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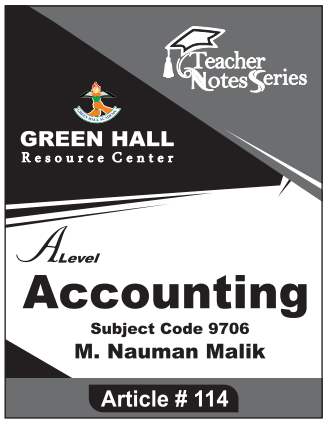

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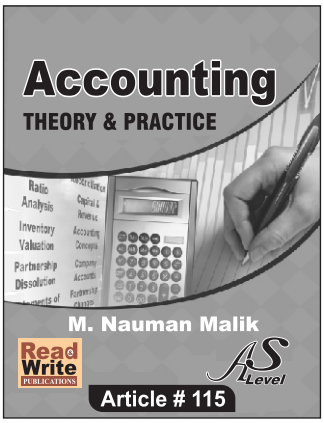

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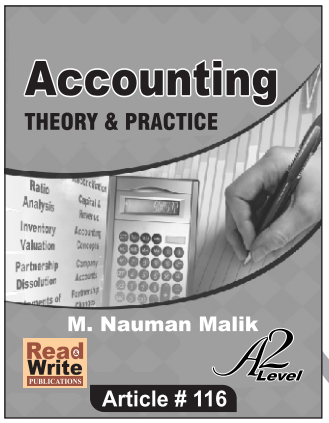

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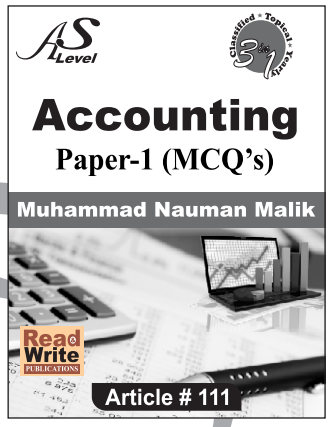

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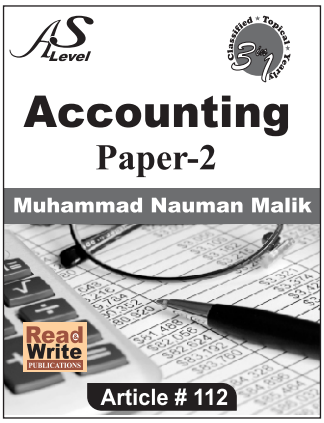

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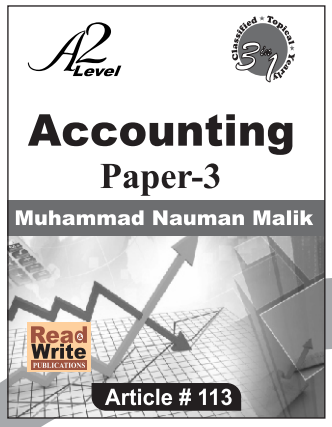

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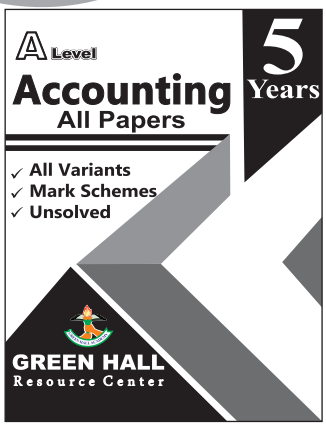

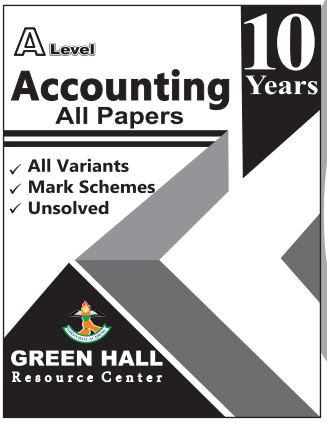

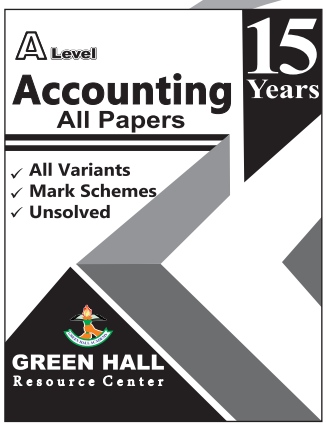

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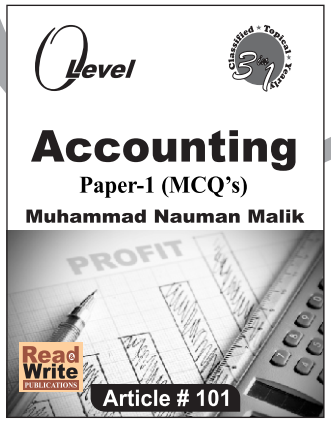

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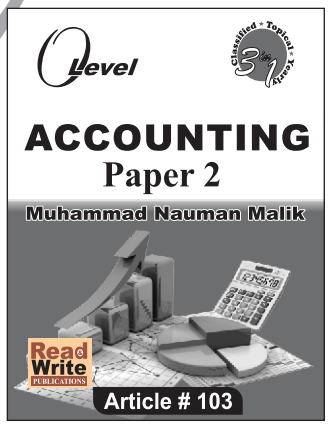

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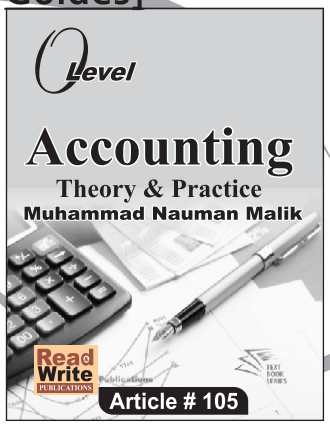

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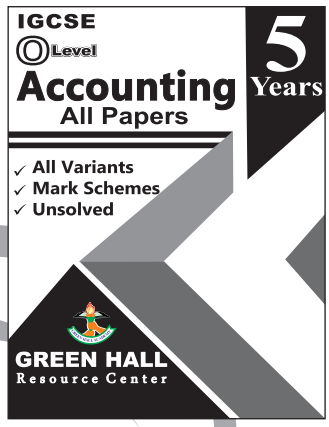

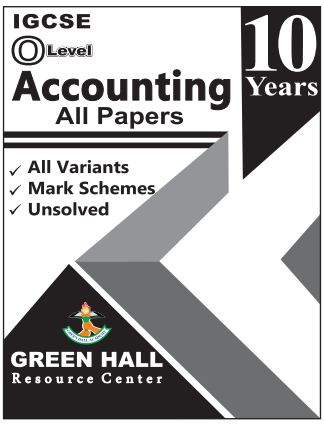

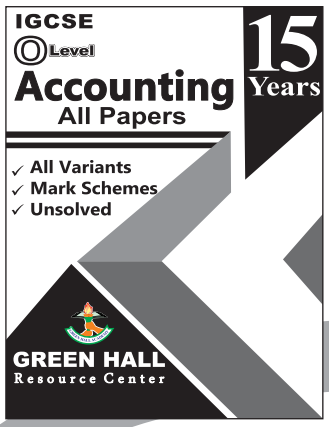

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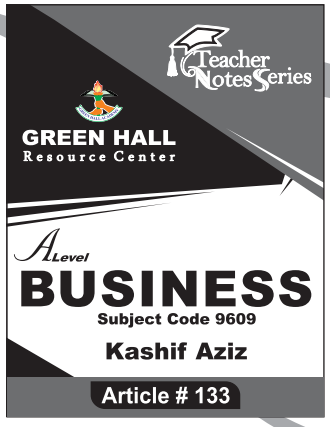

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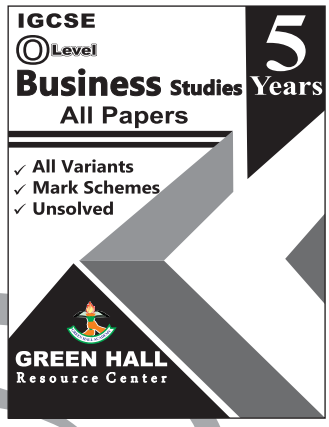

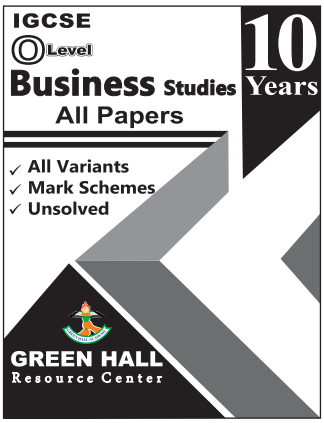

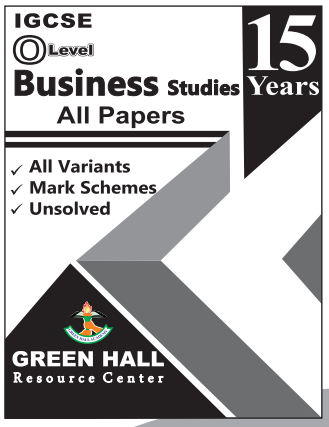

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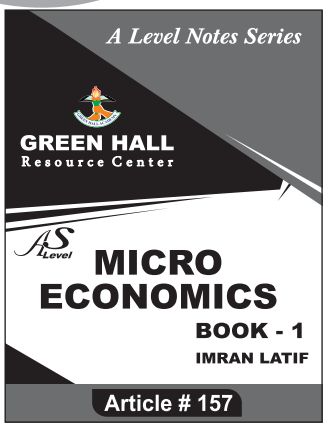

