APPENDIX – A

PLAN FOR
CHAPTER – 12 HERON'S FORMULA

- **Unit Plan For A Chapter**
- **Achievement Test (Post-test) For A Chapter**
- **Reaction-Reflection Sheet For A Chapter**

Appendix – A (i)

S.O.L.O. TAXONOMY BASED INSTRUCTIONAL STRATEGY

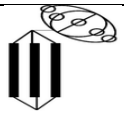
UNIT PLAN - 1

CHAPTER – 12 HERON'S FORMULA

■ Topics Of A Chapter In A Mathematics Class-IX Textbook

- Introduction
- Area of a Triangle – by Heron's Formula
- Application of Heron's Formula in finding Areas of Quadrilaterals
- Summary

■ SOLO Level-wise Concept/ Conceptual Mapping

SOLO Levels	Learning Points / Concepts / Topics
 Pre-structural	• Previous knowledge about basic geometrical shapes (□, ▯, △, ○) as well how to find areas and perimeters of these shapes • To find the area of Triangle - △ (I) using the concept of number of block squares - 1cm^2 area covered by the Triangles and (ii) using basic formula as A = ½ × base × height • Examples /Activities
 Uni-structural	• To understand equilateral triangles and to find its area / perimeter • To understand isosceles triangles and to find its area/perimeter • Examples / Activities
 Multi-structural	• Differentiating Scalene triangles from Isosceles or Equilateral triangles • To understand Scalene triangles and to find its area / perimeter • Understanding on heights/altitudes of a scalene triangle from all the vertices of the triangle • To find the area of scalene Triangles by using Heron's Formula o Brief about Heron o Examples / Exercises / Activities
 Relational	• Triangle based Tangram • Application of Heron's formula for finding the area of quadrilaterals • Examples / Activities
 Extended Abstract	• Some more higher level applications of Heron's Formula • Understanding on Pyramid-structures having triangular faces/sides • Activity / Examples

■ S.O.L.O. Level-wise Instructional Objectives

Pre-structural

1) Students know about basic geometrical shapes like square, rectangle, circle and triangle.
2) Students have learnt about the Quadrilaterals.
3) Students can list the characteristics/properties of respective basic shapes.
4) Students know how to apply / calculate the area and perimeter of respective basic geometrical shapes.
5) Students having knowledge and able to identify the base and height of a triangle.
6) Student know how to calculate the area of a triangle based on the given values of base and height of a triangle.
7) Students know about the Pythagorean Theorem.

Uni-structural

1) Students will be able to recall different types of Triangles with their basic characteristics.
2) Students will be able to recall and identify the equilateral as well isosceles triangles.
3) Students will be able to state the formula for area and perimeter of equilateral & isosceles triangles.

Multi-structural

1) Students will be able to rework on the formulas used to calculate area and perimeter of equilateral and isosceles triangles.
2) Students will be able to examine the scalene triangles where sides are known but height / altitude is not known or not considered.
3) Student will be able to clarify about heights or altitudes of a Triangle when observed from all the vertices of a triangle.
4) Students will be able to construct the knowledge about a concept for Heron's formula.
5) Students will be able to interpret about the triangles with respective to the application of Heron's formula.
6) Students will be able to solve difficult and relevant examples based on Heron's formula.
7) Students will be able to explain about Heron and his contributions to the field of Mathematics.

Relational

1) Students will be able to classify the various Quadrilaterals.
2) Students will be able to observe and relate the Quadrilaterals as parts of Triangles.
3) Students will be able to apply Heron's formula on parts of Triangles formed within a Quadrilateral.
4) Students will be able to combine other formulas along with Heron's Formula in order to calculate the area or perimeter of a Quadrilateral.
5) Students will be able to analyse the area /perimeter of a Quadrilateral calculated through Heron's formula.
6) Students will be able to demonstrate their understanding on proper applications of Heron's formula.

Extended Abstract

1) Students will be able to visualize various shapes imbibed or made with Triangles and their available values in order to calculate the area and perimeter of given shapes.
2) Students will be able to judge the applications of various formulas as well Heron's formula in terms to find/calculate the areas and perimeters of Triangles or Triangle based shapes.
3) Student will be able to invent knowledge on Pyramids-the structures having triangular faces/sides as well Pyramid based civil structures.
4) Students will be able to reflect on need and application of Heron's formula to the Pyramids.

■ METHODOLOGY

Method : Activity based and Heuristic Method

Approach : Inductive and Inducto-deductive

Media : Chalk/White board, Roller board, Charts (as shown below), Tablet-PC

Materials : SOLO Worksheets, Card boards, Thread, Geometrical box, another material used as shown in Appendix-G (Photo Gallery-1)

■ LESSON - PLAN

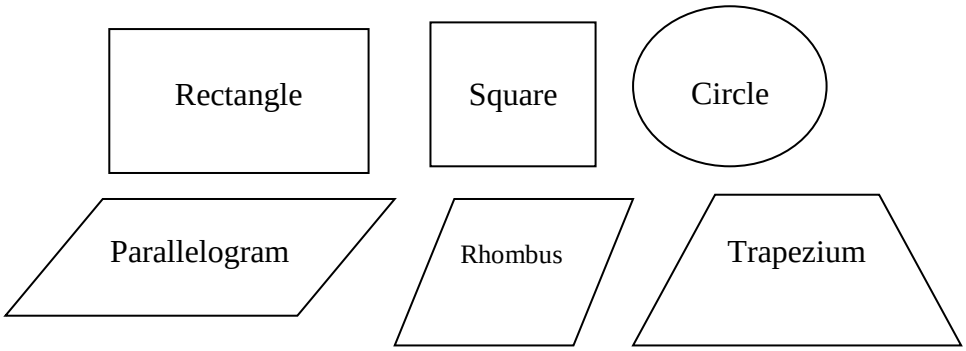
Day No.	Date	Day	Time (am)	Content Details	Settings	SOLO Level
1.	26/08/2014	Tues	08:30 – 09:10	**Introduction, Interaction;** **Activity – 1: Counting Blocks** **(Do as directed as given in a worksheet)**	Pair	●
				Topics Covered: Basic Geometrical shapes, its area & perimeter, both the methods as counting blocks and using formula used for calculating the areas and perimeters		
				Questioning & Probing: a) Have you experienced any difference between two methods while finding area & perimeter of various shapes? What? b) Which one was more feasible? Why? c) What understood from this activity?		
				Home Task: Get more information about the properties of a triangle, why triangles need to study, important role of triangles in our day-to-day life and list the objects or things where this shape is utilized		

2.	27/08/2014	Wed	08:55 – 09:35	**Activity-2: Types of Triangles (Solve the given examples in a worksheet)** Topics Covered: Learning of triangles based on sides like equilateral, isosceles, scalene and finding the areas / perimeters Questioning & Probing: d) Which are the properties have found from triangles of this activity based on angles and sides? e) Comment on the heights observed in the triangles and utilized it in calculating the areas for triangles. Home Task: Find out any triangle object or thing and try to measure its sides and height, then discuss about it in next class.	Individual	I
3.	28/08/2014	Thurs	08:30 – 09:10	(Inspection) **Activity-3: Heights/Altitudes of a Triangle; (Use the cardboard based triangle models given in two colours-pink & green. Show various heights from all the vertices of a triangle by drawing triangles using these models) Introduced Heron's Formula** Topics Covered: Knowing heights and altitudes of a triangle from all its vertices Questioning & Probing: f) How was your experience for measuring the sides and heights of given triangle models? g) Which one was easier to measure-sides or heights? Why? h) Discuss on types of height that you have been observed. i) Different measures of the heights from different vertices make any difference in the total area, discuss. j) What understood from this activity? Home Task: Find or give examples from real life where you feel or think as difficult to measure the heights	Group	III

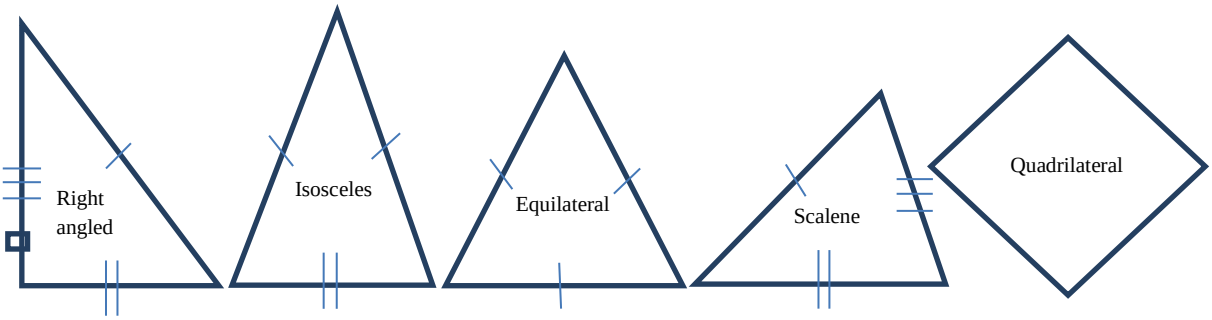
4.	30/08/2014	Sat	08:30 – 09:10	**Practice Work (Solve the examples of given worksheet)** Topics Covered: Solving the examples and finding area of triangles using Heron's formula, Triangles based Tangram Questioning & Probing: Discussion on the experience of measuring the sides of a triangle in the given pictures and then calculating the area of triangles using Heron's formula; creativity with triangles as Tangram Home Task: Solve the complete Exercise – 12.1 of a textbook	Individual	
5.	01/09/2014	Mon	08:30 – 09:10	**Activity-4: Pyramids (Slide Presentation)** **Activity-5: Concept Arrangement (on chart), (Arrange all the interrelated concepts given on the hexagonal shapes)** Topics Covered: Application of Heron's Formula to Quadrilaterals; Exploration with Pyramids – the shapes made from triangles, meaning of a Pyramid, characteristics of the pyramids, types of pyramid, application of Heron's formula for finding the area of a Pyramid Questioning & Probing: Discussion on relation of triangles with quadrilaterals and pyramids as well how it makes easy to calculate the areas using Heron's formula Home Task: Solve the complete Exercise – 12.2 of a textbook	Class Activity	
6.	02/09/2014	Tues	08:30 – 09:10	**Achievement Test For Chapter - 12**		
7.	03/09/2014	Wed	08:55 – 09:35	General Discussion on this chapter, recap & queries **Feedback using SOLO Reflective-Reaction Sheet**		

■ IMPORTANT POINTS FOR EXPLANATION & LEARNING

Geometrical shapes



Types of Triangle



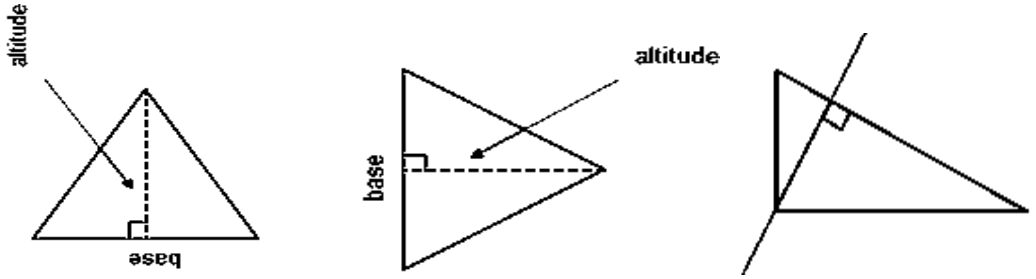
Formulas:

- Rectangle
  - (a) Area = length × breadth
  - (b) Perimeter = 2 × (length + breadth)
  - (c) Diagonal = $\sqrt{(\text{length})^2 + (\text{breadth})^2}$
- Square
  - (a) Area = $(\text{side})^2$
  - (b) Perimeter = 4 × side
  - (c) Diagonal = $\sqrt{2}$ × side

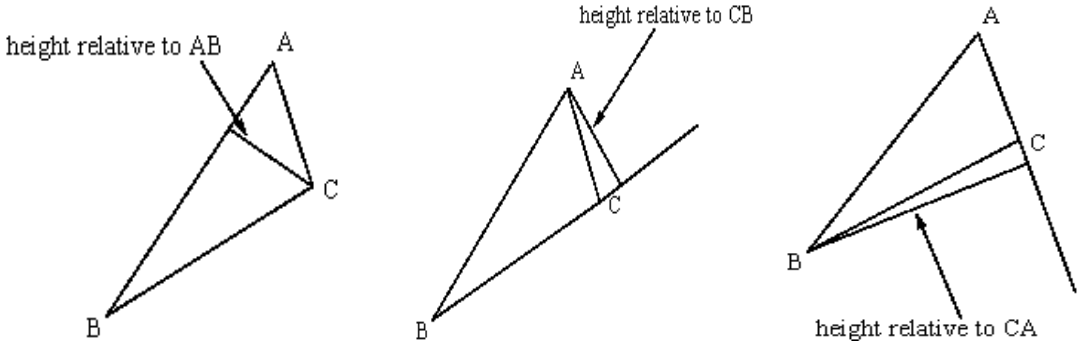
- Triangle with base (b) and altitude (h)
  Area = ½ × b× h
- Triangle with sides as a, b, c
  - (a) Semi-perimeter = (a+b+c) / 2 = s
  - (b) Area = $\sqrt{s(s-a)(s-b)(s-c)}$ (Heron's Formula)
- Isosceles triangle, with base a and equal sides b
  Area of isosceles triangle = a/4 × $\sqrt{4b^2 - a^2}$
- Equilateral triangle with side a
  Area = $\sqrt{3}/4 \times a^2$

The Altitude Of A Triangle

In the case of a triangle, a common way to calculate its area is 'half base times height' where the 'height' is the altitude, or the perpendicular distance from the base to the opposite vertex. The base can be any side, not just the one drawn at the bottom.



