

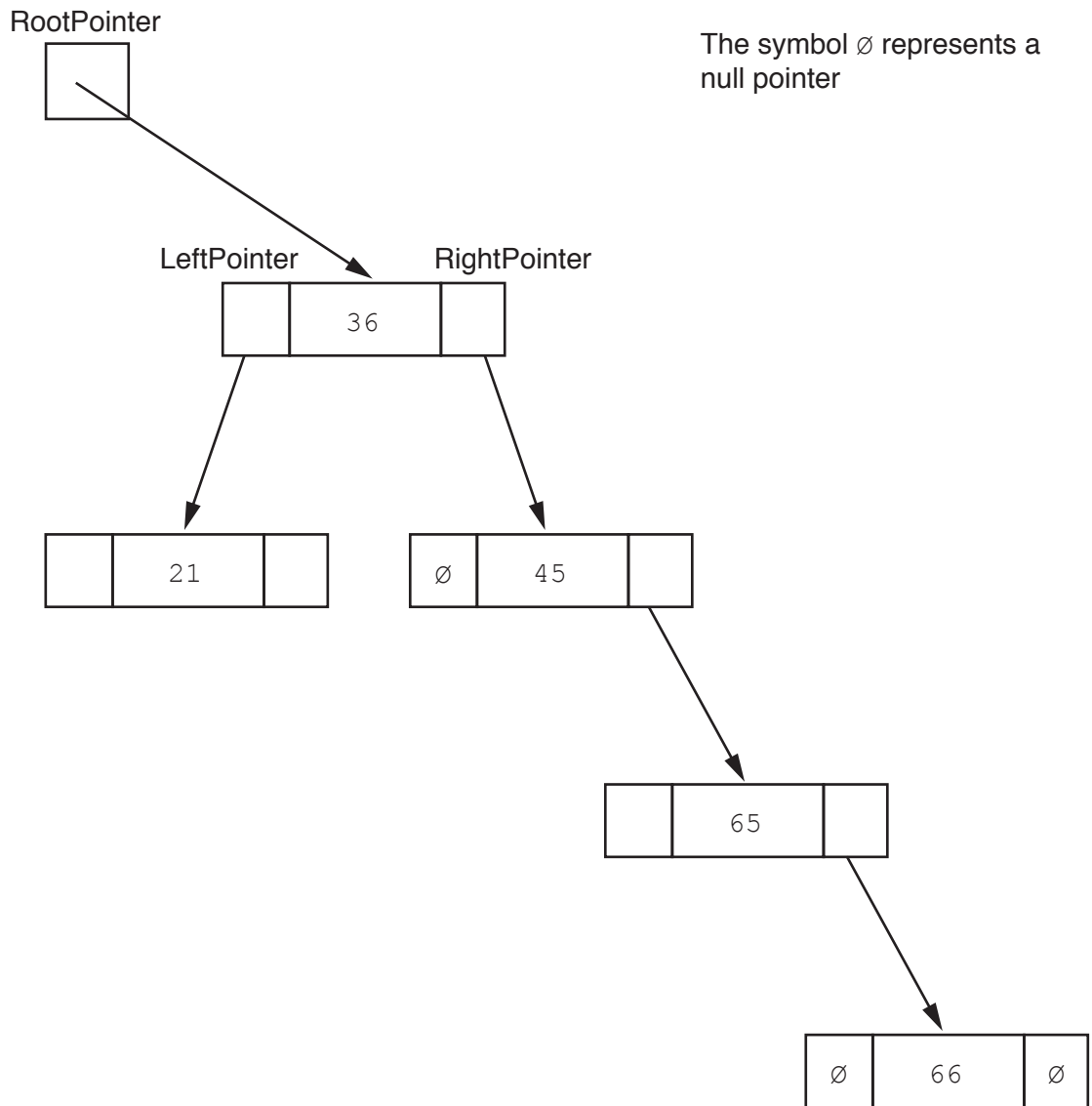
1 A company wants an online marking system for an examination.

(a) The following is a selection of data showing final marks.

36, 45, 21, 65, 66, 13, 54, 53, 34

A linked list of nodes will be used to store the data. Each node consists of the data, a left pointer and a right pointer. The linked list will be organised as a binary tree.

(i) Complete the binary tree to show how the data above will be organised.



[5]

- (ii) The following diagram shows a 2D array that stores the nodes of the binary tree's linked list.

Add the correct pointer values to complete the diagram, using your answer from part (a)(i).

RootPointer

FreePointer

Index	LeftPointer	Data	RightPointer
0		36	
1		45	
2		21	
3		65	
4		66	
5		13	
6		54	
7		53	
8		34	
9			

[6]

- (b) The company wants to implement a program for the marking system. It will do this with object-oriented programming (OOP).

Many candidates take the examination. Each examination paper is given a `PaperID` that is made up of the centre (school) number followed by the candidate number.

Each examination paper is awarded a grade.

The following diagram shows the design for the `ExaminationPaper` class. This includes the attributes and methods.