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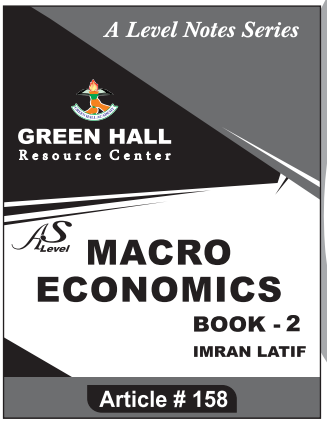

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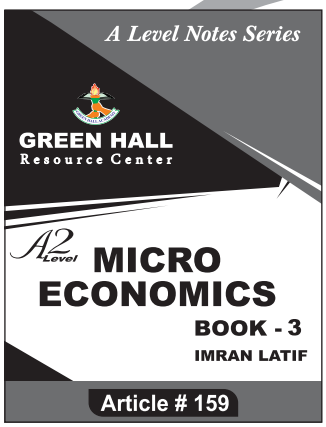

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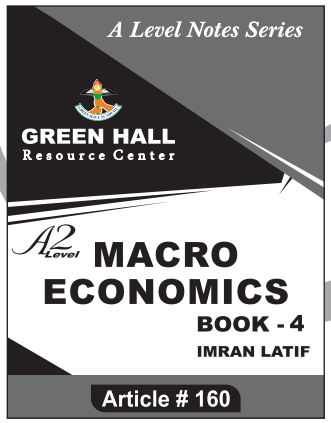

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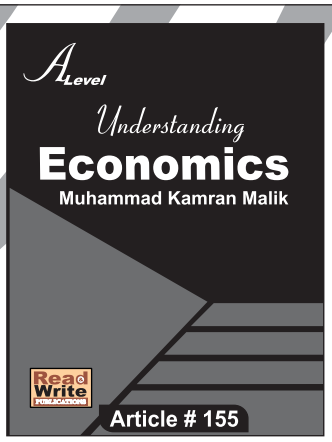

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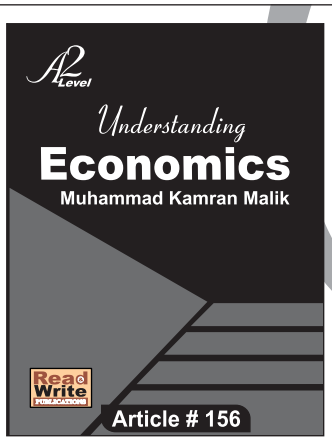

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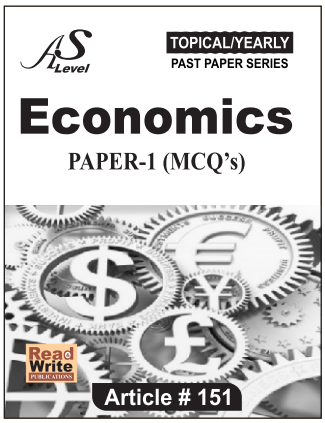

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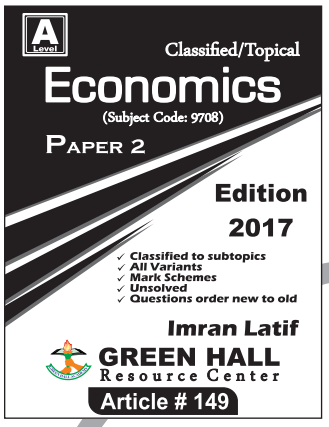

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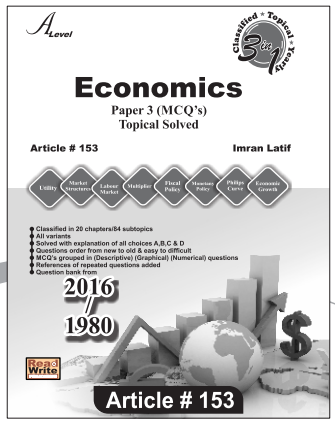

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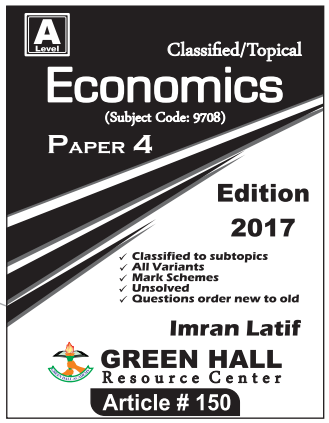

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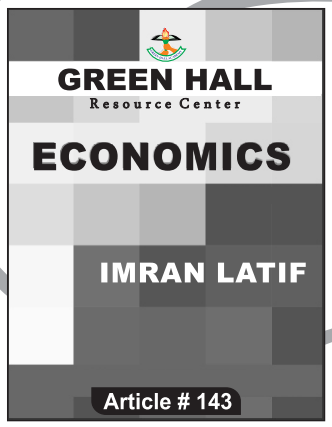

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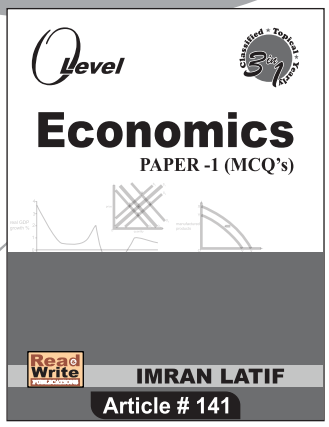

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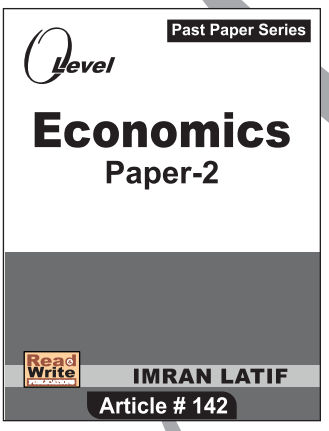

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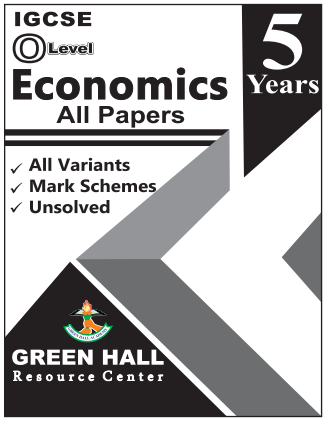

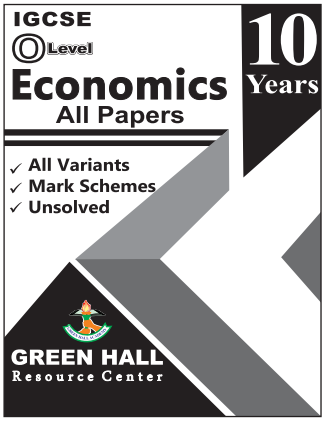

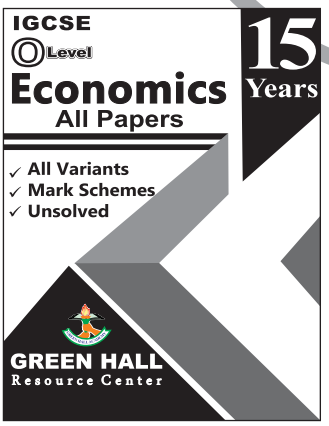

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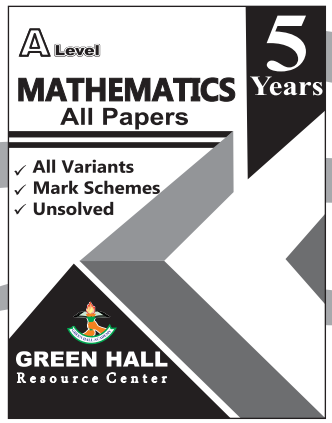

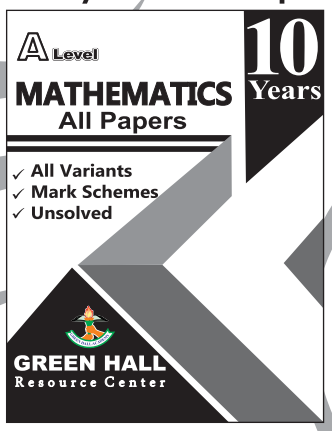

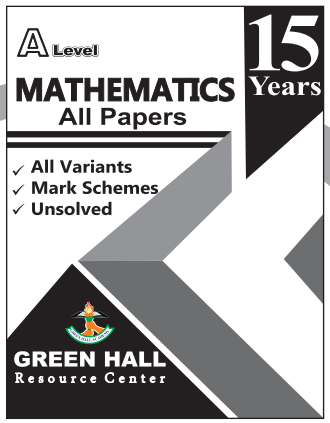

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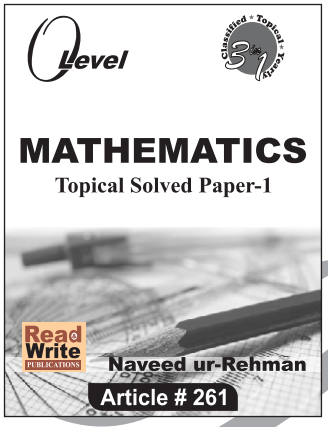
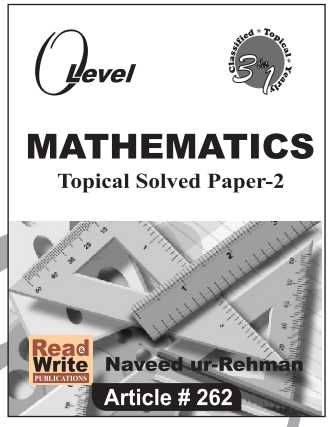
O-Level

