td>[6]</td><td>7</td><td>54</td><td>null</td></tr> <tr><td>[7]</td><td>null</td><td>53</td><td>null</td></tr> <tr><td>[8]</td><td>null</td><td>34</td><td>null</td></tr> <tr><td>[9]</td><td></td><td></td><td></td></tr> </tbody> </table>	RootPointer	0	FreePointer	9	Index	LeftPointer	Data	RightPointer	[0]	2	36	1	[1]	null	45	3	[2]	5	21	8	[3]	6	65	4	[4]	null	66	null	[5]	null	13	null	[6]	7	54	null	[7]	null	53	null	[8]	null	34	null	[9]				<p><b>6</b></p>
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Question	Answer	Marks
1(b)(i)	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• Language specific constructor header and close (where appropriate)</li> <li>• ...with two parameters (variables)</li> <li>• Initialise FinalMark to 0</li> <li>• Initialise Grade to "Fail"</li> <li>• Initialise PaperID to CentreNumber + CandidateNumber</li> </ul> <p><b>PYTHON</b></p> <pre>def __init__(self, CentreNumber, CandidateNumber):     self.__FinalMark = 0     self.__Grade = "Fail"     self.__PaperID = CentreNumber + CandidateNumber</pre> <p><b>PASCAL</b></p> <pre>Constructor NewExaminationPaper.Create(CentreNumber : String, CandidateNumber : String); begin     FinalMark := 0;     Grade := 'Fail';     PaperID := CentreNumber + CandidateNumber; end;</pre> <p><b>VB</b></p> <pre>Public Sub New (ByVal CentreNumber As String, ByVal CandidateNumber As String)     FinalMark = 0     Grade = "Fail"     PaperID = CentreNumber &amp; CandidateNumber End Sub</pre>	<b>5</b>

**PUBLISHED**

<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(b)(ii)	1 mark per bullet point to max 3 <ul style="list-style-type: none"><li>• Used to access/change the properties/attributes</li><li>• ...only using the get/set methods</li><li>• ...that are set to private</li><li>• Provide encapsulation</li><li>• Prevents accidental change</li><li>• To make sure data is valid // act as validation</li><li>• Hides data</li><li>• The get methods allow the data to be accessed/returned</li><li>• The set methods allow the data to be changed/written to</li></ul>	<b>3</b>

Question	Answer	Marks
1(b)(iii)	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• 1 get method header without parameter (returning string where appropriate)</li> <li>• ...returning the property</li> <li>• A second working Get</li> <li>• A third working Get</li> </ul> <p><b>PYTHON</b></p> <pre>def GetFinalMark():     return (FinalMark) def GetGrade():     return (Grade) def GetPaperID():     return (PaperID)</pre> <p><b>PASCAL</b></p> <pre>function GetFinalMark():Integer; begin     GetFinalMark:= FinalMark; end; function GetGrade():String; begin     GetGrade:= Grade; end; function GetPaperID():string; begin     GetPaperID:= PaperID; end;</pre>	<b>4</b>



<b>Question</b>	<b>Answer</b>	<b>Marks</b>
1(b)(iii)	<b>VB</b>  Public Function GetFinalMark() As Integer Return FinalMark End Function Public Function GetGrade() As String Return Grade End Function Public Function GetPaperID() As String Return PaperID End Function	

Question	Answer	Marks
1(b)(iv)	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• Set header taking parameter and close (where appropriate)</li> <li>• check if <b>parameter</b> <math>\geq 0</math> and <math>\leq 90</math></li> <li>• If valid (<math>\geq 0</math> and <math>\leq 90</math>) return TRUE</li> <li>• ...and set FinalMark to parameter</li> <li>• If not valid, return FALSE <b>and</b> do not set FinalMark</li> </ul> <p><b>PYTHON</b></p> <pre>def SetFinalMark (Mark):     if Mark &gt;=0 and Mark &lt;=90:         IsValid = True         FinalMark = Mark     else:         IsValid = False     return(IsValid)</pre> <p><b>PASCAL</b></p> <pre>function SetFinalMark (Mark: Integer) : Boolean; var IsValid : Boolean; begin     If (Mark &gt;=0) AND (Mark &lt;=90) Then         FinalMark := Mark;         IsValid := True;     Else         IsValid :=False; end;</pre>	<b>5</b>