An altitude is also a line which passes through a vertex of a triangle, and is at right angles to the opposite side. A triangle has three altitudes.



Base AB Base BC Base CA

■ BLUEPRINT FOR ACHIEVEMENT TEST

BLUEPRINT **SOLO Level wise structure for Achievement Test** **For the Chapter – 12 Heron's Formula; MM – 25 Time – 30 minutes**			
SOLO Level	**About Content**	**Q. No. & Marks/Q**	**Total Mark**
● **Pre-structural**	Calculate area and perimeter of given triangles using block method	Q-1(a, b) [M-1]	2
▌ **Uni-structural**	Calculate area and perimeter of triangle using formula with height and base	Q-2 [M-3]	3

Multi-structural	Identification of height of the given shapes	Q-3 [M-3]	11
	Calculate area and perimeter of triangle using Heron's formula (without height)	Q – 4(i, ii) [M-4]	
Relational	Solve quadrilateral based example by Heron's Formula	Q-5 [M-3]	3
Extended Abstract	Solve pyramid based example by Heron's Formula	Q-6 [M-3]	6
	Concept arrangement using hexagonal shapes	Q-7 [M-3]	
		Total	**25**

Instructions For Test:

1. First write down your name, your roll number, name of school, date and standard in appropriate place given on the sheet.
2. First read all the questions carefully.
3. All the questions are compulsory. Write it with good handwritings.
4. It's a question cum answer sheet, so all the answers you have to write in this sheet at appropriate place.
5. Ask for the separate sheet for the rough work or as supplementary.
6. Draw neat and clean figures wherever it is required.

■ ACTIVITIES ARE AS FOLLOWS (from next page):

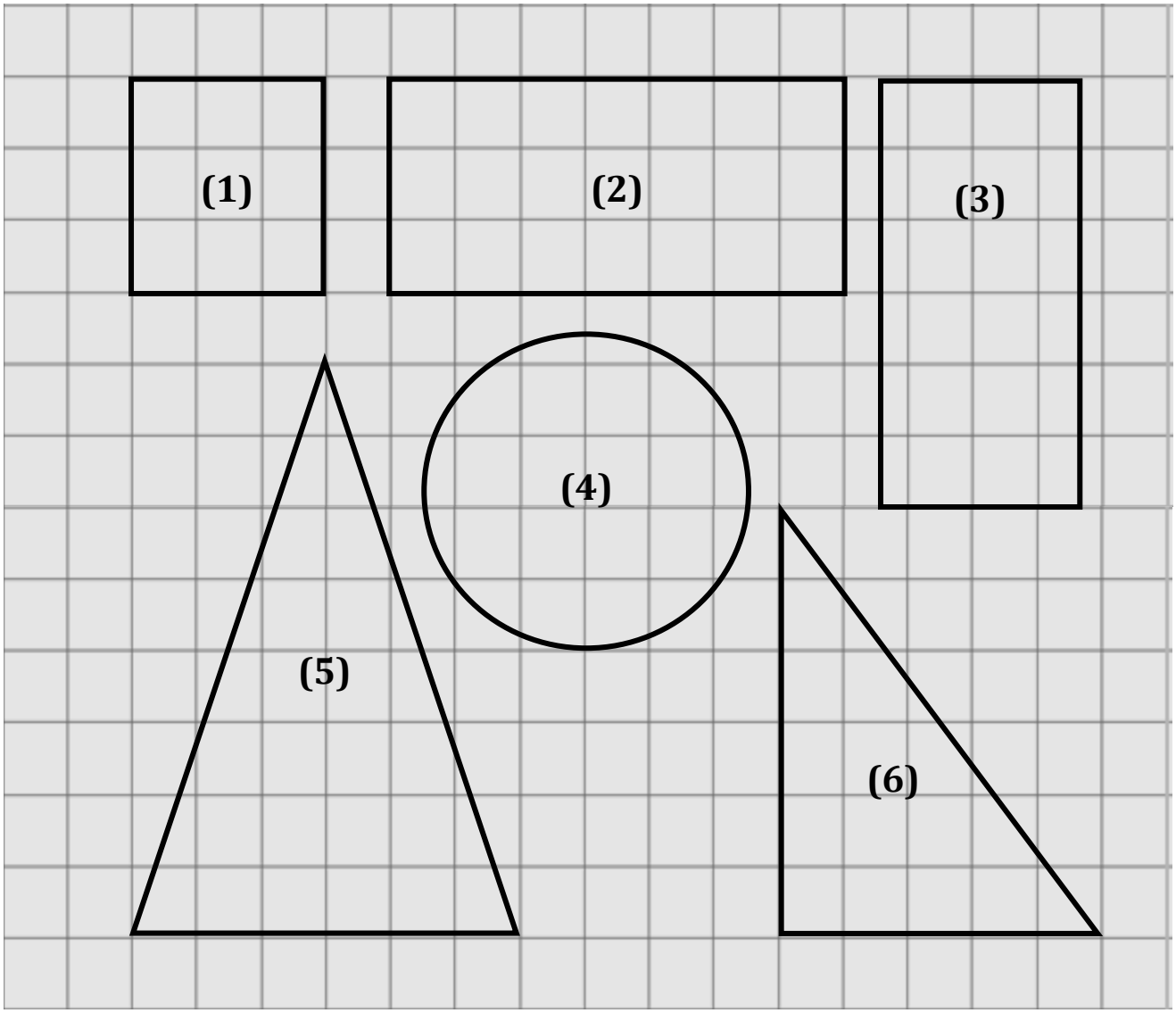
●●●●●END OF UNIT PLAN -1 ●●●●●●

MATHEMATICS
CHAPTER – 12: HERON'S FORMULA

ACTIVITY – 1: COUNTING BLOCKS (1 unit^2)
(Activity in Pair – Basic Geometrical Shapes, its Area & Perimeter)

Name & Roll no. of Students : **Date : _____**
1. _____ **Std. : _____**
2. _____ **School : _____**

☞ Following are the basic Geometrical shapes given on the grid paper. Grid paper is consisting of square blocks of approximately 1 unit^2. You have to count the blocks occupied inside (as Area) and outside (as Perimeter) by each of the shapes. Write down your answers on back of this sheet.



SOLUTION:

Shape No.	Name of a Shape	AREA No. of Inside Square blocks occupied by a shape	PERIMETER No. of Outside Square blocks occupied by a shape
1			
2			
3			
4			
5			
6			

CALCULATING AREAS & PERIMETER BY USING FORMULA:
Here in table, write down the formula for Area and Perimeter of each geometrical shapes and then calculate the respective area and perimeter.

Shape No.	Name of a Shape	AREA	PERIMETER
1		Formula :	Formula :
2		Formula :	Formula :
3		Formula :	Formula :
4		Formula :	Formula :
5		Formula :	Formula :
6		Formula :	Formula :

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MATHEMATICS
CHAPTER – 12: HERON'S FORMULA

ACTIVITY – 2: TYPES OF TRIANGLES (Based on Sides)
(Learning of Triangles (based on sides) & Finding their Areas/Perimeters)

Name & Roll no. of Student : _____

Date: _____ Std. : _____ School : _____

Ex – 1: Draw a Triangle having sides of 9cm, 9cm and 6cm. Specify the type of triangle and label the vertices. Calculate the height by using Pythagoras theorem and measure the base of the triangle. Calculate its Area as well Perimeter using the formula. (A = ½bh).

Ex – 2: Draw a Triangle having sides of 10cm, 7cm and 3cm. Specify the type of triangle and label the vertices. Measure the height and base of the triangle and calculate its Area as well Perimeter using the formula. (A = ½bh).

Ex – 3: Draw a Triangle having sides of 8cm, 8cm and 8cm. Specify the type of triangle and label the vertices. Measure the height and base of the triangle and calculate its Area as well Perimeter using the formula. (A = ½bh).

Note: Use back side of this sheet to solve these problems.

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MATHEMATICS
CHAPTER – 12: HERON'S FORMULA III

ACTIVITY – 3: HEIGHTS / ALTITUDES OF A TRIANGLE

(Knowing Type Of Heights/Altitudes Of A Triangle From All Its Vertices)

Roll no. of Students in a Group : _____

Date: _____ Std. : _____ School : _____

(Note: Use this side of sheet for GREEN Triangle & back side for PINK Triangle to draw a height from each vertex of a triangle and then identify the type of heights)

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MATHEMATICS
CHAPTER – 12 : HERON'S FORMULA

PRACTICE WORK SHEET
(Finding Areas and Perimeters Using Heron's Formula)

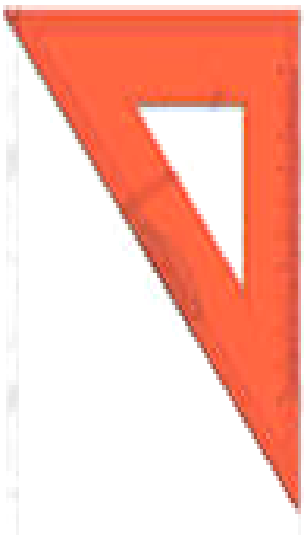
Name & Roll no. of Student: _____

Date: _____ Std. : _____ School : _____

DO AS DIRECTED:

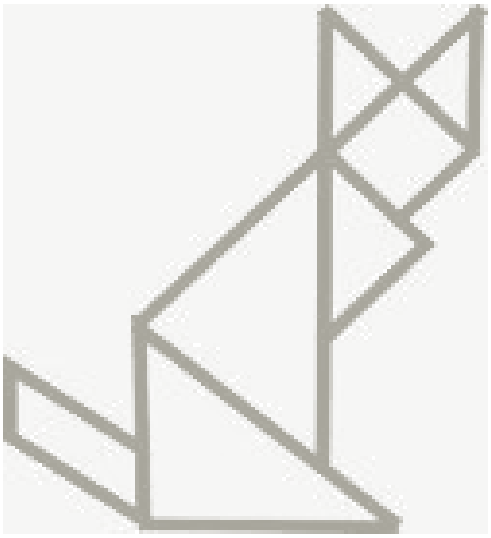
This is a picture of a Signboard. With the help of scale, you have to measure the three sides of the inner triangle (that is in White colour). Multiply the value of each side with 10 (i.e. if measurement of one side is 2cm than 2cm x 10 = 20cm). Then find the area of inner triangle by using Heron's formula.

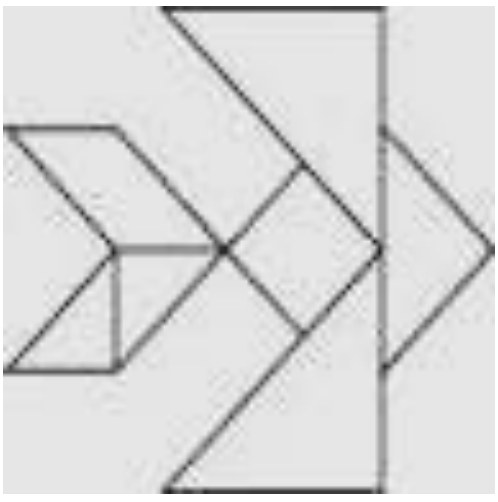
This is a picture of a Setsquare. With the help of scale, you have to measure the outer edges as three sides of a Setsquare. If the area of the inner triangle (white) is $5cm^2$. Than find the actual area of a Setsquare using Heron's formula.



This is a picture of a Sailboat having two sails made up of canvas. With the help of scale, you have to measure the three sides of both the sails. Find out how much canvas used in each of the sail. (use the unit as 'meters' i.e. if one side of the sail is 4cm than take it as 4 meter).

TANGRAM: Following figures are made up of geometrical shapes (major parts are triangles). Fill various parts of the figures by dry colours or paste by pieces of coloured papers on different parts.