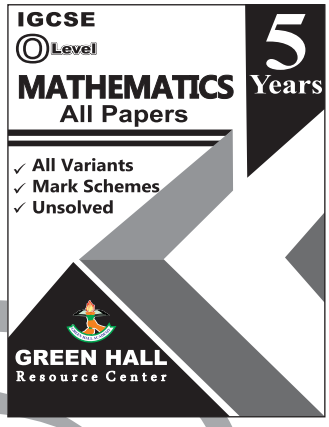


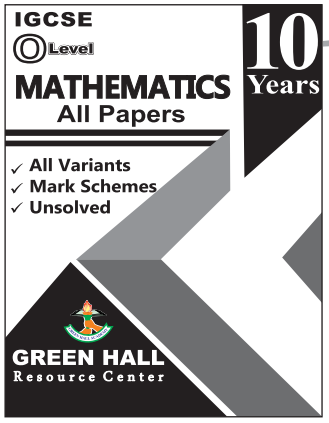
Price: 675/-

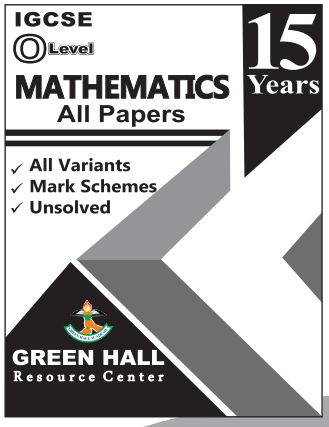


Price: 675/-

[Yearly Past Papers]



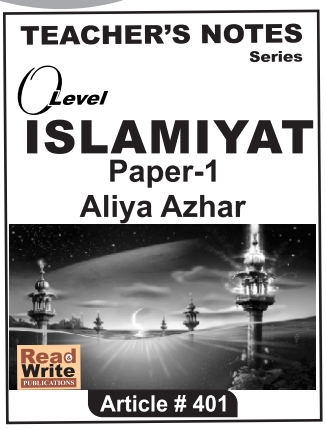




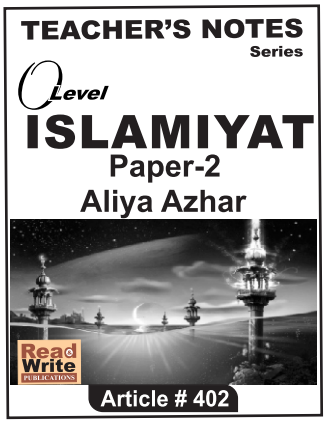
ISLAMIYAT Catalogue

O-Level

[Notes & Revision Guides]

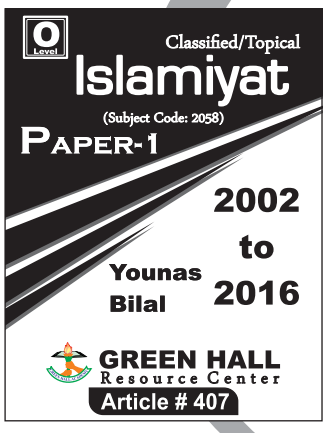


Price: 275/-

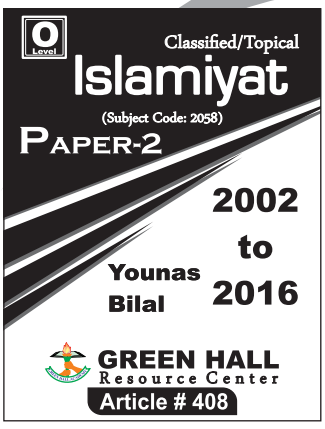


Price: 300/-

[Classified / Topical Past Papers]



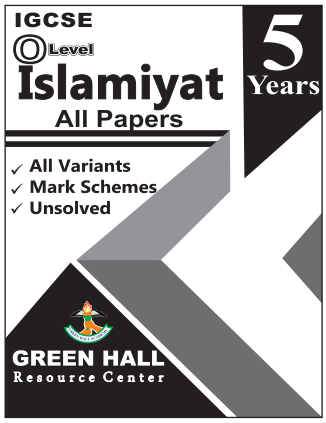
Price: 300/-

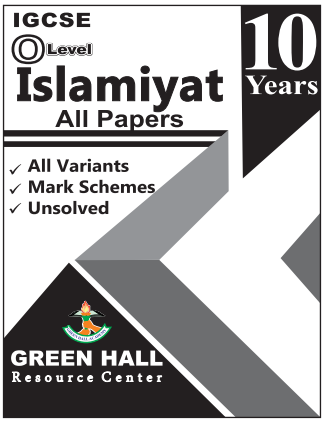


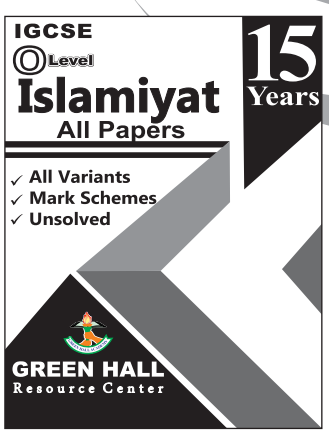
Price: 300/-

IGCSE/O/A-Level Books Catalogue

[Yearly Past Papers]

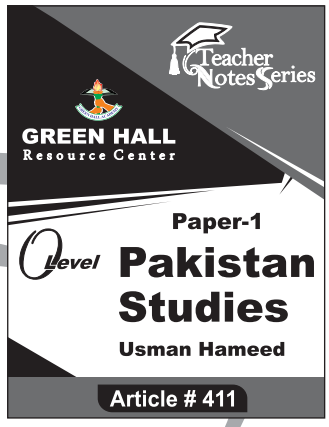




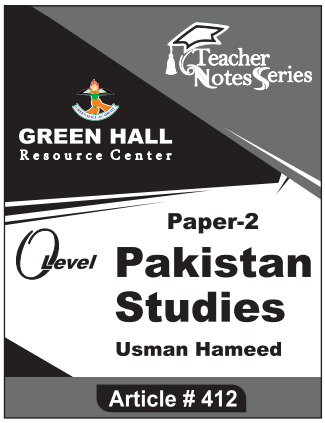


PAK STUDIES Catalogue O-Level

[Notes & Revision Guides]



Price: 300/-



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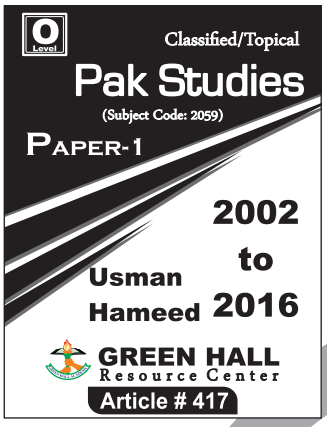
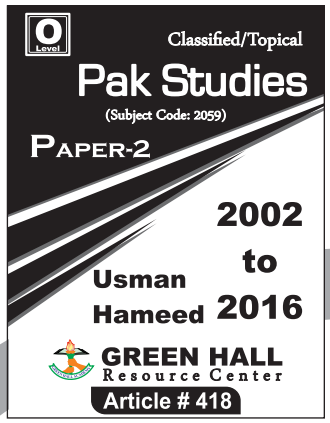
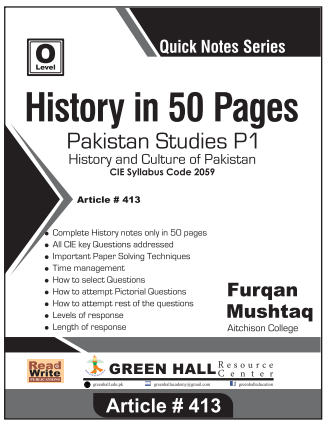
[Classified / Topical Past Papers]



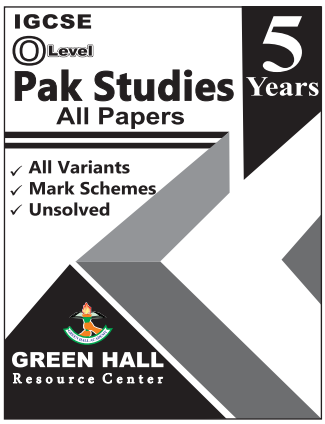


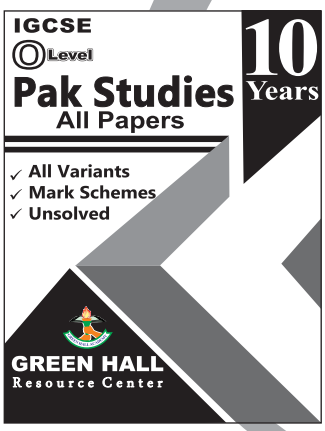
Price: 300/-

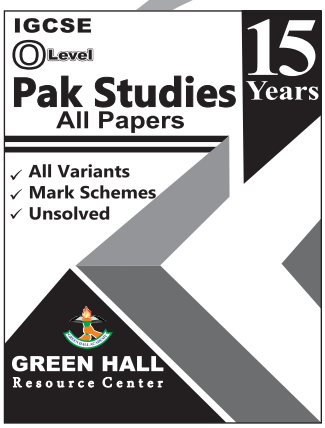
[Yearly Past Papers]



Price:150/-





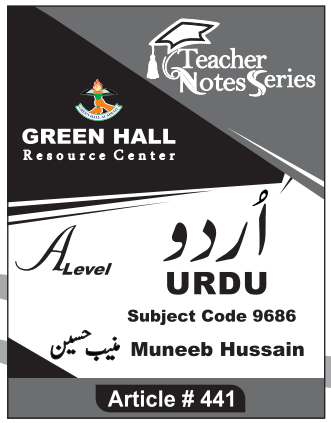


IGCSE/O/A-Level Books Catalogue

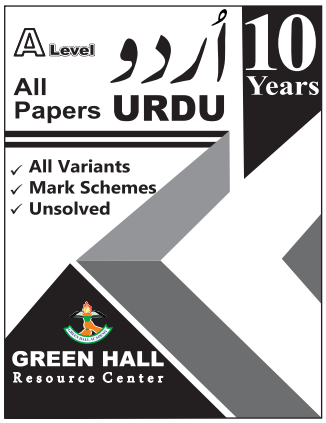
URDU Catalogue

A-Level (Coming Soon)