Question	Answer	Marks
1(b)(iv)	<b>VB</b>  Public Function SetFinalMark(ByVal Mark As Integer) As Boolean If (Mark >=0) And (Mark <=90) Then FinalMark = Mark Return True Else Return False End If End Function	

Question	Answer	Marks
1(b)(v)	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• Procedure header with <b>three</b> parameters (and close where appropriate)</li> <li>• Check if FinalMark is <math>\geq</math> DistMark and Grade set to Distinction</li> <li>• Check if FinalMark is <math>\geq</math> MeritMark and <math>&lt;</math>DistMark and Grade set to Merit Check if FinalMark is <math>\geq</math> PassMark and <math>&lt;</math>MeritMark and Grade set to Pass</li> <li>• Otherwise Grade set to Fail</li> </ul> <p><b>PYTHON</b></p> <pre>def SetGrade(DistMark, MeritMark, PassMark):     if FinalMark &gt;= DistMark:         Grade = "Distinction"     elif FinalMark &gt;= MeritMark:         Grade = "Merit"     elif FinalMark &gt;= PassMark:         Grade = "Pass"     else:         Grade = "Fail"</pre> <p><b>PASCAL</b></p> <pre>procedure SetGrade(DistMark, MeritMark, PassMark) begin     If FinalMark &gt;= DistMark Then         Grade := "Distinction";     Else If FinalMark &gt;= MeritMark Then         Grade := "Merit";     Else If FinalMark &gt;= PassMark Then         Grade:= "Pass";     Else         Grade:= "Fail"; end;</pre>	<b>4</b>

Question	Answer	Marks
1(b)(v)	<b>VB</b>  Public Sub SetGrade(DistMark, MeritMark, PassMark) If FinalMark >= DistMark Then Grade = "Distinction" ElseIf FinalMark >= MeritMark Then Grade = "Merit" ElseIf FinalMark >= PassMark Then Grade = "Pass" Else Grade = "Fail" End If End Sub	

Question	Answer	Marks
1(b)(vi)	<p>1 mark per bullet point to max 8</p> <ul style="list-style-type: none"> <li>• Procedure <code>Main</code> header and close (where appropriate)</li> <li>• Input candidate number, centre number and mark with suitable prompt(s)</li> <li>• Create instance of <code>ExaminationPaper</code> named <code>ThisPaper...</code></li> <li>• ... with input parameters candidate number and centre number</li> <li>• Call <code>SetFinalMark</code> for <code>ThisPaper</code> with mark input as parameter</li> <li>• ...storing/using return value</li> <li>• ...outputting a message if this is valid or invalid</li> <li>• Call <code>SetGrade</code> for <code>ThisPaper</code> with correct thresholds</li> <li>• Output grade for <code>ThisPaper</code> ...</li> <li>• ...using <code>.GetGrade</code></li> </ul> <p><b>PYTHON</b></p> <pre>def main():     candidateNumber = input("Please enter the candidate number")     centreNumber = input("Please enter the centre number")     mark = input("Please enter the mark")     ThisPaper = ExaminationPaper(centreNumber, candidateNumber)     if ThisPaper.SetFinalMark(mark) == FALSE:         print("Invalid mark")     else:         ThisPaper.SetGrade(80, 70, 55)         print(ThisPaper.GetGrade())</pre>	<b>8</b>

Question	Answer	Marks
1(b)(vi)	<p><b>PASCAL</b></p> <pre>procedure Main();   var     candidateNumber, centreNumber : String;     isValid : boolean;     thisPaper : ExaminationPaper;     mark : integer; begin   Writeln(Enter candidate number: ');   Readln(candidateNumber);   Writeln('Enter centre number: ');   Readln(centreNumber);   ThisPaper := ExaminationPaper.Create(centreNumber, candidateNumber);   Writeln('Enter mark: ');   Readln(mark);   isValid := ThisPaper.SetFinalMark(mark);   if isValid = true:     thisPaper.SetGrade(80, 70, 55);     Writeln(ThisPaper.GetGrade());   else:     Writeln("Invalid mark") end;</pre>	

