



Cambridge
International
AS & A Level

Cambridge Assessment International Education
Cambridge International Advanced Subsidiary and Advanced Level

COMPUTER SCIENCE

9608/42

Paper 4 Written Paper

May/June 2019

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 **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:

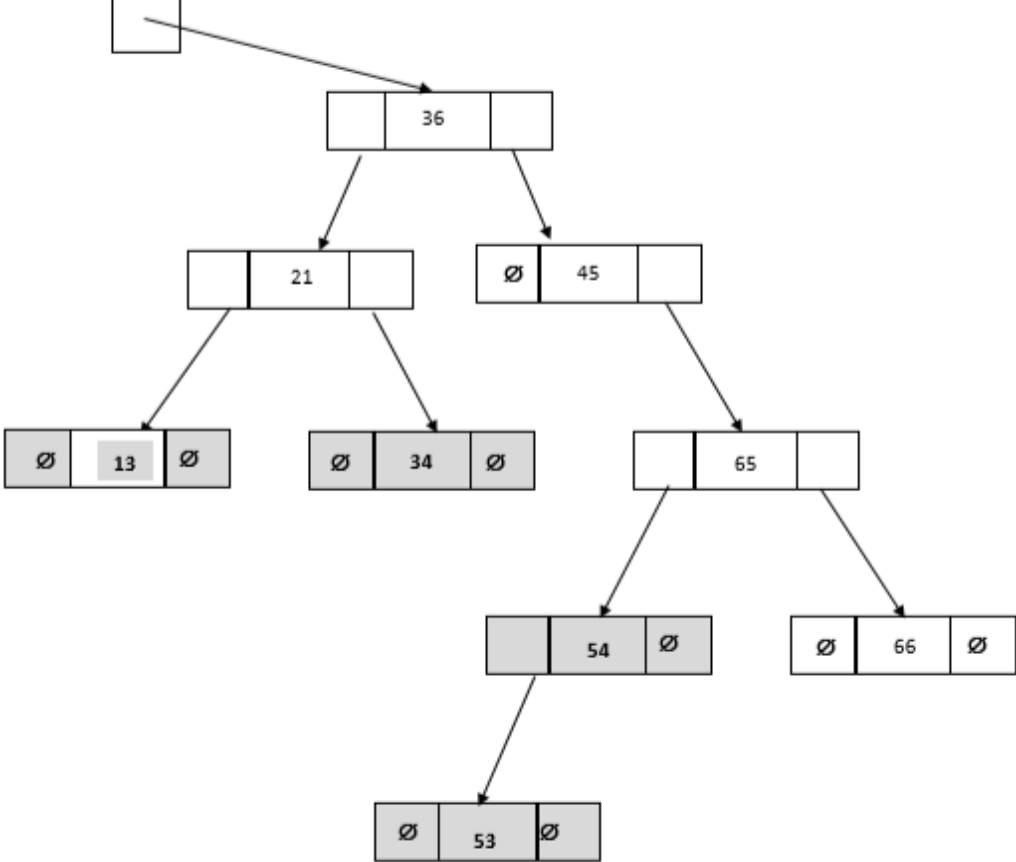
Rules must be applied consistently e.g. in situations where candidates have not followed instructions or in the application of generic level descriptors.

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
1(a)(i)	1 mark per bullet point • 13 to left of 21 • 34 to right of 21 • 54 to left of 65 • 53 to left of 54 • Null and other pointers on all boxes written and no other pointers filled in 	5

Question	Answer	Marks																																																
1(a)(ii)	1 mark per bullet point • FreePointer • 36 • 45 • 21 and 65 • 66 and 13 • 54, 53 and 34 <table><tr><td>RootPointer</td></tr><tr><td>0</td></tr></table> <table><tr><td>FreePointer</td></tr><tr><td>9</td></tr></table> <table><tr><th>Index</th><th>LeftPointer</th><th>Data</th><th>RightPointer</th></tr><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></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]				6
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]																																																		