[Notes & Revision Guides] [Yearly Past Papers]



Price: 450/-



O-Level

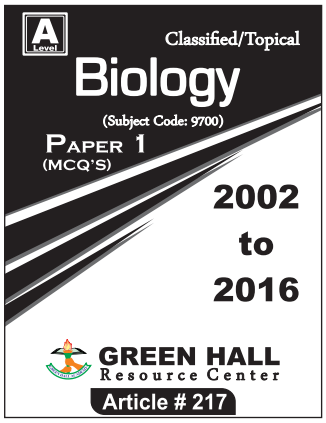
[Notes & Revision Guides] [Yearly Past Papers]

Price: 300/-

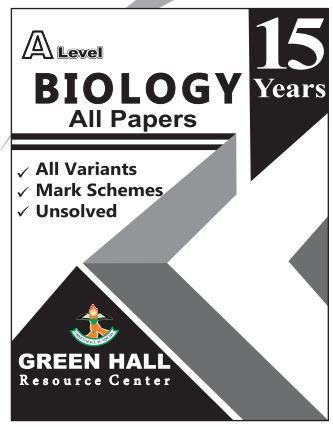
BIOLOGY Catalogue

A-Level

[Classified / Topical Past Papers] [Yearly Past Papers]



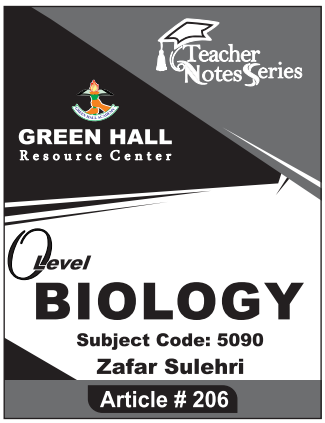
Price: 750/-



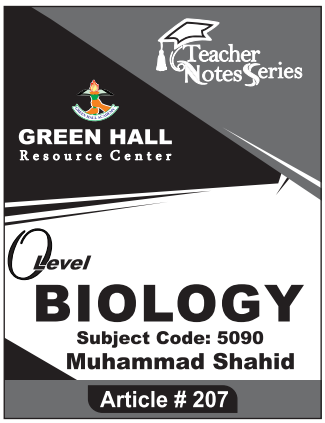
IGCSE/O/A-Level Books Catalogue

O-Level

[Notes & Revision Guides]



Price: 300/-



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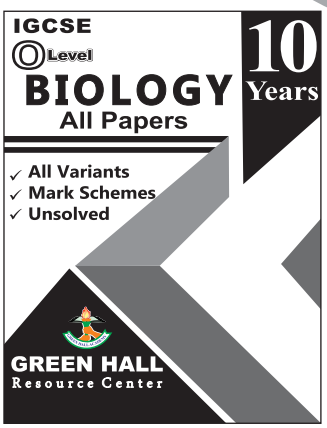
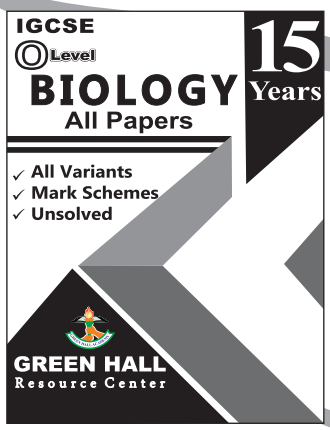
[Yearly Past Papers]

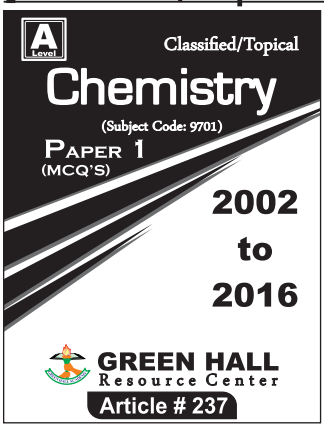




CHEMISTRY Catalogue

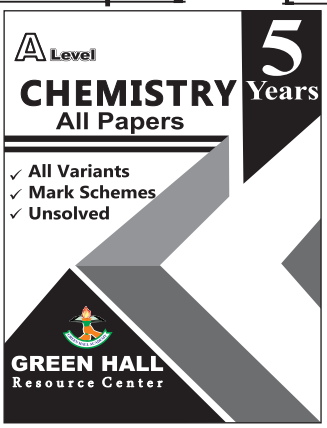
A-Level

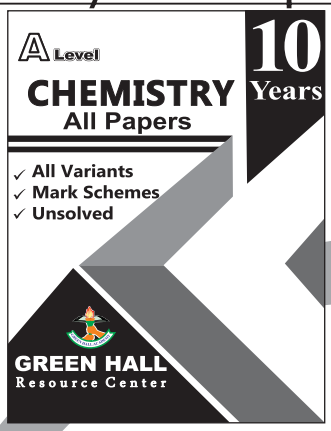
[Classified / Topical Past Papers]

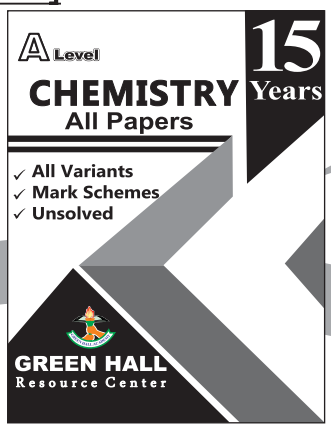


Price: 800/-

[Yearly Past Papers]

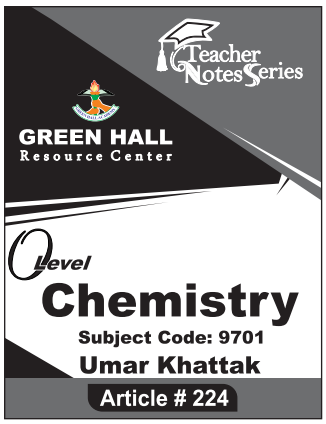




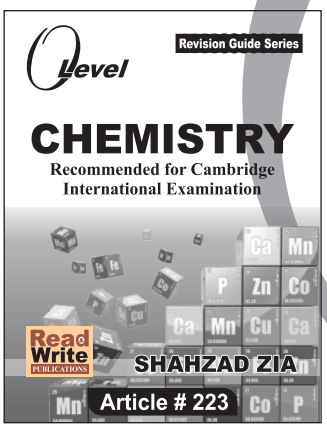


O-Level

[Notes & Revision Guides]

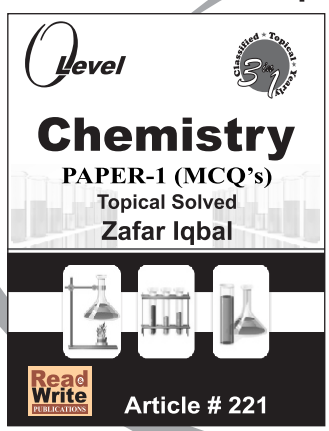


Price: 400/-

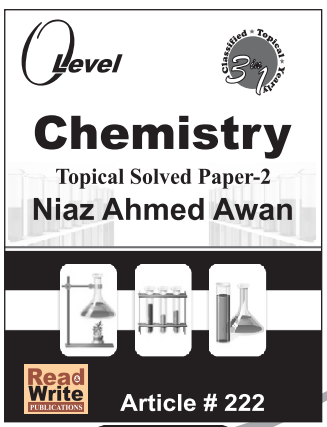


Price: 500/-

[Classified / Topical Past Papers]



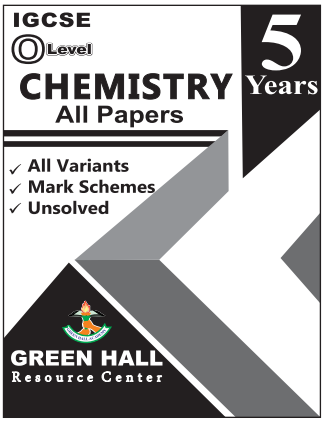
Price: 350/-

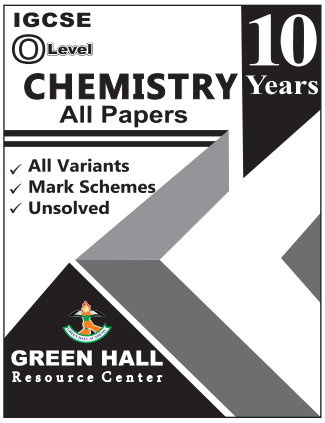


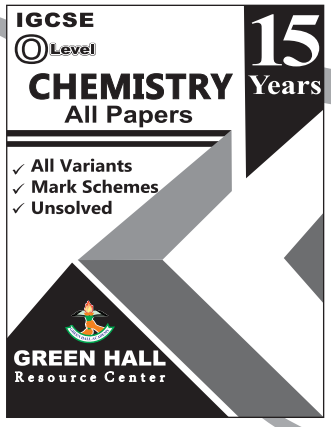
Price: 500/-

IGCSE/O/A-Level Books Catalogue

[Yearly Past Papers]