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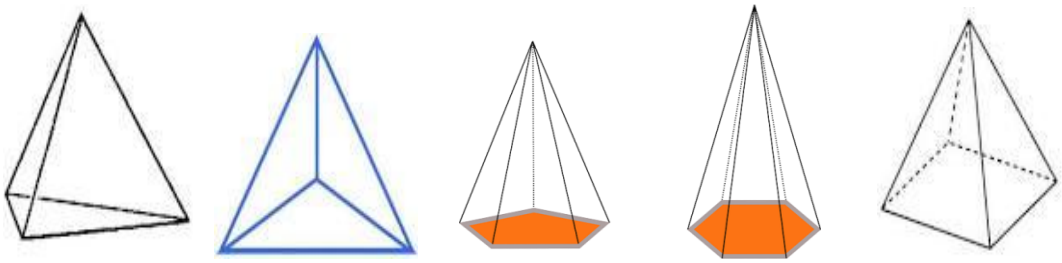
MATHEMATIC
CHAPTER – 12: HERON'S FORMULA

(Class) ACTIVITY – 4 : PYRAMIDS

SLIDES (Tablet-PC) PRESENTATION ON "PYRAMIDS"



The Louvre Pyramid in Paris, France,

The Luxor Hotel in Las Vegas, US

The 32-story Pyramid Arena in Memphis, Tennessee

The Walter Pyramid, home of the basketball and volleyball teams of the California State University

Metairie Cemetery, New Orleans

Explanation About Pyramid:

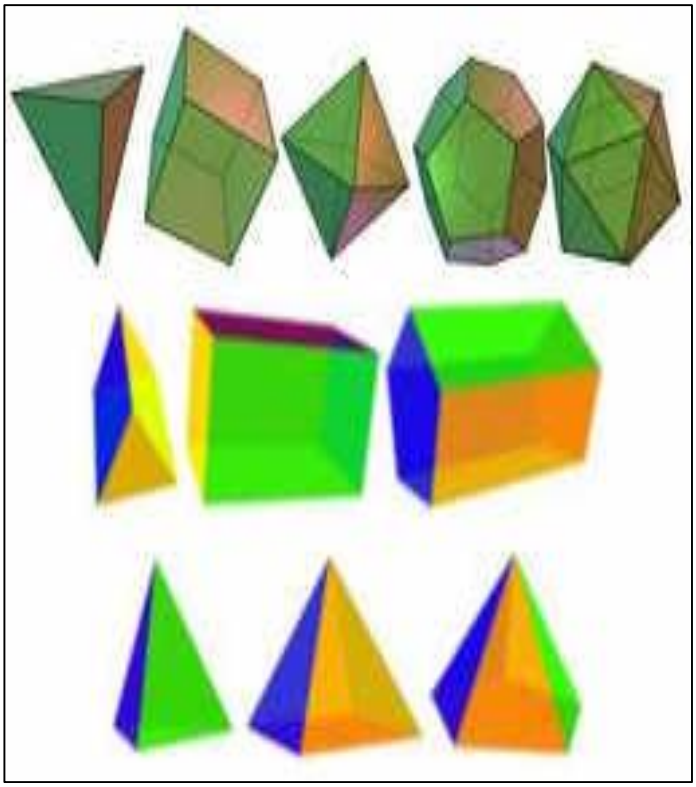
Definition of Pyramid : A pyramid is a polyhedron with a polygonal base and triangles for sides.

How many triangular faces are there in a square based or rectangular pyramid? Ans : 4

a) 6 b) 4 c) 8 d) 9

- The shape of the Pyramid is formed on its base.
- The base of the Pyramid may be a rectangle or square.
- There are 4 base-edges in the Pyramid.
- The faces of the Pyramid joining the base edge to the vertex are the triangular faces of the Pyramid.
- Hence, the number of triangular faces is equal to the number of base-edges of the Pyramid**.**
- Thus, there are 4 triangular faces in a square based or a rectangular Pyramid.

Polyhedron

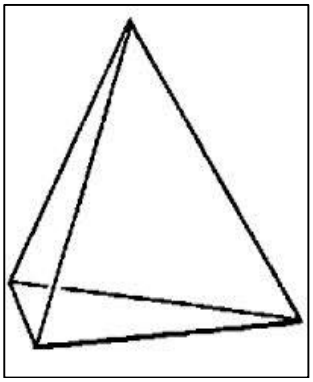


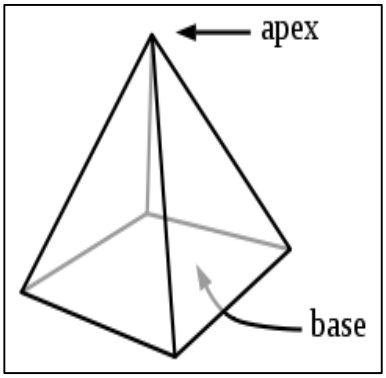
A solid with flat faces (from Greek, poly- meaning "many" and -edron meaning "face").

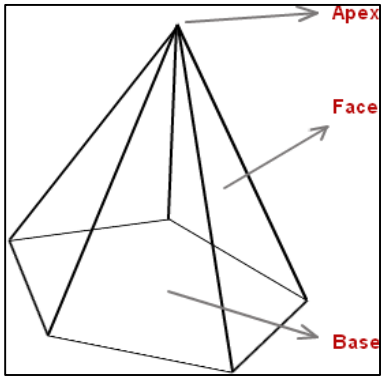
Example: pyramids and prisms

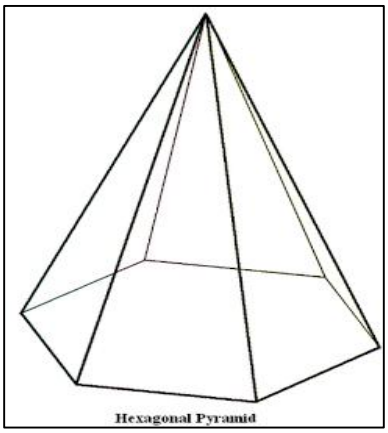
Each flat surface (or "face") is a Polygon.

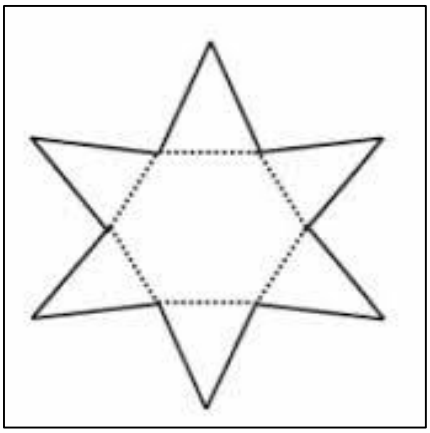
Figure : Polyhedron Source : http://www.mathsisfun.com/definitions/polyhedron.html











The ancient pyramids of Egypt

The main gopura of the Thanjavur Temple pyramid

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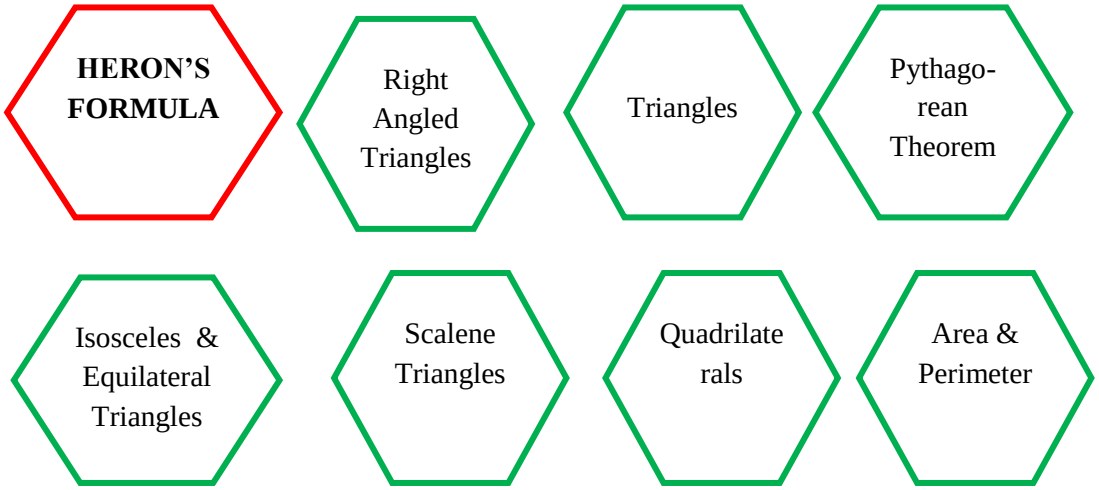
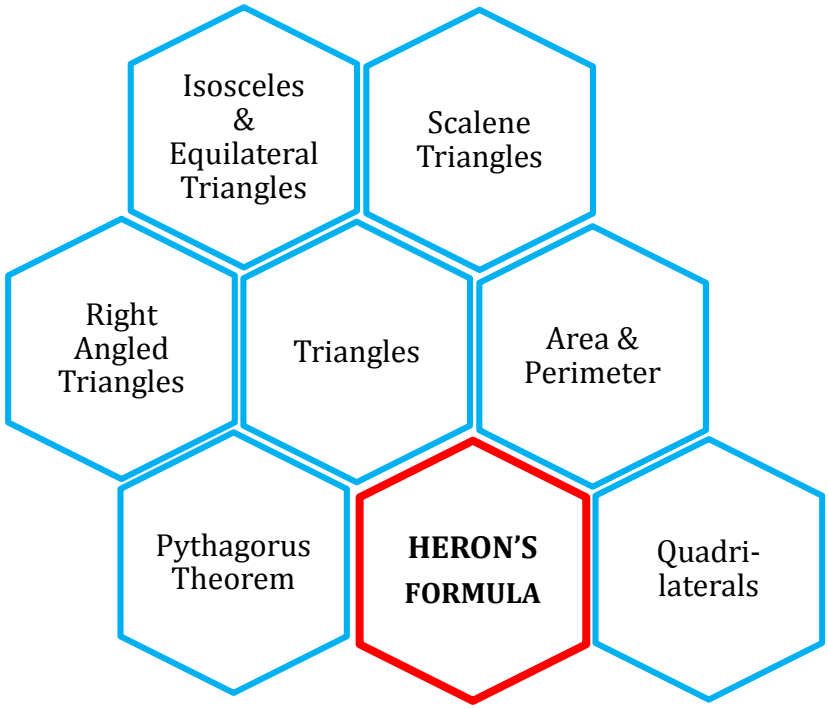
MATHEMATICS
CHAPTER – 12: HERON'S FORMULA

(Class) ACTIVITY – 5: CONCEPT ARRANGEMENT

Recap / summarise the interrelated concepts through Hexagonal Shapes for the Chapter-12 on Heron's Formula





★★★★★★★★★★ **END OF ACTIVITIES** ★★★★★★★★★★

Appendix – A (ii)

Final Draft: POST – TEST

Mathematics Achievement Test: 2014 - 2015

CHAPTER – 12 HERON'S FORMULA

Std. :IX **MM : 25 Marks** **Time : 30 minutes** **Date:**

Name of School: **Name of Student:** **Roll No. :**

Q-1 Find out the area of the Triangles given with the grids as below. Use block (1 cm^2) counting Method. (2)

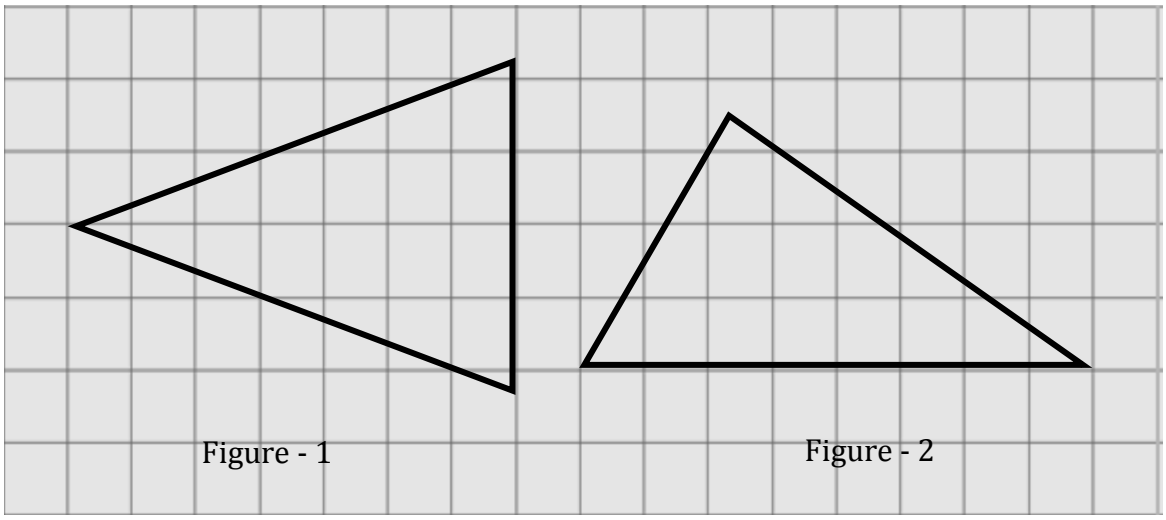


Figure - 1 Figure - 2

a) No. of blocks occupied by Triangle in figure – 1: .....

b) No. of blocks occupied by Triangle in figure – 2: .....