Question	Answer	Marks
1(b)(i)	1 mark per bullet point • Language specific constructor header and close (where appropriate) • ...with two parameters (variables) • Initialise FinalMark to 0 • Initialise Grade to "Fail" • Initialise PaperID to CentreNumber + CandidateNumber PYTHON <pre>def __init__(self, CentreNumber, CandidateNumber): self.__FinalMark = 0 self.__Grade = "Fail" self.__PaperID = CentreNumber + CandidateNumber</pre> PASCAL <pre>Constructor NewExaminationPaper.Create(CentreNumber : String, CandidateNumber : String); begin FinalMark := 0; Grade := 'Fail'; PaperID := CentreNumber + CandidateNumber; end;</pre> VB <pre>Public Sub New (ByVal CentreNumber As String, ByVal CandidateNumber As String) FinalMark = 0 Grade = "Fail" PaperID = CentreNumber & CandidateNumber End Sub</pre>	5

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Question	Answer	Marks
1(b)(ii)	1 mark per bullet point to max 3 • Used to access/change the properties/attributes • ...only using the get/set methods • ...that are set to private • Provide encapsulation • Prevents accidental change • To make sure data is valid // act as validation • Hides data • The get methods allow the data to be accessed/returned • The set methods allow the data to be changed/written to	3

Question	Answer	Marks
1(b)(iii)	1 mark per bullet point • 1 get method header without parameter (returning string where appropriate) • ...returning the property • A second working Get • A third working Get PYTHON <pre>def GetFinalMark(): return (FinalMark) def GetGrade(): return (Grade) def GetPaperID(): return (PaperID)</pre> PASCAL <pre>function GetFinalMark():Integer; begin GetFinalMark:= FinalMark; end; function GetGrade():String; begin GetGrade:= Grade; end; function GetPaperID():string; begin GetPaperID:= PaperID; end;</pre>	4

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Question	Answer	Marks
1(b)(iii)	VB 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)	1 mark per bullet point • Set header taking parameter and close (where appropriate) • check if parameter ≥ 0 and ≤ 90 • If valid (≥ 0 and ≤ 90) return TRUE • ...and set FinalMark to parameter • If not valid, return FALSE and do not set FinalMark PYTHON <pre>def SetFinalMark (Mark): if Mark >=0 and Mark <=90: IsValid = True FinalMark = Mark else: IsValid = False return(IsValid)</pre> PASCAL <pre>function SetFinalMark (Mark: Integer) : Boolean; var IsValid : Boolean; begin If (Mark >=0) AND (Mark <=90) Then FinalMark := Mark; IsValid := True; Else IsValid :=False; end;</pre>	5

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Question	Answer	Marks
1(b)(iv)	VB 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)	1 mark per bullet point • Procedure header with three parameters (and close where appropriate) • Check if FinalMark is $\geq$ DistMark and Grade set to Distinction • Check if FinalMark is $\geq$ MeritMark and $<$ DistMark and Grade set to Merit • Check if FinalMark is $\geq$ PassMark and $<$ MeritMark and Grade set to Pass • Otherwise Grade set to Fail PYTHON <pre>def SetGrade(DistMark, MeritMark, PassMark): if FinalMark >= DistMark: Grade = "Distinction" elif FinalMark >= MeritMark: Grade = "Merit" elif FinalMark >= PassMark: Grade = "Pass" else: Grade = "Fail"</pre> PASCAL <pre>procedure SetGrade(DistMark, MeritMark, PassMark) begin If FinalMark >= DistMark Then Grade := "Distinction"; Else If FinalMark >= MeritMark Then Grade := "Merit"; Else If FinalMark >= PassMark Then Grade:= "Pass"; Else Grade:= "Fail"; end;</pre>	4

Question	Answer	Marks
1(b)(v)	VB <pre> 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 </pre>	

Question	Answer	Marks
1(b)(vi)	1 mark per bullet point to max 8 • Procedure <code>Main</code> header and close (where appropriate) • Input candidate number, centre number and mark with suitable prompt(s) • Create instance of <code>ExaminationPaper</code> named <code>ThisPaper...</code> • ... with input parameters candidate number and centre number • Call <code>SetFinalMark</code> for <code>ThisPaper</code> with mark input as parameter • ...storing/using return value • ...outputting a message if this is valid or invalid • Call <code>SetGrade</code> for <code>ThisPaper</code> with correct thresholds • Output grade for <code>ThisPaper</code> ... • ...using <code>.GetGrade</code> PYTHON <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>	8