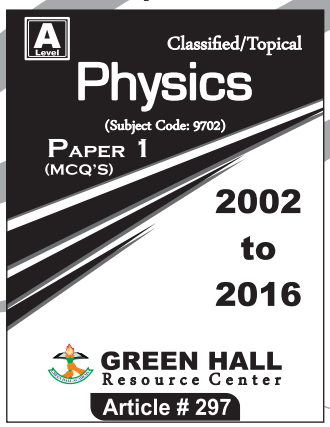




PHYSICS Catalogue

A-Level

[Classified / Topical Past Papers]



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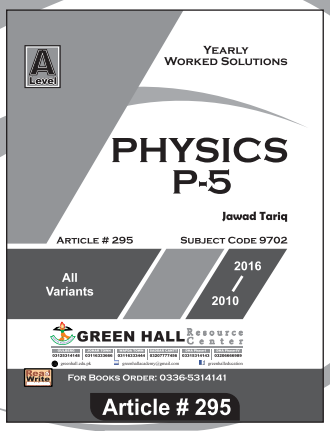
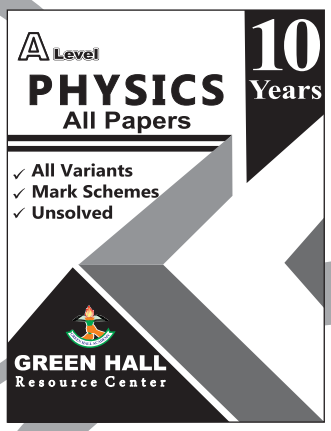
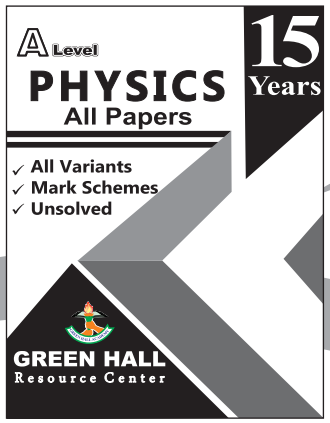


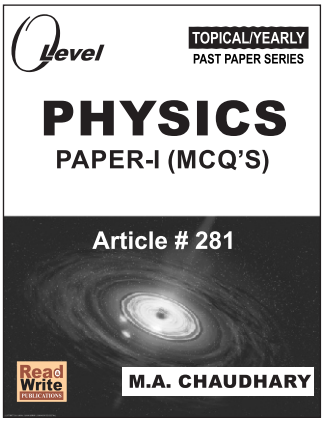




Price: 500/-

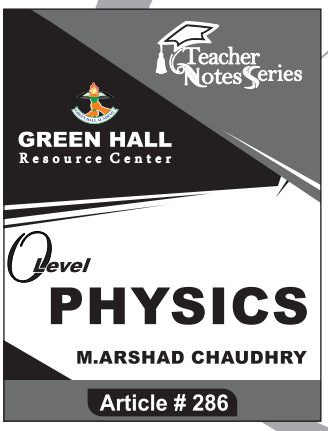
O-Level

[Classified / Topical Past Papers]

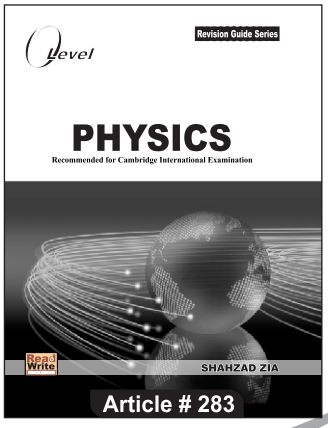


Price: 550/-

[Notes & Revision Guides]



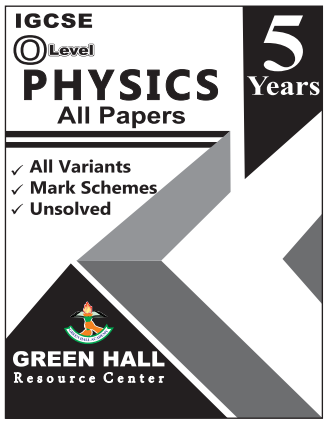
Price: 300/-

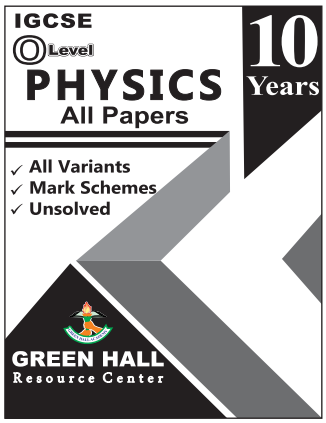


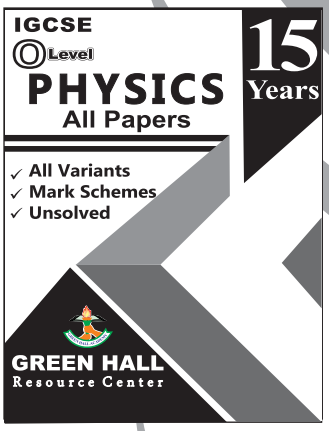
Price: 500/-

IGCSE/O/A-Level Books Catalogue

[Yearly Past Papers]



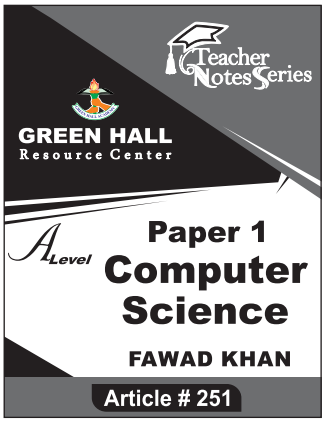




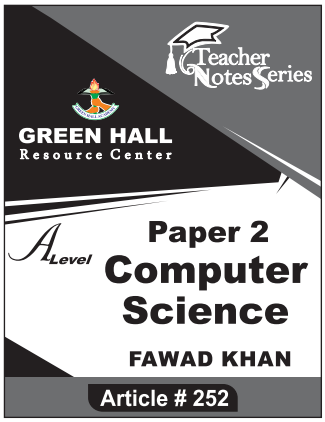
COMPUTER Catalogue

A-Level

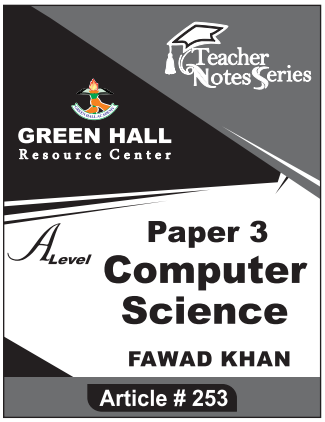
[Notes & Revision Guides]



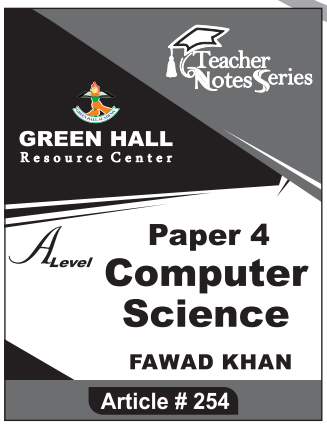
Price: 400/-



Price: 400/-



Price: 300/-



Price: 600/-

[Yearly Past Papers]

IGCSE/O/A-Level Books Catalogue

O-Level

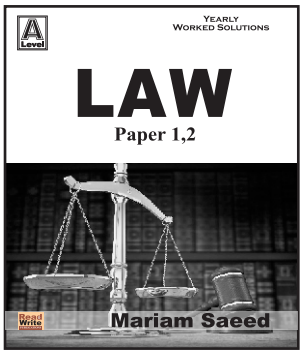
[Yearly Past Papers]

LAW Catalogue

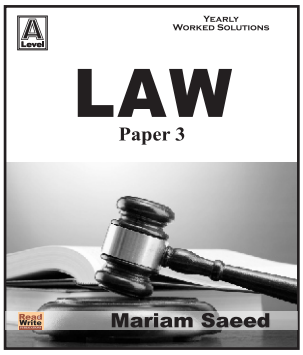
A-Level

[Yearly Worked Solutions]

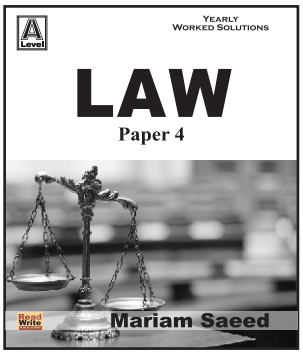
[Yearly Past Papers]



Article # 481



Article # 482



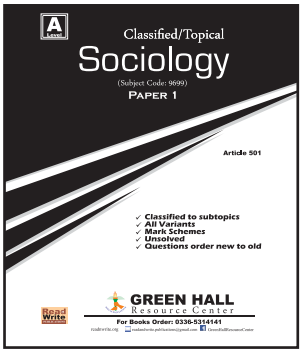
Article # 483

SOCIOLOGY Catalogue

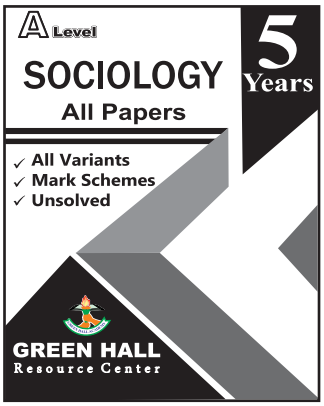
A-Level

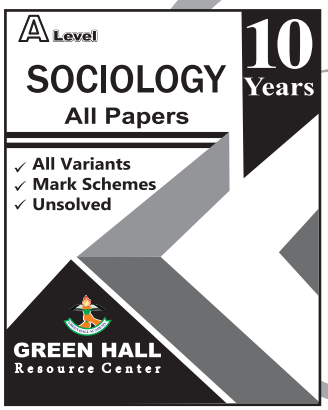
[Classified / Topical Past Papers]

[Yearly Past Papers]



Article # 501





PREFACE

This is a comprehensive and carefully balanced compilation of all the relevant topics that need to be essentially covered and understood by any O Level candidate who wishes to ace his Chemistry paper. We have managed to adopt a purely focused and goal oriented approach in this context that would enable students not only to grasp the content but also assist them in analysing and evaluating individual components.