Q-2 An isosceles triangle has perimeter of 30cm and each of its equal sides are 12cm. Find its height (using Pythagoras theorem) and find its area (using height & base). (3)

(Space for Diagram)	(Space for step-wise calculation)

Q-3 In the following diagram of triangles, show or highlight (draw with blue pen) the height or altitude from a vertex C to base $\bar{A}B$ and write about the type of height of a respective triangle. (3)

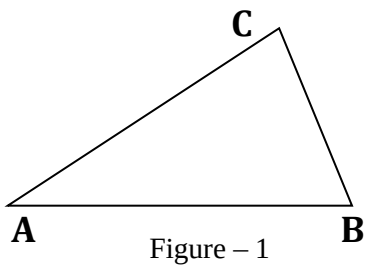


Figure – 1

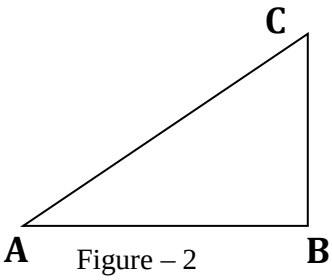


Figure – 2

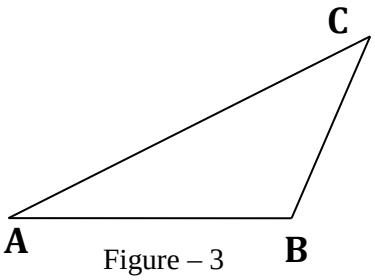
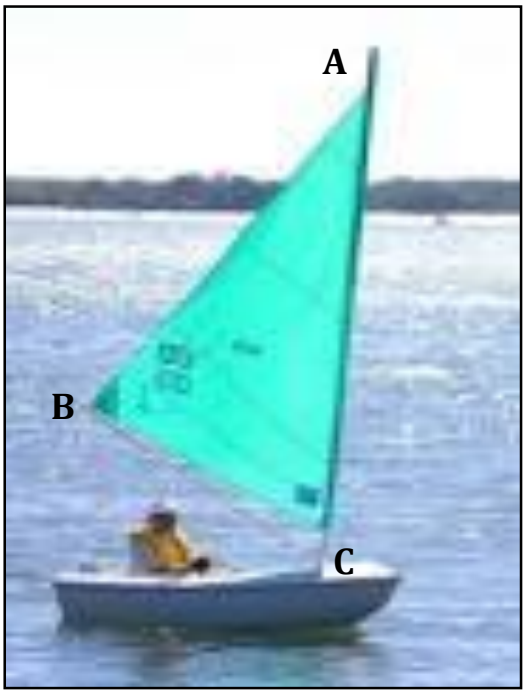


Figure – 3

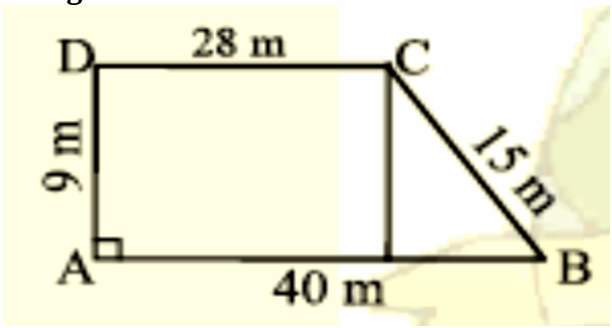
Q-4 Measure all the sides of the triangles shown in the following pictures (i and ii). Write down all the measures of sides and calculate the perimeter (P), semi-perimeter (s) and area (A) by using Heron's formula. (8)

(Space for Diagram) **(i)**	(Space for step-wise calculation) **(**use unites as meters i.e. one of side is 3cm then consider it as 3m)



(Space for step-wise calculation) (use unites as feet i.e. one of side is 3cm then consider it as 3ft)	(Space for Diagram) **(ii)** 

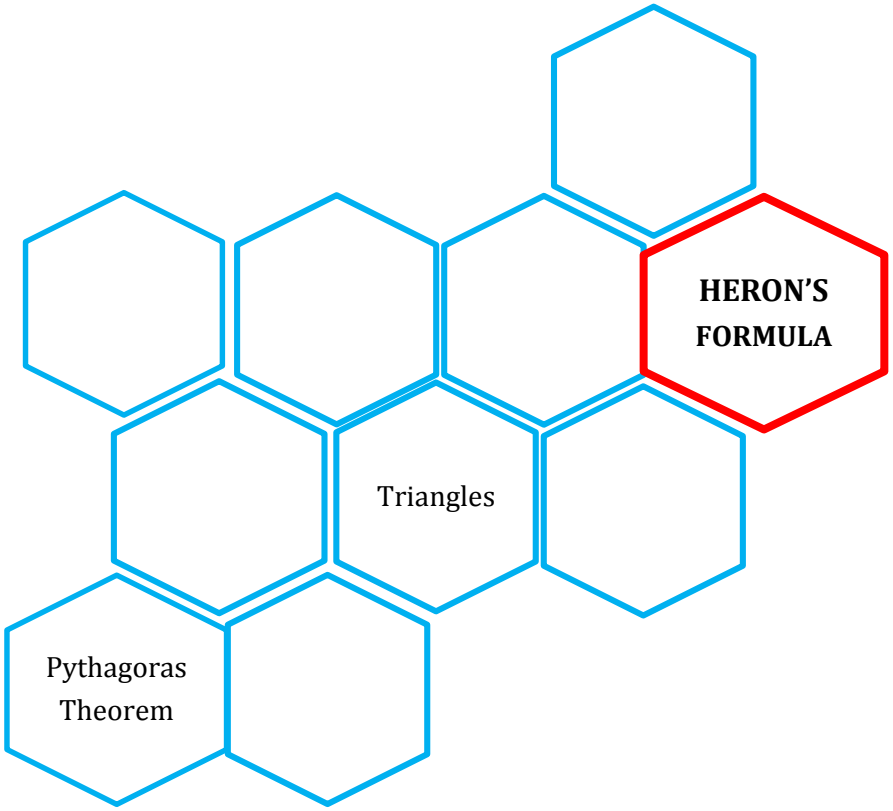
Q-5 Using Heron's Formula, find the area of a Trapezium given in the following figure. (3)



Q-6 A triangular Pyramid is made up of equilateral triangles having all sides of 10cm. Find the total area of a triangular pyramid using Heron's formula. (3)

Q-7 Following is a diagram consists of ten hexagonal shapes of a graphical organiser. Fill the shapes with appropriate key-words (out of ten key-words) given below, which should give proper understanding of the concepts given in a chapter of Heron's Formula. (3)

1) Height & Base	2) Pythagoras Theorem
3) Scalene Triangles	4) Isosceles & Equilateral Triangles
5) Area & Perimeter	6) Quadrilaterals
7) Right Angled Triangles	8) Triangles
9) Heron's Formula	10) A = ½ x height x base



Space for Rough Work:

✶✶✶✶✶✶ALL THE BEST ✶✶✶✶✶✶

Appendix – A (iii)

Final Draft

REACTION - REFLECTION SHEET

2014 – 2015

Name of Student: _____ **IX** Roll No

Name of School: _____

► **Put tick-marks at appropriate option/s (a, b, c, or d):**

Chapter – 12 Heron's Formula		
SOLO Levels	**Item No.**	**Item-Statements About My Learning Experiences and Achievements**
	I-1)	**Whether I have participated in an Activity-1 'Block Counting Method' for finding the area of various geometrical shapes?**
	a)	Yes
	b)	No as I was absent in school
	c)	No as I was engaged with other school-activity
	I-2)	**How was an Activity-1 ?**
	a)	Easy but of primary grade level
	b)	Difficult
	c)	Appropriate to understand and to learn about the Area of various shapes
	d)	Not appropriate for the grade of IX
	I-3)	**How was an Activity-1 for me ?**
	a)	Interesting & Just enjoyed
	b)	Not Interesting
	c)	I have experienced a new way of learning about the Areas and Perimeters
●	d)	Don't know
	I-4)	**What I have learnt from this Activity-1 ?**
	a)	Learnt about the new method for finding the Areas and Perimeters
	b)	Concept of Area and Perimeter got understood clearly through this activity
	c)	Helped me to recall my previous knowledge that learnt in previous class/grade
	d)	Nothing
	I-5)	**Where I found difficulties in doing this Activity-1?**
	a)	Having less time
	b)	Counting the Blocks outside the shapes in terms to find the Perimeter
	c)	Counting the Fractional Blocks in terms to find the Area and Perimeter of given shapes
	d)	No difficulties
▌	**I-6)**	**Whether I have solved the Worksheet given for Activity – 2 on the Types of Triangles (Based on Sides) given as home-assignment (with 3 examples)?**
	a)	Yes
	b)	No

	I-7)	**Which are the following topics or concepts learnt or understood by me completely? Let me put tick mark/s.**
	a)	The Types of Triangles based on the angles and the sides
	b)	Differentiation between Scalene, Isosceles and Equilateral triangles
	c)	Finding the value of height/s in Isosceles and Equilateral triangles using Pythagoras theorem
	d)	Finding the Area of triangles by using a basic formula A = ½ x b x h, when height is known
	I-8)	**Whether I have participated in an Activity-3 on Heights/ Altitude of a Triangle (Knowing heights/altitude of a Triangle from all its vertices) given in small group?**
	a)	Yes
	b)	No as I was absent in school
	c)	No as I was engaged with other school-activity
	**I-9)**	**How was an Activity-3 for me ?**
	a)	Gave a clear idea about identifying the heights from any vertex of a triangle is whether its internal (interior) or external(exterior) or on an edge
	b)	Not understood this activity
	c)	Understood an activity but concept of identifying the height is not clearly understood by me
	d)	I Don't know as other member/s of my group did this activity
	I-10)	**Whether I have solved a Practise Worksheet given as home-task about to find the area of Triangles by using Heron's Formula (with 3 examples and one Tangram activity)?**
	a)	Yes
	b)	No
	I-11)	**How I found this Practise worksheet for me ?**
	a)	Interesting & enjoyed the examples to solve by using Heron's formula
	b)	What rubbish, as sides of the triangles were not given and I was to do or to find
	c)	Confused with the examples
	d)	Don't know
	I-12)	**I have learnt about the Quadrilaterals in Grade -VIII.**
	a)	Yes
	b)	No
	c)	Don't know
	d)	Kept it as optional
	I-13)	**I am able to relate the Triangles with the Quadrilaterals and able to divide the quadrilaterals to form the triangle shapes within it.**
	a)	Absolutely
	b)	In some quadrilaterals only
	c)	Not at all
	d)	No comments
	I-14)	**Learning /knowing about the concept of Pyramids for me was:**
	a)	Interesting
	b)	Non-interesting
	c)	Time-pass
	d)	Higher level learning
	I-15)	**'Concepts/topics arrangement through Hexagonal shapes'- a**

		Graphical Organiser helped me to understand thoroughly the concepts of Heron's formula.
	a)	Yes-Innovatively & more than my expectations
	b)	Not understood & confused
	c)	Partially understood
	d)	Don't' know
	I-16)	**Whether my Knowledge /Understanding have been improved ?**
	a)	Yes but little
	b)	Yes and more
	c)	Unable to say
	d)	No/Not much
What I liked Most?		
What I not liked?		
How I felt about this way of learning?		
Which way I would like to learn?		
Your General Comments (About Instructor, Teaching-learning process, Remarks/ Improvements, Suggestions...):		

◆◆◆◆◆◆◆◆◆◆

◆◆◆◆◆◆HOPE ENJOYED THE LESSON◆◆◆◆◆

APPENDIX – B

PLAN FOR
CHAPTER – 4 LINEAR EQUATION IN TWO VARIABLES

- **Unit Plan For A Chapter**
- **Achievement Test (Post-test) For A Chapter**
- **Reaction-Reflection Sheet For A Chapter**

Appendix – B (i)

S.O.L.O. TAXONOMY BASED INSTRUCTIONAL STRATEGY

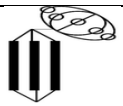
UNIT PLAN - 2

CHAPTER – 4 LINEAR EQUATION (L.E.) IN TWO VARIABLES

■ Topics Of A Chapter In A Mathematics Class-IX Textbook

- Introduction
- Linear Equation
- Solution of a Linear Equation
- Graph of a Linear Equation in two variables
- Equations of Lines Parallel to x-axis and y-axis
- Summary

■ SOLO Level-wise Concept/ Conceptual Mapping

SOLO Levels	Learning Points / Concepts / Topics
 Pre-structural	• Previous knowledge about Linear equation in one variable, expressions for the said equation • To get/find the solution of the Linear equation in one variable, • Examples /Activities
Uni-structural	• To understand the problem to formulate the Linear equation with two variables • To understand the elements of the equation such as Variables, Coefficients, Constants. • More Examples / Activities to formulate the L. E. in two variables
 Multi-structural	• Understanding on finding solutions from single L.E. in two variables • More Examples / Exercises / Activities for finding solutions of various equations
 Relational	• Understanding on plotting Graph of a Linear Equation in two variables • Learning on equations of Lines Parallel / Perpendicular to x-axis and y-axis • Examples / Exercises / Activities
 Extended Abstract	• Making equations from graph • Graph of two linear equations – Getting unique solution at intersecting point of two lines - Discussions • Activity / Examples

■ SOLO Level-wise Instructional Objectives:

Pre-structural

1) Students having knowledge about Linear Equation in one variable.
2) Students having understanding about the variable and its meaning.
3) Students know how to solve the equation to get the value of a variable of the linear equation.
4) Student are able to formulate the expressions for L.E in one variable from given word problem.