Question	Answer	Marks
1(b)(vi)	<p><b>VB</b></p> <pre> Sub main()     Dim candidateNumber As String     Dim centreNumber As String     Console.WriteLine("Please enter the candidate number")     candidateNumber = Console.ReadLine()     Console.WriteLine("Please enter the centre number")     centreNumber = Console.ReadLine()     Dim ThisPaper As New ExaminationPaper(centreNumber, candidateNumber)     Dim IsValid As Boolean     Console.WriteLine("Please enter the mark")     Dim mark As Integer     mark = Console.ReadLine()     IsValid = ThisPaper.SetFinalMark(mark)     if IsValid = True then         ThisPaper.SetGrade(80, 70, 55)         Console.WriteLine(ThisPaper.GetGrade())     else         Console.WriteLine("Invalid mark")     endif End Sub </pre>	
1(c)	<p>1 mark per bullet point to max 4</p> <ul style="list-style-type: none"> <li>• There are a large number of objects/records to store // hash is better for a large number of objects/records</li> <li>• A hashing <b>algorithm/hash</b> performed on <b>key field/record</b> (to form the address)</li> <li>• ...to allow direct access to the object</li> <li>• ...so it is likely to be faster in finding the object // linked list is slower in finding the object</li> <li>• In a linked list, each object needs to be checked until found // sequentially/linear accessed</li> <li>• ...the left/right/next pointer is followed // have to trace pointers</li> </ul>	<b>4</b>



Question	Answer	Marks														
2(a)	<p>1 mark for correct tick</p> <table border="1" data-bbox="322 284 703 580"> <thead> <tr> <th data-bbox="322 284 568 384">Statement</th> <th data-bbox="568 284 703 384">Tick (✓)</th> </tr> </thead> <tbody> <tr> <td data-bbox="322 384 568 448">Last in first out</td> <td data-bbox="568 384 703 448">✓</td> </tr> <tr> <td data-bbox="322 448 568 512">First in first out</td> <td data-bbox="568 448 703 512"></td> </tr> <tr> <td data-bbox="322 512 568 580">Last in last out</td> <td data-bbox="568 512 703 580"></td> </tr> </tbody> </table>	Statement	Tick (✓)	Last in first out	✓	First in first out		Last in last out		1						
Statement	Tick (✓)															
Last in first out	✓															
First in first out																
Last in last out																
2(b)(i)	<p>1 mark for correct stack</p> <table border="1" data-bbox="322 679 551 963"> <tbody> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td>10</td></tr> <tr><td>35</td></tr> <tr><td>20</td></tr> </tbody> </table>											10	35	20	1	
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2(b)(ii)	<p>1 mark for correct stack</p> <table border="1" data-bbox="322 1064 551 1348"> <tbody> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td> </td></tr> <tr><td>65</td></tr> <tr><td>50</td></tr> <tr><td>35</td></tr> <tr><td>20</td></tr> </tbody> </table>											65	50	35	20	1
65																
50																
35																
20																

Question	Answer	Marks
2(b)(iii)	<p>1 mark for each bullet</p> <ul style="list-style-type: none"> <li>• Function Push ...</li> <li>• ...taking parameter (returning Boolean)</li> <li>• Checking if Top = 7 ...</li> <li>• ...returning FALSE if full</li> <li>• ...returning TRUE otherwise</li> <li>• if not full, increment Top</li> <li>• ... add parameter to Top of ArrayStack</li> </ul> <pre> FUNCTION Push (BYVALUE DataItem : Integer) (RETURNS Boolean)   IF Top = 7     THEN       RETURN FALSE     ELSE       Top ← Top + 1       ArrayStack[Top] ← DataItem       RETURN TRUE   ENDF ENDFUNCTION </pre>	<b>7</b>