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Unit-1

Teacher's Guide

A Level

Computer Science

P-2 NOTES

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Topics

- Context
- Outline
- Teaching time
- Programming languages
- VB.Net Resources

Unit 1: Teacher's Guide

1.1 Context

– Paper 2 should be completed prior to starting Paper 4.

– It is recommended that this paper be taught in a practical way with learners having access to a computer that supports VB.Net (console mode).

– Learners should be encouraged to write their own programs, debug and execute them using a computer with the assistance of their teacher

1.2 Outline

Paper 2 provides learners with knowledge and understanding of the following core aspects of problem-solving and programming:

– Algorithm design

– Data representation

– Programming

– Software development

1.3 Teaching time

– It is recommended to spend about 90 hours on Paper 2.

1.4 Programming languages

– VB.Net (console mode) has been chosen as programming language for this book because it is procedural and supports object oriented programming.

1.5 VB.Net Resources

– www.homeandlearn.co.uk/net/vbnet.html

– http://www.tutorialspoint.com/vb.net/

– http://howtostartprogramming.com/vb-netJ

– http://www.microsoftvirtualacademy.com/training-courses/vbfundamentals-for-absolute-beginners

– http://www.studyvb.com/

Unit-2

Alogrithms

A Level

Computer Science

P-2 NOTES

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Topics

- Pseudocode
- Program Flowcharts

Unit 2: Algorithms

An algorithm is a set of instructions that either solves a problem or informs the user that there is no solution.

Representing algorithms

There are two main ways of representing algorithms using:

- Pseudocode
- Flowchart

Common keywords used when writing algorithms

Several keywords are often used to indicate common input, output, and processing operations.

(i) Keywords used to take data from a user
- INPUT, READ, OBTAIN, GET
- Example: Input radius

(ii) Keywords used to give information to a user

(iii) Keywords used for processing data
- COMPUTE, CALCULATE, DETERMINE, DO
- Example: Calculate volume

(iv) Keywords used for declaring variables
- INITIALISE, SET
- Example: Set count to 0 (Le. count = 0)

(v) Keywords used to increase a variable value
- ADD, INCREMENT
- Example: Add 1 to count (i.e. count = count + 1)

(vi) Keywords used to decrease a variable value
- SUB, DECREMENT
- Example: Decrement count by 1 (i.e., count = count - 1)

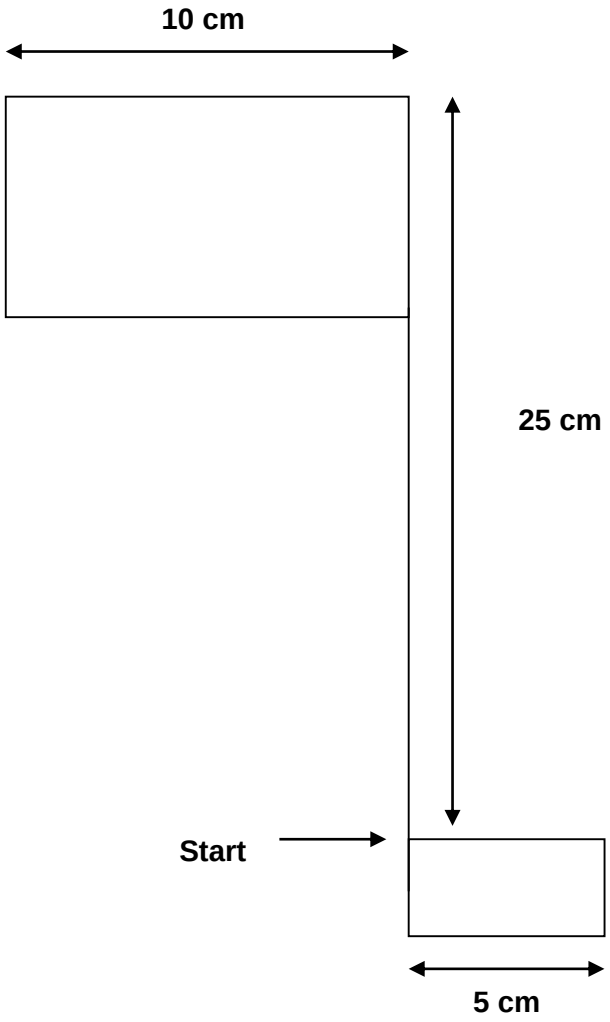
Case Study: Consider the movement of an electronic toy

An electronic toy can move over the floor according to commands that it is given through a keypad. As it moves, it draws a line. It can obey the instructions shown in table below:

Instruction	Meaning
Forward *n*	Move forward *n* cm
Backward *n*	Move backwards *n* cm
Left *n*	Turn left *n* degrees
Right *n*	Turn right *n* degrees
Repeat *n*	Repeat the instruction which follows *n* times

Class Activity 1:

Write an algorithm for the toy to draw the diagram shown below:



2.1 Pseudocode

Pseudocode is the language that combines programming terminology or high-level programming language terms (e.g. if, while, repeat etc.) and ordinary English (nouns and verbs: number, total, set count to 0 etc.). It is a halfway house (i.e. combines two features) between written English and the program code for the problem.

The idea is that, once the pseudocode is written, a programmer using any high-level language (e.g. VB, Java, C ++ etc.) should be able to write the program code from the pseudocode design.

Pseudocode and programming constructs/structures

Algorithms and programs are expressed using 4 basic structures/constructs:

- Assignment construct (Le. assigning values to identifiers)
- Sequence construct (i.e. instructions which are executed one after the other)
- Selection construct (Le. if statements or select case statements}
- Iteration construct (i.e. loops)

2.1.1 Assignment constructs

<variable> = value Or <constant> = value

Example: *Declare* a *variable Name with initial value Fawad and another variable Pie with initial value* 3. 142
Name ← " *Fawad* " Pie ← 3.142

Class Activity 2:

Write a pseudocode that declares two variables (Mark1 and Mark2) that stores initial values 40 and 90 respectively.

2.1.2 Sequence construct

This means a two or more statements are going to be executed one after the other.

Example: *Using pseudocode, write an algorithm that calculates the sum of two numbers input by* a *user.*
Input num1 Input num2 Print num1 + num2

Note: The pseudocode below is an example where instructions are not executed in sequence

1. Input num1
2. Goto line 4
3. Print num1 + num2
4. Input num2
5. Goto line 3

Class Activity 3:

Write the Pseudocode that will allow a user to calculate volume of a cylinder using formula.

V = pie * radius * radius * height.

2.1.3 Selection constructs

It is used when a decision or comparison has to be made in the form of a condition. If the condition is true, it will execute certain instructions else if it is false, it will execute another set of instructions.

Testing a condition

In selection or condition statements comparisons can be tested using the following operators:

– = (Equals)

– > (Greater than)

- < (less than)
- >= (greater than or equal to)
- <= (less or equal to)
- < > (is not equal to)

Types of selection constructs

We can have two types of selection construct:

- IF construct
- CASE construct

(i) IF construct

There are different types or variations of IF construct/structures including:

- IF structure without 'ELSE' clause
- IF structure with 'ELSE' clause
- Nested IF structure

1. IF structure without 'ELSE' clause

IF <condition> THEN

<statement>

ENDIF

Example: *Using pseudocode, write an algorithm that takes* a *mark from* a *user and output pass if the mark is above 60.*

Input mark
If mark> 60 Then
Print "Pass"
End IF

Class Activity 4:

Write the pseudocode that take a mark from a user and output fail if the mark is below 40

Class Activity 5:

(i) Write the pseudocode to input an examination mark and output the grade awarded. The maximum mark is 100. The table below shows the grades that correspond to the marks gained.

Mark	Grade
0-59	U
60-69	E
70-74	D
75-79	C
80-84	B
85-89	A
90-100	A*

2. IF structure with 'ELSE' clause

```
IF <condition> THEN
        <statement>
ELSE
        <statement>
ENDIF
```

Example: *Using pseudocode, write an algorithm that takes* a *mark from* a *user and output pass if the mark is above* 59 *and fail if it is below 59*

Input mark
If mark> 59 Then
Print "Pass"
Else
Print "fail"
End IF

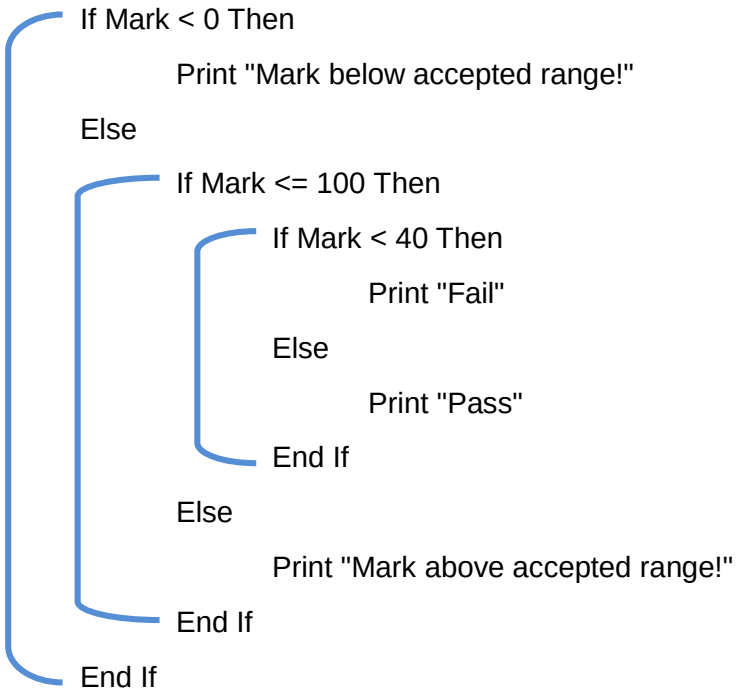
Class Activity 6:

Write the pseudocode that take a temperature from a user and output high if the temperature is above 40, else output low.