Uni-structural

1) Students will be able to recognise the concept of Linear equation in two variables from stated example of daily life.
2) Students will be able to identify the variables from expressions of the Linear equation.
3) Students will be able to state the meaning of a Variable, Coefficient and Constant.
4) Students will be able to tell some examples of Linear Equation in two variables.

Multi-structural

1) Students will be able to construct the statements of Linear Equation in two variables.
2) Students will be able to define and derive the variables, coefficients and constants from statement of equation.
3) Students will be able to examine the values of two variables which fulfil the given linear equation.
4) Students will be able to solve the Linear Equation in two variables to find the possible solution/s.
5) Students will be able to explain about having one or two or many solutions for a given Linear equation in two variables.

Relational

1) Students will be able to demonstrate the understanding about plotting the values obtained as solutions of a L.E. on a graph.
2) Students will be able to observe the linearity and relate it with the solutions of a equation..
3) Students will be able to apply the knowledge and to understand the type of solutions to get parallel or perpendicular lines with the axes.
4) Students will be able to analyse the parallel and perpendicular lines with the axes of a graph.

Extended Abstract

1) Students will be able to visualize various shapes imbibed with Graph made from L. E. In two variables.
2) Students will be able to judge on the applications of a graph with straight lines to generate the linear equations from its co-ordinates.
3) Students will be able to reflect on need and derivation of the linear equations from the straight lines plotted on a graph.

■ METHODOLOGY

Method : Activity based and Heuristic Method

Approach : Inductive and Inducto-deductive

Media : Chalk/White board, Roller board, Charts (as shown below)

Materials : SOLO Worksheets, Beads, Currency notes (not real), Geometrical box, another material used as shown in following figure

■ LESSON - PLAN

Day No.	Date	Day	Time (am)	Content Details	Settings	SOLO Level
1.	14/10/2014	Tues	08:30 – 09:10	**Activity -1 (Class Activity) : Vegetable Vendor (Three vegetable items taken to sell with current rates. Different currencies were given to different groups and instructed (i) to purchase one item only within the amount given to the groups; then (ii) to purchase two items only within the amount given to the groups Discussion conducted on the strategies used to purchase one and then two items)** Topics Covered: Understanding the meaning of variables, coefficients, constants and Linear equation in one variable as well in two variables Questioning & Probing: a) What is purchased by your group? Why? b) Which component was your decisive factor for purchasing? Why? Home Task: Find out such five examples and then discuss it in next-class.	Class & Group	● ▌
2.	15/10/2014	Wed	08:55 – 09:35	**Class Worksheet–1 Framing Equations** **Activity – 2 Currency Notes** **(Solve worksheet based on activity-1 and framing linear equation in one and two variables)**	Class & Individual	▌

				(Solve a worksheet which is based on a picture of currency notes to do swapping between the values of currency and the numbers of currency notes & explore your understanding with variables, constant, coefficients)		
				Topics Covered: Understanding the relativity of variables and coefficients of Linear equation in two variables Framing Linear equation in two variables		
				Questioning & Probing: c) How were these activities?		
				Home Task: Read this chapter from textbook and define coefficients, variables, constant, meaning of linear equation, solutions		
3.	16/10/ 2014	Thurs	08:30 – 09:10	**Discussion on Activity – 2** **Class Worksheet – 2 Standard Form of L.E.**	Class & Individual	I
				Topics Covered: Identify variables, coefficients, constants Converting Linear equation to Standard Form		
				Questioning & Probing: d) What do you mean by coefficient/s and variable/s? e) What is the relation between coefficients and variables? f) Based on activity-1, in which situations we can consider rupees/currency as variable or coefficient? Why? g) Based on activity-1, in which situations we can consider kg/weight as variable or coefficient? Why?		
				Home Task: Write down the definitions of the variables, coefficients, constants and L.E. in two variables. Read all the illustrations from a textbook.		
4.	17/10/	Fri	08:30 –	**Activity – 3 Solving an Equation** **(Solve the examples on L.E. in two**	Individual	III

	2014		09:10	**variables given in a worksheet)** Topics Covered: Finding solutions of a L. E. in two variables Questioning & Probing: h) What do you mean by Linear? i) What do you mean by solution? j) What do you mean by the solutions of a L.E. in two variables? k) How many solutions are possible for a linear equation? Discuss Home Task: Complete the Exercises 4.1 and 4.2 from a chapter-4 of a textbook		
5.	18/10/2014	Sat	08:30 – 09:10	**Activity – 4 Plotting Graph** **Activity – 5 Graphs** **(Plot a graph using the solutions obtained in activity-3, then observe the line/s and discuss)** **(Study the graphs given in a worksheet and make out the conclusions about the forms of L.E. in two variables and the parallel or perpendicular lines of a graph)** Topics Covered: Drawing graphs from the solutions of a L.E. in two variables Type of lines (straight lines; parallel or perpendicular lines to the respective axes) generated from an equation and identifying a L.E. from the graphs Questioning & Probing: l) Explain about the lines parallel or perpendicular to the axes. m) Which kind of graphs or lines we are getting from a L.E. in one variable? Home Task: Complete the Exercises 4.3 from a chapter-4 of a textbook	Class And Individual	
6.	21/10/2014	Tues	08:30 – 09:10	**Activity – 5 Graphs (continue..)** **Activity –6 Equation from graph** **Recap with class activity on Concept Arrangement (on chart),** **(Complete an activity-5)**	Class And Individual	 

				(A worksheet with several graphs has given to exercise to identify or generate L.E. in two variables from the co-ordinates of the graphs)		
				Topics Covered: Identifying a L.E. from the graphs Framing L.E. in two variables from the graphs		
				Questioning & Probing: n) What is the meaning of co-ordinates of a graph? o) What strategies have you applied or followed to derive the equations from the lines given on a graph?		
				Home Task: Complete the Exercises 4.3 and 4.4 from a chapter-4 of a textbook		
7.	29/10/2014	Wed	08:55 – 09:35	**Achievement Test For Chapter - 4**		
				Feedback using SOLO Reflective-Reaction Sheet		

■ IMPORTANT POINTS FOR EXPLANATION & LEARNING

Meanings of Term:

Coefficient

1. A numerical or constant quantity placed before and multiplying the variable in an algebraic expression (e.g. *4* in *4x*).
2. A multiplier or factor that measures a particular property.

Variables

An element, feature, or factor that is liable to vary or change

Constant

1. Occurring continuously over a period of time.
2. A situation that does not change.

SUMMARY

- An equation of the form $ax + by + c = 0$, where a, b and c are real numbers, such that a and b are not both zero, is called a linear equation in two variables.
- A linear equation in two variables has infinitely many solutions.
- The graph of every linear equation in two variables is a straight line.
- $x = 0$ is the equation of the y-axis and $y = 0$ is the equation of the x-axis.
- The graph of $x = a$ is a straight line parallel to the y-axis.
- The graph of $y = a$ is a straight line parallel to the x-axis.
- An equation of the type $y = mx$ represents a line passing through the origin.

- Every point on the graph of a linear equation in two variables is a solution of the linear equation. Moreover, every solution of the linear equation is a point on the graph of the linear equation.

■ BLUEPRINT FOR ACHIEVEMENT TEST

BLUEPRINT **SOLO Level wise structure for Achievement Test** **For the Chapter – 4 L. E. In Two Variables; MM – 25 Time – 30 minutes**			
SOLO Level	**About Content**	**Q. No. & Marks/Q**	**Total Mark**
 **Pre-structural**	Linear equation in one variable	Q-1 [M-1] Q-2(1 & 2) [M-1]	3
Uni-structural	Linear equation in two variables (variables, coefficients, constants, standard form of an equation)	Q-3(a & b) [M-1.5] Q-4 [M-4] Q-5 [M-3]	10
 **Multi-structural**	Solutions of a linear equation in two variables	Q-6 (a) [M-2] Q – 7 [M-½]	2½
 **Relational**	Linear equation and a graph	Q-6 (b) [M-4] Q-8 [M-2½]	6½
 **Extended Abstract**	Linear equation from a graph and concept arrangement	Q-9 [M-1½] Q-10 [M-1½]	3
		Total	**25**

Instructions For Test:

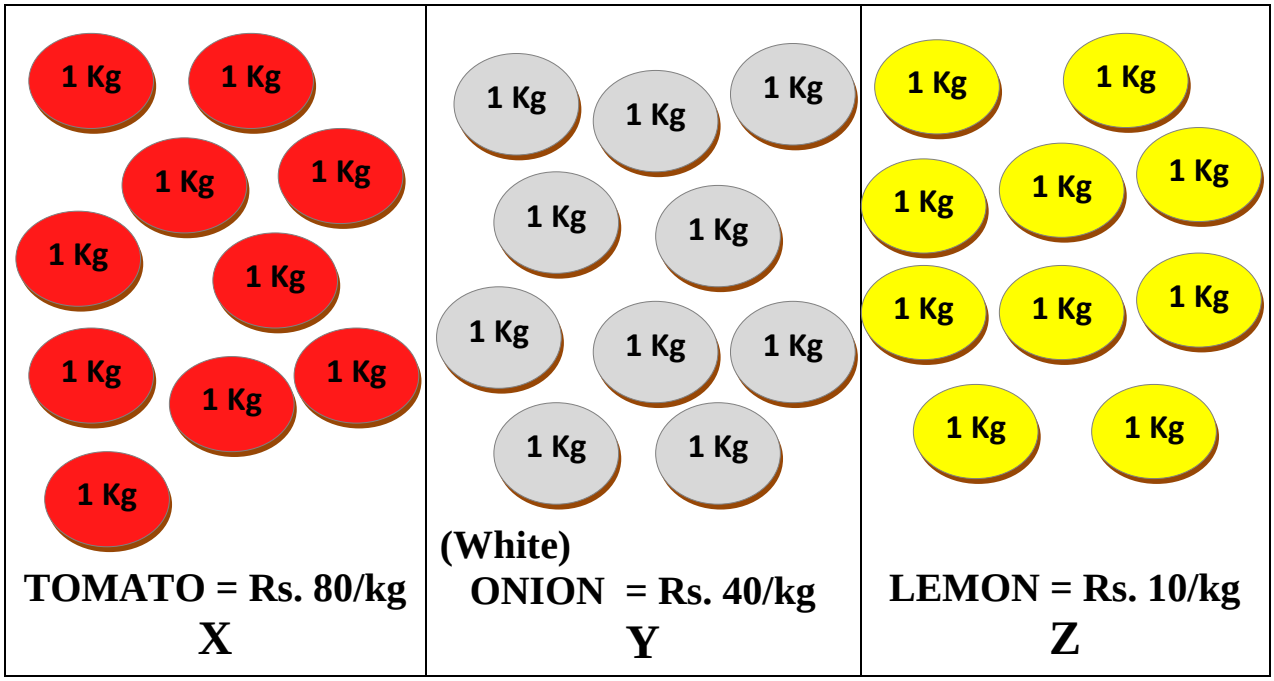
1. First write down your name, your roll number, name of school, date and standard in appropriate place given on the sheet.
2. First read all the questions carefully.
3. All the questions are compulsory. Write it with good handwritings.
4. It's a question cum answer sheet, so all the answers you have to write in this sheet at appropriate place.
5. Ask for the separate sheet for the rough work or as supplementary.
6. Draw neat and clean figures wherever it is required.