ExaminationPaper	
FinalMark : INTEGER Grade : STRING PaperID : STRING	// maximum 2 digits, initialised to 0 // "Pass", "Merit", "Distinction" // or "Fail", initialised to "Fail" // centre number followed by the // candidate number, for example // "ZZ00991001"
Create() SetFinalMark() SetGrade() GetFinalMark() GetGrade() GetPaperID()	// creates and initialises a new instance // of the ExaminationPaper class using // language-appropriate constructor // checks that the mark parameter has a // valid value, if so, assigns it to // FinalMark // sets Grade based on FinalMark // returns FinalMark // returns Grade // returns PaperID

- (i) The constructor receives the centre number and candidate number as parameter values to create `PaperID`. Other properties are initialised as instructed in the class diagram.

Write **program code** for the `Create()` constructor method.

Programming language

Program code

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..... [5]

- (ii) Get and set methods are used to support the security and integrity of data in object-oriented programming.

Explain how get and set methods are used to support security and integrity.

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..... [3]

(iii) Write **program code** for the following three get methods.

Programming language

GetFinalMark ()

Program code

.....
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.....
.....

GetGrade ()

Program code

.....
.....
.....
.....

GetPaperID ()

Program code

.....
.....
.....
.....

[4]

(c) The examination paper will be taken by many candidates in centres around the world.

The program stores the objects of the `ExaminationPaper` class in a file. The company has decided to use a hash table, rather than a linked list to store the objects.

Explain why a hash table is more suitable than a linked list to store the objects.

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..... [4]

Question 2 begins on the next page.

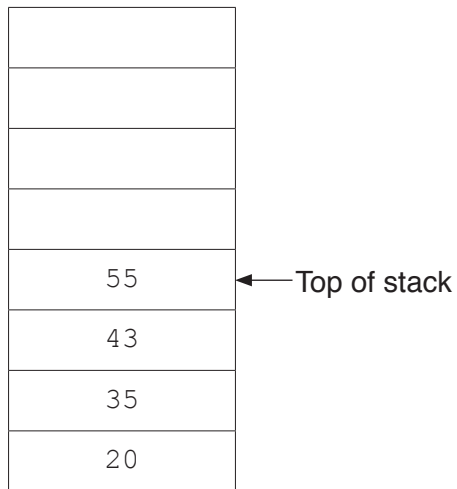
2 A stack is an Abstract Data Type (ADT).

(a) Tick (✓) **one** box to show the statement that describes a stack data structure.

Statement	Tick (✓)
Last in first out	
First in first out	
Last in last out	

[1]

(b) A stack contains the values 20, 35, 43, 55.

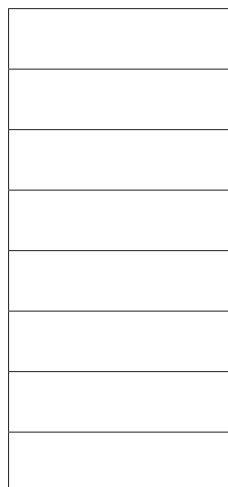


(i) Show the contents of the stack in **part (b)** after the following operations.

POP ()

POP ()

PUSH (10)



[1]

(ii) Show the contents of the stack from **part (b)(i)** after these further operations:

POP ()

PUSH (50)

PUSH (55)

POP ()

PUSH (65)

[1]

3 (a) Identify **and** describe **two** features of an editor that can help a programmer to write program code.

Feature 1

Description

.....

.....

Feature 2

Description

.....

.....

[4]

(b) A programmer can use three types of test data when testing a program.

Identify the **three** different types of test data.

1

2

3

[3]

- 4 (a) A program has sorted some data in the array, *List*, in ascending order.

The following binary search algorithm is used to search for a value in the array.

```

01 ValueFound ← FALSE
02 UpperBound ← LengthOfList - 1
03 LowerBound ← 0
04 NotInList ← FALSE
05
06 WHILE ValueFound = FALSE AND NotInList = FALSE
07     MidPoint ← ROUND((LowerBound + UpperBound) / 2)
08
09     IF List[LowerBound] = SearchValue
10         THEN
11             ValueFound ← TRUE
12         ELSE
13             IF List[MidPoint] < SearchValue
14                 THEN
15                     UpperBound ← MidPoint + 1
16                 ELSE
17                     UpperBound ← MidPoint - 1
18             ENDIF
19             IF LowerBound > MidPoint
20                 THEN
21                     NotInList ← TRUE
22             ENDIF
23         ENDIF
24     ENDWHILE
25
26 IF ValueFound = FALSE
27     THEN
28         OUTPUT "The value is in the list"
29     ELSE
30         OUTPUT "The value is not found in the list"
31     ENDIF

```

Note:

The pseudocode function

ROUND(Reall : REAL) RETURNS INTEGER

rounds a number to the nearest integer value.

For example: ROUND(4.5) returns 5 and ROUND(4.4) returns 4

(i) There are four errors in the algorithm.

Write the line of code where an error is present **and** write the correction in **pseudocode**.

Error 1

Correction

Error 2

Correction

Error 3

Correction

Error 4

Correction

[4]

(ii) A binary search is one algorithm that can be used to search an array.

Identify another searching algorithm.

..... [1]

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