3. Nested IF structure

```
IF <condition> THEN
        <Statement>
        IF <condition> THEN
                <Statement>
        ELSE
                < Statement >
        END IF
        < Statement >
ELSE
        < Statement >
END IF
```

An example is illustrated below:



This is called a nested IF structure. It has one IF statement nested (sitting inside) another.

Note: Nested selection

A nested structure (such as an IF statement) is contained inside another similar structure (e.g. IF statement). This is emphasised by indenting the code to show how the statements are nested.

Class Activity 7:

Which algorithm is the more efficient (If structure v/s nested IF structure)?

Example: *Using pseudocode, write an algorithm take an age from a user, first check if the age is valid (must be between* 0 *and* 100*), if* so, *print young if the age is below* 40 *or print old if the age is above 39.*

Input age
If age> 0 and age <=100
If age < 40 Then
Print "young"
Else
Print "old"
End If
End If

Class Activity 8:

Write pseudocode for a program that takes a mark from a user. Firstly, check that the mark is above 39 and if so, check if the mark is above 90 and below 101, then print "Excellent Mark", else print "Pass Mark". If the mark is below 60, print "fail mark".

(ii) Case construct

Case construct is used when there are multiple options from which to choose.

There are different types or variations of Case structures including:

- Case structure without 'otherwise' clause
- Case structure with 'otherwise' clause

1. Case structure without 'otherwise' clause

CASE OF <identifier>

<value 1>: <statement>

<value 2>: <Statement>

ENDCASE

Example: *Using pseudocode, write an algorithm (using case .. structure) that takes* a *temperature, print "room temperature" if the temperature is from* 1 *to 37, prints "extreme temperatures" if the temperature is from* 38 *to 100 or print "freezing temperatures" if temperature is from* -15 *to* o *degrees Celsius.*
Input temperature Case of temperature 1 to 37: print "room temperature" 38 to 100: print "extreme temperatures" -15 to 0: print "freezing temperatures" End Case

Class Activity 9:

Write an algorithm that displays Grade E when student marks are 0 to 20, Grade D when student marks are 21 to 35, Grade C when student marks are 36 to 45, Grade B when student marks are 46 to 60, Grade A when student marks are 60+.

2. Case structure with 'otherwise'

CASE OF <identifier>

<value 1>: <statement>

<value 2>: <Statement>

OTHERWISE

<statement>

ENDCASE

***Example:** -Using pseudocode, write an algorithm that displays Grade E when student marks are 0 to 20, Grade D when student marks are* 21 *to* 35, *Grade* C *when student marks are 36 to 45*, *Grade B when student marks are 46 to 60, Grade A when student marks are 60+. 1f students mark are not within the range, print Grade F (use case of ... otherwise structure)*
Input grade Case of grade 0 to 20: Display "Grade E" 21 to 35: Display "Grade D" 36 to 45: Display "Grade C" 46 to 60: Display "Grade "8" 60 +: Display "Grade A" Otherwise: Display "Grade F" End Case

Class Activity 10:

Write the pseudocode for a program where someone types in the name of an animal and it outputs the sound the animal makes. The animals it should handle are:

- Pig - Oink
- Cow- Moo
- Bear - Grr
- Sheep - Baa
- Tiger - Grr
- everything else – Meow

2.1.4 Iteration constructs

A loop is used when a block of program instructions is executed a finite number of times according to some condition. Because the instructions inside the loop are repeated, these loops are called iteration, or repetition, constructs.

There are 3 main types of iteration constructs/structures:

- For ... Next loop structure
- Repeat. .. Untilloop structure
- While ... End While structure

(i) For ... Next loop structure

This loop is used when you want to perform the sequence of instructions in a loop a number of times. This construct take the following form:

FOR <identifier> ← <start value> TO <end value>

<statements>

NEXT<identifier>

ENDFOR

Note: The for loop is a count controlled loop since we know the number of iterations initially (e.g. for count = 1 to 10). The identifier is the variable that will increase or decrease each time and it is known as the loop counter.

Example: *Using pseudocode, write an algorithm (use for ...loop structure) that takes* 10 *numbers from* a *user and output their total.*
Total ← 0 For N = 1 to 10 Read number Total ← Total + number End For Print Total

Class Activity 11:

Write the pseudocode to read an integer, n, and output the squares of the first n integers:

Class Activity 12:

Write the Pseudocode that that will allow a user to enter an employee's name, number of hours worked rate of pay. It then calculates the employee's total pay: total pay = rate of pay * number of hours worked. Then it output the name and total pay of the employee. Note: If the name entered is END, the program ends. The Pseudocode must cater for 50 employees.

(ii) Repeat ... Untilloop structure

The sequence on instructions inside the loop is always performed at least once. If the condition is false, the loop repeats, else it stops. This construct take the following form:

REPEAT

<Statement>

UNTIL <condition>

Note: The repeat ... until loop is a post-condition loop since the condition is found at the end, after executing the statements.

Example: *Write an algorithm using repeat ... until structure that adds up a series* of *numbers until the total exceeds 100.*
Total ← 0 Repeat Read number Total ← Total + number Until Total >100 Print Total

Class Activity 13:

Write an algorithm using repeat ... until structure that will allow a user to continuously input names of students and print them but stop when a name "End" is encountered.

(iii) While ... End While loop structure

This structure is used when you do not know how many times the steps inside a loop need to be performed. This loop may not execute at all compared to for ... Ioop which will execute at least once.

This construct take the following form:

WHILE <condition>

<statement>

ENDWHILE

Note: The while loop is a pre-conditioned loop since the condition is at the start itself, before executing the loop.

Example: Using pseudocode, *write an algorithm using while ...Ioop structure that will allow* a *user to calculate area* of a *circle* as *long as the radius being entered is positive.*
Pie ← 3.142 Input radius While radius > 0 Area ← Pie * radius * radius Output area Input radius End While

Class Activity 14:

Write an algorithm that will read an item name and display it as long as the total number of item is not equal to 100.

Note: Nested iteration Statements

Loops can also be nested. Consider a program that inputs a student's name followed by a set of examination marks.

Hadi 66, 22, 55,-1

Mustafa 34, 22, 77,-1

Fawad 54, 32, 76, -1

The process repeats for a number of students and terminates when input of the student name END. The list of marks for each student is terminated by a negative mark. The program outputs the average mark for the student.

The solution can be:

```
Input Name
While Name <> "END"
        Sum ← O
        Count ← 0
        Input Mark
            While Mark >= 0
                Sum ← Sum + Mark
                Count = Count + 1
                Input Mark
            End While
        AverageMark ← Sum/Count
        Output "Average mark for" Name, "is “  AverageMark
        Input Name
End While
```

Note: Notice the use of nested while loops

2.1.5 Further exercises on pseudocode

(1) Write an algorithm using pseudocode that asks the user to enter two integers, obtains them from the user and displays the larger number followed by the words "is larger". If the numbers are equal, it must print the message "These numbers are equal".

(2) Write an algorithm using pseudocode that asks the user to input three integers from the user and displays the sum, average, product, smallest and largest of the numbers.

(3) Write an algorithm using pseudocode that reads 10 numbers from the user then prints out how many positive numbers and negative numbers user has entered (consider 0 a positive number).

(4) Write an algorithm using pseudocode that will accept the name, math mark, English mark and French mark of 50 students, calculates the sum, average of the three marks and output the average of each student together with their name.

(5) Write an algorithm using pseudocode that accept 10 marks and output its average.

(6) Write an algorithm using pseudocode that counts the number of even and odd numbers when 20 numbers are input.

(7) (a) Write an algorithm using pseudocode with For... loop structure to input 15 different values for radius and calculate the area of circle in each case.

(b) Modify the algorithm so that whenever a value less than or equal to 0 is entered for radius, the computer displays a message saying that "Error! Radius must be greater than 0".

(8) Write an algorithm using pseudocode that accepts 10 temperatures reading in Celsius, calculate and output the temperatures then in Fahrenheit. (Fahrenheit = 32 + *9/5* * Celcius).

(9) Write an algorithm using pseudocode that outputs the smallest and largest number when 10 numbers are input.

(10) Using Pseudocode, write an algorithm to print the even and odd numbers from 0 until 26.