■ ACTIVITIES ARE AS FOLLOWS (from next page):

●●●●●● **END OF UNIT PLAN - 2** ●●●●●●

MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

ACTIVITY -1 (Class Activity): VEGETABLE VENDOR
(Understanding On Linear Equation In One & Two Variables)



Vegetable Vendor: **Two or three students will play the role of seller & money collector for the task of selling three vegetable items as shown in the above table.**

Vegetable Buyers: **Other students will be divided into groups of 3 – 4 students and play the role of buyers. Some amount will be given to groups.**

Guidelines:

- Only one Indian currency note (not real) of Rs. 10/-, 20/-, 50/- or 100/- will be given to the groups to purchase the vegetable item/s.
- All the groups have to purchase any one or maximum two vegetable items from the three items according to amount given to their respective group.
- All the groups have to buy vegetable item/s within the amount given to them (to utilize the full amount).
- No amount will be returned by the vendor as a change or remainder.

Discussion:

All the sell-report (total& item-wise) in terms of Kgs & Rs. will be collected (from vendor) by instructor and it will not be disclosed to the groups. Then instructor will put the questions for the discussion as: "Total earning from tomato and onion is Rs. 280/- . Then, how many Kgs. of tomato and onion were sold by a vendor?" So table will be created with various solutions and general form will be formed as Rs. 80 * (?) + Rs. 40 * (?) = Rs. 280. Then, variables like X, Y, Z will be introduced to modify the mathematical expression as:

Rs. 80 * X + Rs. 40 * Y = Rs. 280 OR 80x + 40y = 280 is called the Linear Equation in two variables. In the same way, all the groups will form Linear Expression/s according to items purchased by them.

MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

CLASS WORKSHEET - 1: FRAMING EQUATIONS
(Framing Linear Equation In Two Variable)

Name & Roll no. of Student : _____

Date: _____ Std. : _____ School : _____

Exercise–1: This is related with Activity-1 (Vegetable Vendor). Answer the following questions related with your group task conducted during Activity-1. Accordingly frame the Linear Equation in two variables and write down in the given box.
(Rates: Tomato = Rs. 80/kg; Onion =Rs. 40/kg; Lemon =Rs. 10/kg)
(Quantity of the items in kg: Tomato = x; Onion = y; Lemon = z)

A. How many Rupees were given to your group? _____

B. Which items were purchased by your group?

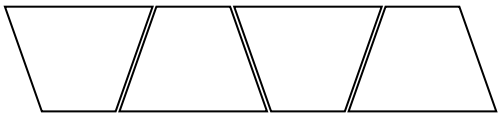
a. Tomato = _____ kg

b. Onion = _____ kg

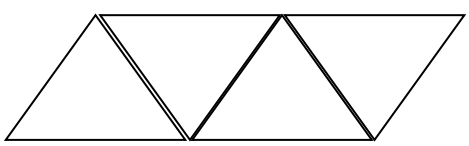
c. Lemon = _____ kg

Write down the Equation here:

Exercise–2: Following picture is about some pattern of joint figures made from sticks/lines. Count the sticks/lines used for first figure and respectively other joint figures and based on that frame the corresponding Linear equation in two variables.
(Use variables as for Lines= L/l, Triangles= T/t, Quadrilaterals=Q/q).



Write down the Equation here:



Write down the Equation here:

****

MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

ACTIVITY – 2: CURRENCY NOTES
(Identifying/ Learning about Variables, Coefficient, Constant)

Name & Roll no. of Student : _____

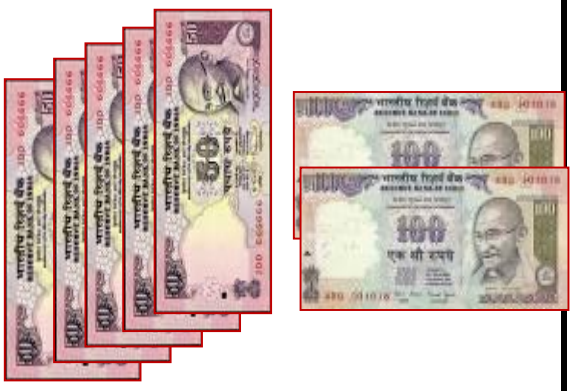
Date: _____ **Std. :** _____ **School :** _____

In the given picture, two sets of some currency notes of India are given. You have to select no. of notes of only one kind from each set to make the total of Rupees 200/-. Make possible combination and show it in the following table.

SET – 1

5 Notes of Rs. 20/- **5 Notes of Rs. 10/-**

SET – 2



5 Notes of Rs. 50/- **2 Notes of Rs. 100/-**

No.	X Set-I Select no. of notes (Rs. 20 or Rs. 10)	Y Set-II Select no. of notes (Rs.50 or Rs.100)	Total Rs.	In your case (Rs. Or No.)		Express as L.E. in ax + by = c For each combination
				Variable	Coefficient	
1.	Rs. ___ No.: ___	Rs ___ No.: ___	**200**			
2.	Rs ___ No.: ___	Rs ___ No.: ___	**200**			
3.	Rs ___ No.: _0__	Rs ___ No.: ___	**200**			
4.	Rs ___ No.: ___	Rs ___ No.: ___	**200**			
5.	Rs ___ No.: ___	Rs ___ No.: ___	**200**			
6.	Rs ___ No.: ___	Rs ___ No.: ___	**200**			
7.	Rs ___ No.: ___	Rs ___ No.: ___	**200**			
8.	Rs ___ No.: ___	Rs ___ No.: ___	**200**			

- How many maximum combinations are possible? _____

****

MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

CLASS WORKSHEET – 2 : STANDARD FORM
(Standard form of L. E. , identification of Coefficients & Constants)

Name & Roll no. of Student : _____

Date: _____ Std. : _____ School : _____

Fill in the following entries:

No.	Linear Equation	Write in ax + by + c = 0	Coefficient of x	Coefficient of y	Constant term
1	**2x + 3y = 5**				
2	**3x -2y = 7**				
3	**4x = 9**				
4	**-3x + 5y = -8**				
5	**5x + 7y = -9**				
6	**3y = -7**				
7	**4x = -9**				

****

MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

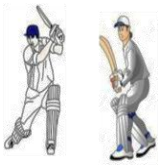
ACTIVITY – 3: SOLVING AN EQUATION
(Learning to find the Solutions of a L. E. In two variables)

Name & Roll no. of Student : _____

Date: _____ **Std. :** _____ **School :** _____

Example - 1

In one of the one day match, two Indian batsman together scored 125 runs. Guess at least five possible solutions in terms of runs scored by each batsman with the help of following equation.



m + n = 125,
Where,
m = runs scored by batsman1
n = runs scored by batsman2

No.	Solutions		Coordinates (m, n)
	m	n	
1			
2			
3			
4			
5			

Example - 2

No.	Solutions		Coordinates (x, y)
	x	y	
1			
2			
3			
4			
5			

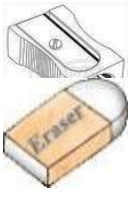
Roma and Rohit saved their pocket money in the moneybag. Total is Rupees 85/- in the money bag. So now guess how much is saved by each with reference to the following equation.

2 x + y = 85,
Where,
x = money saved by Roma
Y = money saved by Rohit

Example - 3

A store sells sharpener at Rs. 5/- and eraser at Rs. 2/- . Following equation is true and find out 5 possible solution.

5s + 2e = 39,
Where,
s = number of sharpener sold
e = number of eraser sold

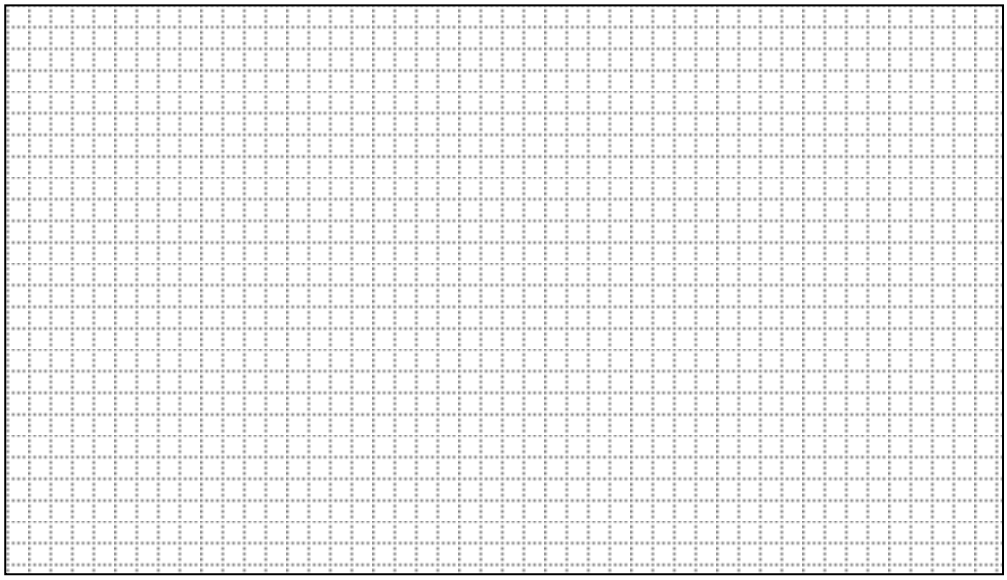


No.	Solutions		Coordinates (s, e)
	s	e	
1			
2			
3			
4			
5			

(continue….)

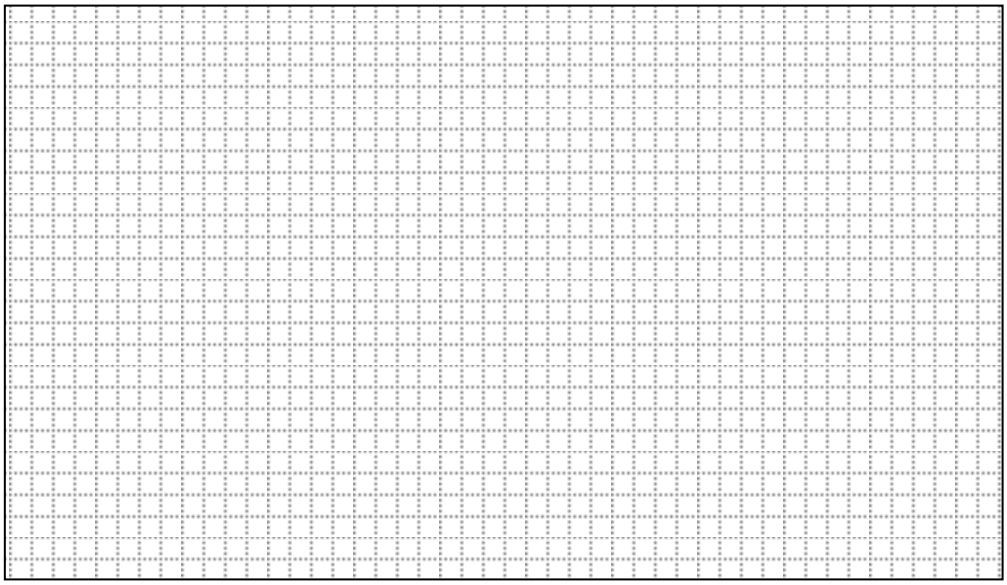
ACTIVITY – 4 : PLOTTING GRAPH

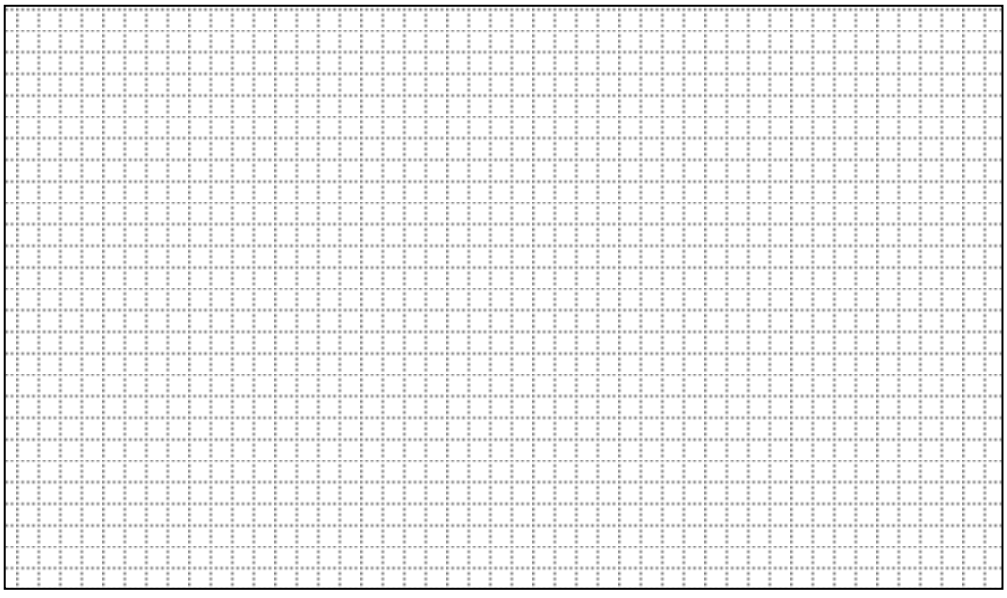
(Drawing Graph From The Solutions Of L.E. In Two Variables)



Plot a Graph for solutions obtained in Example–1.