Question	Answer	Marks
1(b)(vi)	PASCAL <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>	

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Question	Answer	Marks
1(b)(vi)	VB <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)	1 mark per bullet point to max 4 • There are a large number of objects/records to store // hash is better for a large number of objects/records • A hashing algorithm/hash performed on key field/record (to form the address) • ...to allow direct access to the object • ...so it is likely to be faster in finding the object // linked list is slower in finding the object • In a linked list, each object needs to be checked until found // sequentially/linear accessed • ...the left/right/next pointer is followed // have to trace pointers	4

Question	Answer	Marks								
2(a)	1 mark for correct tick <table><tr><th>Statement</th><th>Tick (✓)</th></tr><tr><td>Last in first out</td><td>✓</td></tr><tr><td>First in first out</td><td></td></tr><tr><td>Last in last out</td><td></td></tr></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)	1 mark for correct stack <table><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></table>						10	35	20	1
10										
35										
20										
2(b)(ii)	1 mark for correct stack <table><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></table>					65	50	35	20	1
65										
50										
35										
20										

Question	Answer	Marks
2(b)(iii)	1 mark for each bullet • Function Push ... • ...taking parameter (returning Boolean) • Checking if Top = 7 ... • ...returning FALSE if full • ...returning TRUE otherwise • if not full, increment Top • ... add parameter to Top of ArrayStack <pre> FUNCTION Push (BYVALUE DataItem : Integer) (RETURNS Boolean) IF Top = 7 THEN RETURN FALSE ELSE Top ← Top + 1 ArrayStack[Top] ← DataItem RETURN TRUE ENDIF ENDFUNCTION </pre>	7

Question	Answer	Marks
3(a)	1 mark for name of feature; 1 mark for description e.g. • Colouring code//Pretty printing • This is how the code is presented in the IDE e.g. colour coding and indentation • Context-sensitive prompts • Displays keywords or hints at the point of insertion e.g. drop-down list of commands • Auto-indent • Automatically indent your code for selection/iteration/procedures/methods • Auto-complete • Avoid typing errors // speeds up process of typing • Expand/collapse subroutines/code • To make it easier to view code currently working on	4
3(b)	1 mark per each correct bullet point • Normal • Abnormal / erroneous / invalid • Boundary / extreme	3

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Question	Answer	Marks																																																																																																									
4(a)(i)	1 mark for error and correction Error 1 – IF List[LowerBound] = SearchValue Correction – IF List[MidPoint] = SearchValue Error 2 – UpperBound ← MidPoint + 1 Correction – LowerBound ← MidPoint + 1 Error 3 – IF LowerBound > MidPoint Correction - IF LowerBound > UpperBound Error 4 – IF ValueFound = FALSE Correction – IF ValueFound = TRUE	4																																																																																																									
4(a)(ii)	Linear search	1																																																																																																									
4(b)(i)	1 mark per shaded section <table><tr><th rowspan="2">Count</th><th rowspan="2">TempValue</th><th rowspan="2">Sorted</th><th colspan="6">ArrayData</th></tr><tr><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th></tr><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></td><td>12</td><td>20</td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4</td><td>29</td><td>(FALSE)</td><td></td><td></td><td></td><td></td><td>29</td><td>32</td></tr><tr><td>0</td><td></td><td>TRUE</td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>1</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>2</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>3</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></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									4
Count	TempValue				Sorted	ArrayData																																																																																																					
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Question	Answer	Marks
4(b)(ii)	1 mark per bullet point - Initialising a counter variable to 0 and must be the same variable used to access array elements - While loop checking counter is < 5 or <= 4 - Incrementing counter inside the loop and outside IF, and remainder of algorithm completed (The IF to ENDIF) e.g. <pre> Count ← 0 WHILE Count < 5 IF ArrayData[Count] > ArrayData[Count + 1] THEN TempValue ← ArrayData[Count + 1] ArrayData[Count + 1] ← ArrayData[Count] ArrayData[Count] ← TempValue Sorted ← False ENDIF Count ← Count + 1 ENDWHILE </pre>	3
4(b)(iii)	Bubble sort	1
4(b)(iv)	One from: - Insertion sort - Merge sort - Quick sort	1