2.2 Program Flowcharts

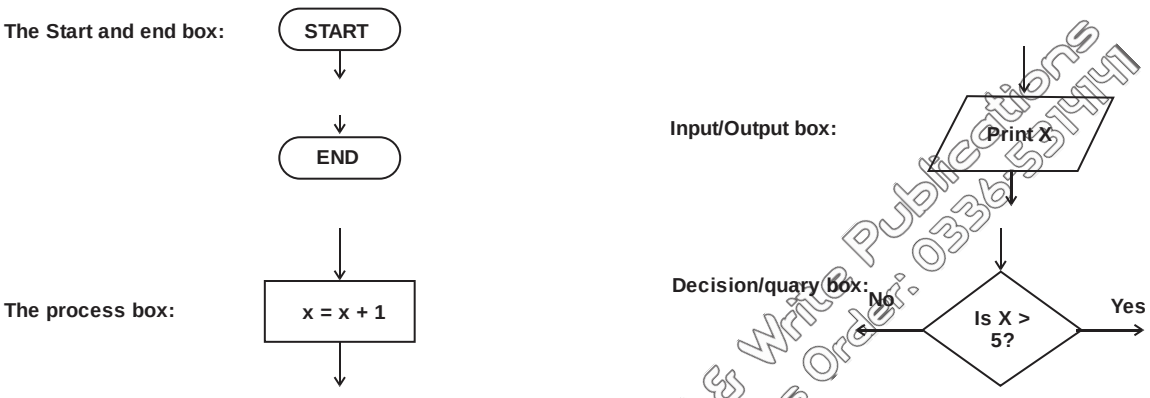
- A program flowchart is a diagram that can be very helpful to explain an algorithm.
- Flowchart is combination of two words i.e. flow and chart. Charts consist of different symbols to display information about any program. Flow indicates the direction of processing that takes place in the program. Flowchart is a graphical representation of an algorithm. It is used to show all the steps of an algorithm in a sequence

Uses of logic flowcharts

Flowchart is used for the following reasons:

- Flowcharts are used to represent an algorithm in simple graphical manner.
- Flowcharts are used to show the steps of an algorithm in an easy way.
- Flowcharts are used to understand the flow of the program.
- Program can be reviewed and debugged easily.

2.2.1 Symbols used in program flowcharts



2.2.2 Trace table

It is a technique used to test Pseudocode or flowcharts to make sure that no logical errors occur.

The trace table when built must consist of the

- Inputs: These are data taken from the user

– Variables: They stores changing values

– Output: This is data that is to be printed

2.2.3 Hand *tracing/Dry* run

It is the process where you use a trace table to:

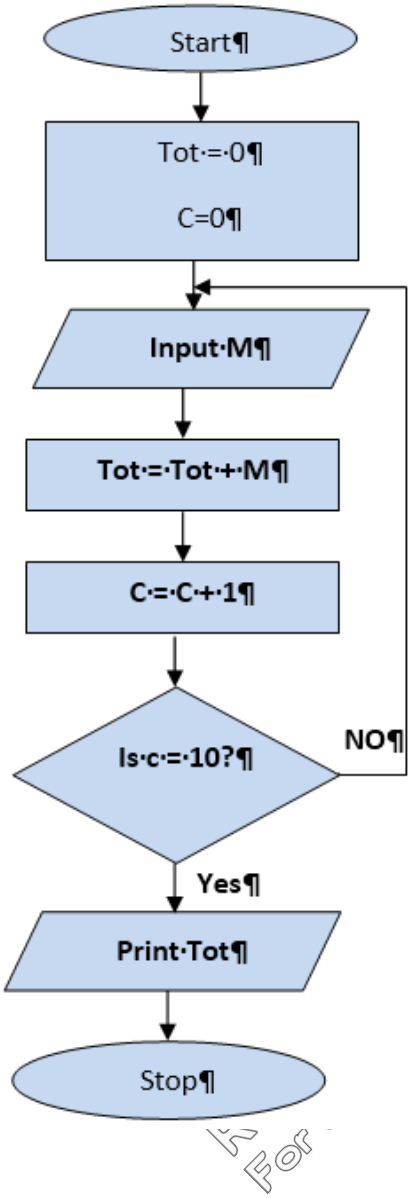
– see what the pseudocode or flowchart will do before you have to run it

– find where errors in your pseudocode or flowchart are

2.2.4 Test data

Test data are the values that will be used as sample in the trace table to test whether the pseudocode or flowchart is doing what it should do.

Example: Design a *flowchart that takes* 10 *numbers* as *input and outputs their total*



Draw a trace table using the following test data: M = 2,4,6,8,1,3,5,7,9,10,11

Solution:

Tot	C	M	Output
0	**0**		
2	**1**	**2**	
6	**2**	**4**	
12	**3**	**6**	
20	**4**	**8**	
21	**5**	**1**	
24	**6**	**3**	
29	**7**	**5**	
36	**8**	**7**	
45	**9**	**9**	
55	**10**	**10**	**55**

Note: (1) Notice that the test data 11 is not taken into consideration since the flowchart cater for 10 values only.

(2) This flowchart makes use of a counter-controlled loop as shown by the arrow which goes upwards. Counter-controlled loops are used when a flowchart need to take input and processed a fixed number of items.

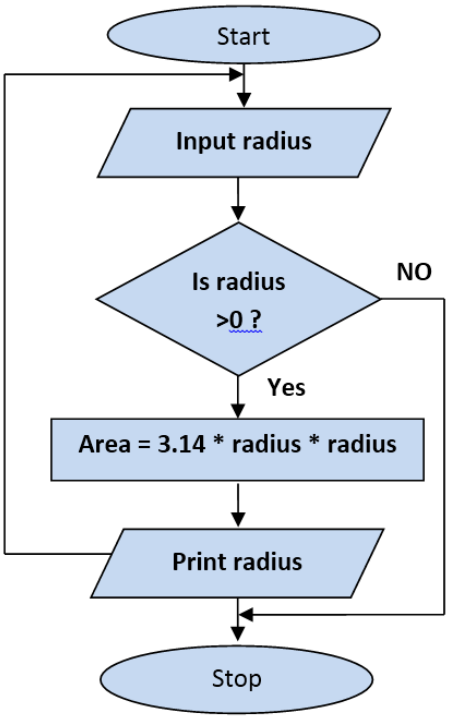
Class Activity 15:

(i) Design a flowchart to calculate area of a circle while radius is positive

(ii) Draw a trace table with test data: r = 1, 2, –3, 5, 6

2.2.5 Condition-controlled loop

In the flowchart below, we do not know in advance the number of times we wish the loop to repeat. The flow of data in this case is interrupted by using a rogue value/data terminator. For example here, the loop will repeat until the special data item (a rogue value is that is less 0) is met and thus terminates the loop.



Class Activity 16:

(i) Design a flowchart to calculate the smallest mark when 5 marks are input (note: marks are from 0 to 100)

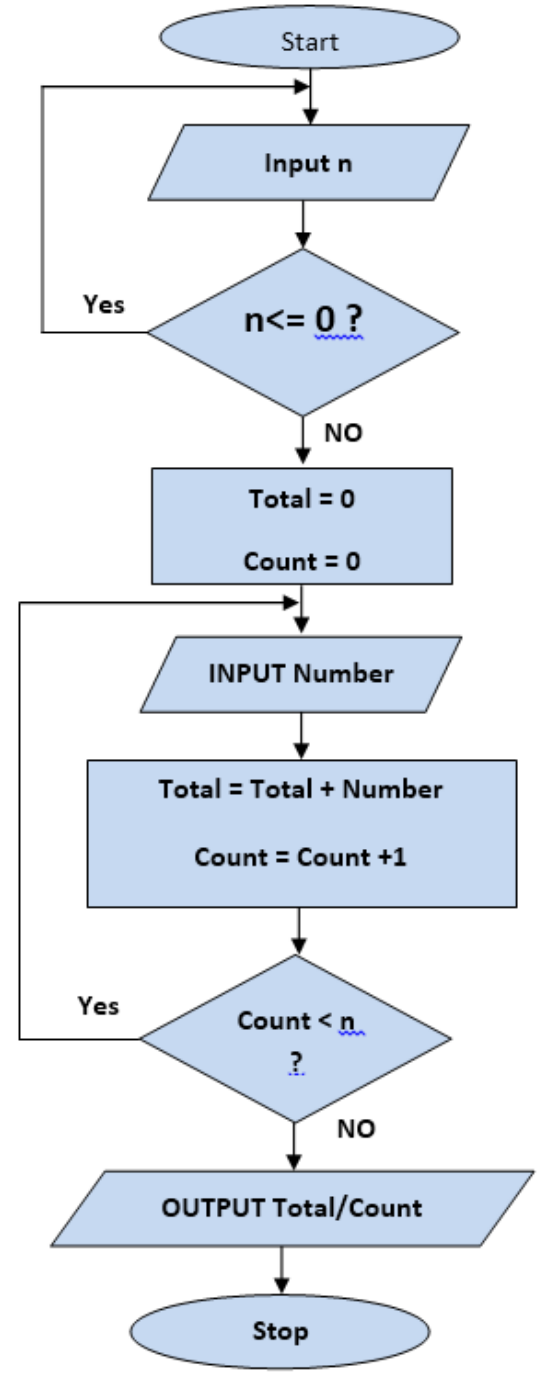
(ii) Draw the trace table using test data for Marks: 80, 50, 60, 40, 10, and 70

Class Activity 17:

(i) Dry run the following flowchart using the following test data:

N=3

Number = 10, 20, 15



(ii) State the purpose of the flowchart.

(iii) Write the pseudocode algorithm for the flowchart above.

2.2.6 Further exercises on flowcharts

1. (i) Design a flowchart to calculate the smallest mark when 5 marks are input (note: marks are from 0 to 100)

(ii) Draw the trace table using test data for Marks: 80, 50, 60, 100, 10, 70

2. The pseudocode below that finds the roots of three inputs: a, band c. [Assuming there is a function SQRT(x) which return the square root of x (x is an integer.]

```
Input a
Input b
Input c
        d ← b * b - 4 * a * c
        If d < 0 Then
                Output "No real roots"
        Else
                SquareRoot = SQRT(d)
                Root1 ←  ( - b + SquareRoot ) / ( 2 * a )
                Rootz ←  ( - b - SquareRoot ) / ( 2 * a )
                Output Root1 , Root2
        End If
```

Draw the flowchart for the above pseudocode and dry run it using your own test data.

3.

```
Total ← 0
For N = 1 to 10
        Read number
        Total +- Total + number
Next N
End For
Print Total
```

Draw the flowchart for the above pseudocode and dry run it using your own test data.

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