Plot a Graph for solutions obtained in Example-2.





Plot a Graph for solutions obtained in Example–3.

****

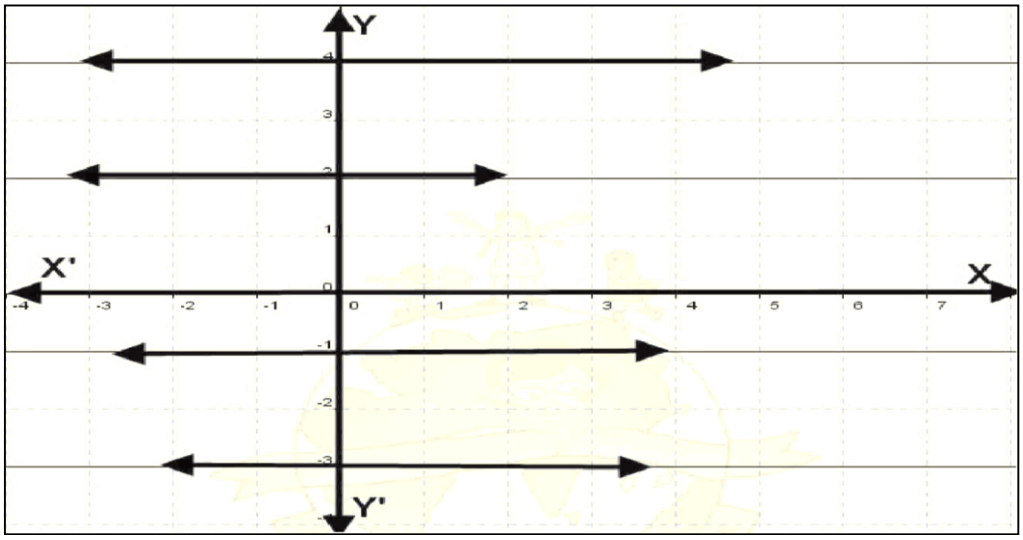
MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

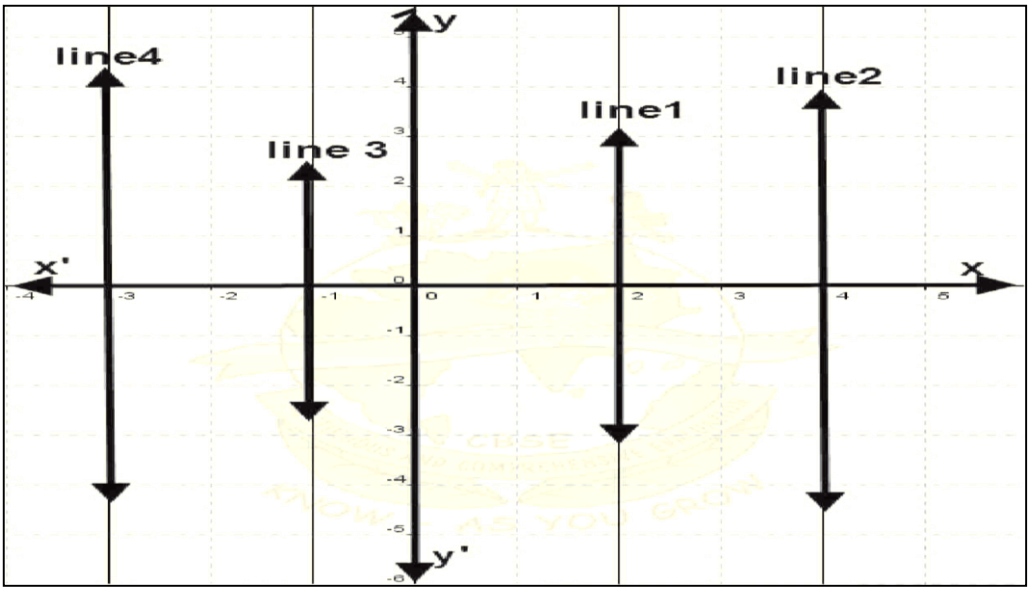
ACTIVITY – 5 : GRAPHS
(Learning of Graphs Parallel / Perpendicular to X-axis and Y-axis; Identifying Linear Equation from given Graph)

Name & Roll no. of Student : _____

Date: _____ Std. : _____ School : _____

Study the following graphs and write down your observations on the backside of this page. Also frame the Linear Equation for each line of both the graphs.





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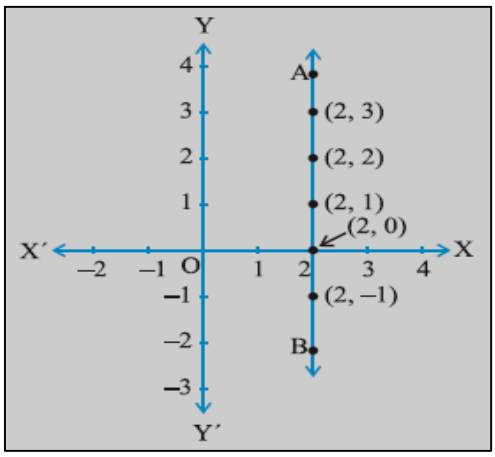
MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

ACTIVITY – 6: EQUATIONS FROM GRAPHS
(Framing/Identifying Linear Equation in Two Variables from given Graph)

Name & Roll no. of Student : _____

Date: _____ **Std. :** _____ **School :** _____

Ex – 1: Observe the following graphs and write down X and Y coordinates in the given tables. Based on these values (are the solutions of the L,E. in two variables), identify (put √) an appropriate Linear Equation for the corresponding graphs.

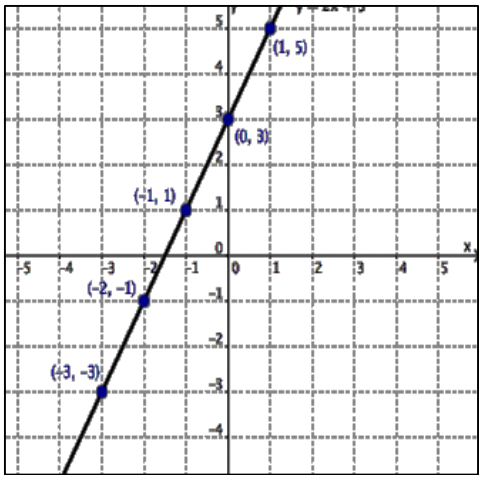


Order Pair	X	Y
(2, 3)	2	3

Identify the L. E. :

(i) x + y = 0 (ii)x= 2

(iii) y = 2x + 4 (iv) y = x – 4



Order Pair	X	Y

Identify the L. E. :

(i) 7y= 2+3x (ii)x = 0

(iii) y = 2x + 3(iv) x= y– 4

Ex – 2: The points on the line are (–1, –2), (0, 0), (1, 2), (2,4). By inspection, frame the equation corresponding to this line of a graph.

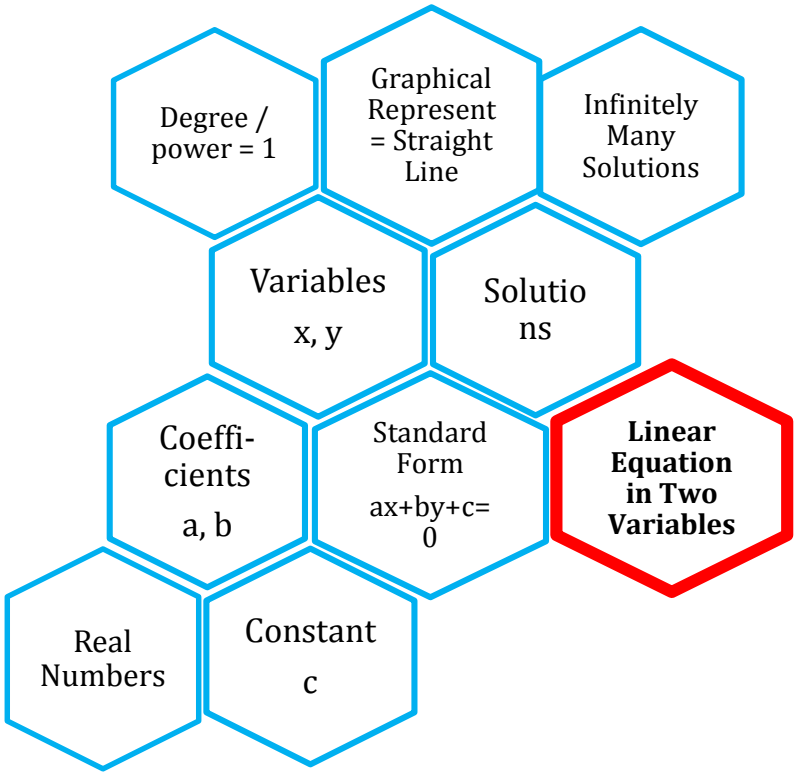
****

MATHEMATICS
CHAPTER – 4: L. E. IN TWO VARIABLES

(Class) ACTIVITY: CONCEPT ARRANGEMENT

Observe the key-terms of the concept related to Linear Equation in two variables and discuss about it in the class with relevant examples and justifications.

1) Standard Form ax+by+c=0
2) Real Numbers
3) Constant c
4) Variables x, y
5) Linear Equation in Two Variables
6) Infinitely Many Solutions
7) Coefficients a, b
8) Solutions
9) Degree / Power = 1
10) Graphical Represent = Straight Line



★★★★★★★★★ END OF ACTIVITIES ★★★★★★★★★

Appendix – B (ii)

Final Draft: POST – TEST

Mathematics Achievement Test: 2014 - 2015

CHAPTER – 4 LINEAR EQUATION IN TWO VARIABLES

Std. :IX **MM : 25 Marks** **Time : 30 minutes** **Date:**

Name of School: **Name of Student:** **Roll No. :**

Q-1 Look at the following figure and write a Linear Equation in one variable. (1)

Write Linear Equation here :

Q-2 Solve the following Equations in one variable. (2)

1) $X + 8 = 3$

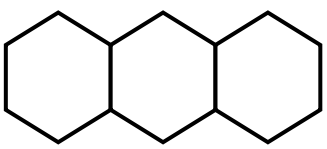
2) $4X + 5 = X - 4$

Q-3 Write a Linear Equation in two variables for each of the following: (3)

(a) Mumtaz has purchased 4 dresses for herself as well 6 dresses for her son and for that, she spend total Rupees 2216/-. Write down a Linear Equation in two variables.

Write Linear Equation here :

(b) Following pattern is made of sticks. For first hexagonal, 6 sticks are used. Then, 11 sticks are used for two hexagonals and so on. Frame the general equation to count the total number of sticks for any number of hexagonals within this pattern.



Write Linear Equation here :

Space For Rough Work

Q-4 Fill the required entries in the following table: (4)

No.	Linear Equation	Write in Standard form ax + by + c = 0	Coefficient of m	Coefficient of n	Constant term
1	**19m = 13n – 7.5**				
2	**-7n = 8**				
3	**31 = 9m**				

Q-5 Based on the given information, fill the entries in the following table: (3)

Rani has scored total 64 marks in a test. The structure of the question paper with the details about types of questions and respective total marks is given as below. Write down three combinations of questions attempted by her and frame the Linear Equation in two variables for the same.