Question	Answer	Marks
3(a)	<p>1 mark for name of feature; 1 mark for description e.g.</p> <ul style="list-style-type: none"> <li>• Colouring code//Pretty printing</li> <li>• This is how the code is presented in the IDE e.g. colour coding and indentation</li>   <li>• Context-sensitive prompts</li> <li>• Displays keywords or hints at the point of insertion e.g. drop-down list of commands</li>   <li>• Auto-indent</li> <li>• Automatically indent your code for selection/iteration/procedures/methods</li>   <li>• Auto-complete</li> <li>• Avoid typing errors // speeds up process of typing</li>   <li>• Expand/collapse subroutines/code</li> <li>• To make it easier to view code currently working on</li> </ul>	<b>4</b>
3(b)	<p>1 mark per each correct bullet point</p> <ul style="list-style-type: none"> <li>• Normal</li> <li>• Abnormal / erroneous / invalid</li> <li>• Boundary / extreme</li> </ul>	<b>3</b>

Question	Answer	Marks																																																																																																								
4(a)(i)	<p>1 mark for error and correction</p> <p>Error 1 – IF List[LowerBound] = SearchValue                      Correction – IF List[MidPoint] = SearchValue</p> <p>Error 2 – UpperBound ← MidPoint + 1                      Correction – LowerBound ← MidPoint + 1</p> <p>Error 3 – IF LowerBound &gt; MidPoint                      Correction - IF LowerBound &gt; UpperBound</p> <p>Error 4 – IF ValueFound = FALSE                      Correction – IF ValueFound = TRUE</p>	<b>4</b>																																																																																																								
4(a)(ii)	Linear search	<b>1</b>																																																																																																								
4(b)(i)	<p>1 mark per shaded section</p> <table border="1" data-bbox="322 842 1787 1321"> <thead> <tr> <th rowspan="2">Count</th> <th rowspan="2">TempValue</th> <th rowspan="2">Sorted</th> <th colspan="5">ArrayData</th> </tr> <tr> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>""</td> <td>TRUE</td> <td>5</td> <td>20</td> <td>12</td> <td>25</td> <td>32</td> <td>29</td> </tr> <tr> <td>1</td> <td>12</td> <td>FALSE</td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;">12</td> <td style="background-color: #cccccc;">20</td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>4</td> <td>29</td> <td>(FALSE)</td> <td></td> <td></td> <td></td> <td></td> <td style="background-color: #cccccc;">29</td> <td style="background-color: #cccccc;">32</td> </tr> <tr> <td>0</td> <td></td> <td>TRUE</td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>1</td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>2</td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>3</td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> <tr> <td>4</td> <td></td> <td></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> <td style="background-color: #cccccc;"></td> </tr> </tbody> </table>	Count	TempValue	Sorted	ArrayData					0	1	2	3	4	5	0	""	TRUE	5	20	12	25	32	29	1	12	FALSE		12	20				2									3									4	29	(FALSE)					29	32	0		TRUE							1									2									3									4									<b>4</b>
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Question	Answer	Marks
4(b)(ii)	<p>1 mark per bullet point</p> <ul style="list-style-type: none"> <li>• Initialising a counter variable to 0 <b>and</b> must be the same variable used to access array elements</li> <li>• While loop checking counter is &lt; 5 or &lt;= 4</li> <li>• Incrementing counter inside the loop and outside IF, <b>and</b> remainder of algorithm completed (The IF to ENDIF)</li> </ul> <p>e.g.</p> <pre> Count ← 0 WHILE Count &lt; 5   IF ArrayData[Count] &gt; ArrayData[Count + 1]     THEN       TempValue ← ArrayData[Count + 1]       ArrayData[Count + 1] ← ArrayData[Count]       ArrayData[Count] ← TempValue       Sorted ← False     ENDIF   Count ← Count + 1 ENDWHILE </pre>	<b>3</b>
4(b)(iii)	Bubble sort	<b>1</b>
4(b)(iv)	<p>One from:</p> <ul style="list-style-type: none"> <li>• Insertion sort</li> <li>• Merge sort</li> <li>• Quick sort</li> </ul>	<b>1</b>