X : Section I: Objective type quesstions
Total No. of Questions (Q) – 25 Total Marks (M) – 25 x 2 = 50
Y : Section II: Descriptive type quesstions
Total No. of Questions (Q) – 10 Total Marks (M) – 10 x 5 = 50

No.	X Section -I Select no. of questions	Y Section -II Select no. of questions	Total Marks	Questions (Q); Marks (M)		Express as Linear Equation in ax + by = c For each combination
				Variable	Coefficient	
1.	Q. ___ M. _2_	Q. ___ M. _5_	**64**	**Q**	**M**	
2.	Q. ___ M. _2_	Q. ___ M. _5_	**64**	**M**	**Q**	
3.	Q. ___ M. _2_	Q. ___ M. _5_	**64**	**Q**	**M**	

Q-6 Find (a) five solutions for a given equation and then (b) plot a graph. (2+4)

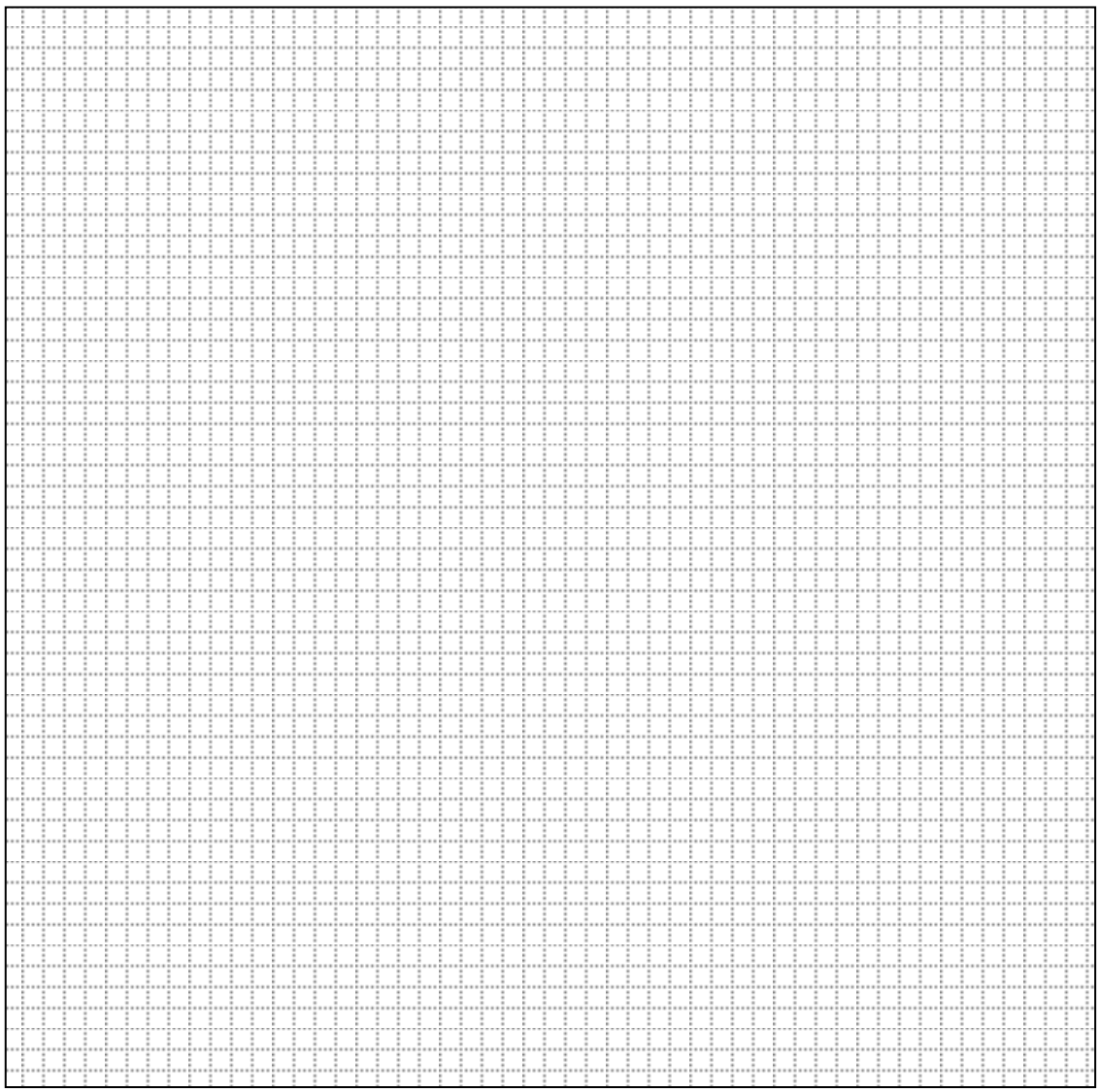
For a particular show of a movie, a cost of a ticket for an adult is ₹. 50/- and for a child is ₹. 20/-. The total amount collected from that particular show is ₹. 2000/-. Find five solutions for the number of tickets sold for each.

50x + 20y = 2000,

Where,
x = number of tickets for an adult sold
y = number of tickets for a child sold

No.	Solutions		(x, y)
	x	y	
1			
2			
3			
4			
5			

Space For Rough Work



Q-7 For a given equation 3x + 2y = 24, determine that ordered pair (4, 6) is one of the solution of an equation. (½)

Q-8 Mention about the following statements whether are True or False: (2½)

(a) y = 0 is an equation of x-axis. _____

(b) A Linear equation in two variables has only some finite solutions. _____

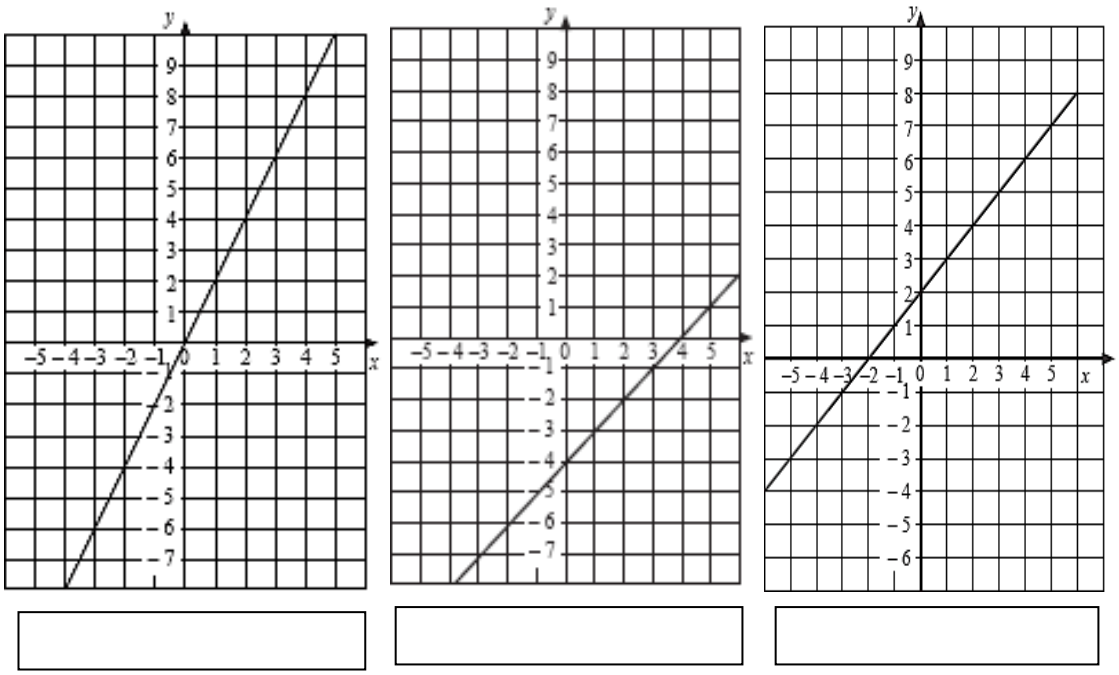
(c) The graph of x = a is a straight line parallel to the x-axis. _____

(d) The graph of every linear equation in two variables is a straight line._____

(e) y = mx represents a line passing through the origin. _____

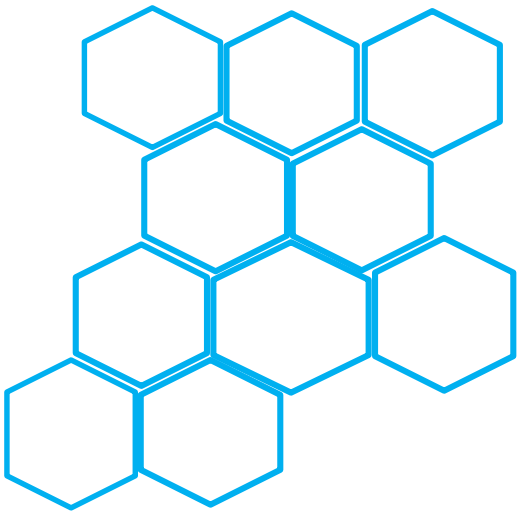
Q-9 Identify the appropriate equations from given options and write down in the boxes given below the respective graphs. (1½)

(Options : (i) x = 2; (ii) y = 2x; (iii) y = 4x – 3; (iv) y = x – 4; (v) y = x + 2)



Q-10 Fill the hexagonal shapes with appropriate key-words given below: (1½)

1) Standard Form ax + by + c = 0
2) Real Numbers
3) Constant c
4) Variables x, y
5) Linear Equation in Two Variables
6) Infinitely Many Solutions
7) Coefficients a, b
8) Solutions
9) Degree / Power = 1
10) Graphical Represent = Straight Line



●●●●●ALL THE BEST ●●●●●

Appendix – B (iii)

Final Draft

REACTION - REFLECTION SHEET

2014 – 2015

Name of Student: _____ **IX** Roll No

Name of School: _____

► **Put tick-marks at appropriate option/s (a, b, c, or d):**

Chapter – 4 Linear Equation In Two Variables		
SOLO Levels	**Item No.**	**Item-Statements About My Learning Experiences and Achievements**
●	**I-1)**	**Whether I have participated in an Activity-1 on 'Vegetable Vendor'?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	I-2)	**How was an Activity-1 (in general)?**
	a)	Entertaining only
	b)	Real life based example/situation to understand the concept of L. E. in two variables
	c)	Easy to understand but not relevant with the said concept/topic
	d)	Not appropriate for the grade- IX
	I-3)	**How was this Activity-1 for me ?**
	a)	Interesting & Just enjoyed
	b)	Not understood by me
	c)	Made easy to understand the topic of L.E. in two variables and its elements
	d)	No comments
	I-4)	**What I have learnt from this Activity-1 ?**
	a)	Really, learnt about what the means of variables, coefficients, solutions of a L. E. within one activity only
	b)	Just enjoyed the concept/activity of 'sell-purchase'
	c)	It was a small group activity so I was just a spectator in my group
	d)	Nothing
I	**I-5)**	**Whether I have solved a Worksheet given as an Activity – 2 on "Currency Notes"?**
	a)	Yes
	b)	No
	I-6)	**What I have learnt or understood from an Activity-2? Let me mark.**
	a)	Just making the combinations of currency notes given in Set I & II
	b)	Learnt to differentiate the Variables & Coefficients
	c)	Learnt to frame the Mathematical expressions i.e. L. E. in two variables
	d)	Not appropriate activity according to my learning
III	**I-7)**	**Whether I did an Activity-3 on "Solving Equations" to find/ understand the various solutions of a L. E. in two variables?**
	a)	Yes
	b)	No as I was absent in school/engaged with other school-activity
	I-8)	**How was an Activity-3 for me ?**

	a)	Clearly understood by me that what do mean by the solutions of a L. E.
	b)	Activity was not appropriate
	c)	Difficult Activity and not understood by me
	d)	No Comments
	I-9)	**Whether I have participated in an Activity-4 on "Plotting Graphs" based on the solutions of a L. E. in two variables?**
	a)	Yes
	b)	No as I was absent in school/engaged with other school-activity
	**I-10)**	**How I found this Activity-4 for me ?**
	a)	Appropriate to practise the plotting graphs based on the solutions of a L. E.
	b)	I was feeling difficult as things were not clear to me
	c)	Confused with the given examples on L.E.
	d)	Unable to comment
	I-11)	**My Learning experience from Activity-5 & 6 on observing "Graphs" based on the parallel/perpendicular lines as well framing the Linear Equations from the graphs was :**
	a)	Interesting to learn about to think for the L. E. of given lines on graphs
	b)	Non-interesting
	c)	Felt difficulties in how to frame L. E. for a straight line given in the graphs
	d)	Honestly I succeeded to frame L. E. for the straight lines given on the graphs
	I-12)	**'Concepts/topics arrangement through the Hexagonal shapes, helped me to understand thoroughly the concepts of L. E. in two variables**
	a)	Yes-Innovatively & more than my expectations
	b)	I am not clear with this exercise
	c)	I feel, it's an useless exercise
	d)	Don't' know
	I-13)	**Whether my Knowledge/Understanding have been improved?**
	a)	Yes but little
	b)	Yes and more
	c)	Unable to say
	d)	No/Not much
	I-14)	**What I felt about this way of learning & understanding process rather than the regular learning process?**
	a)	Total activity based
	b)	Traditional/Regular
	c)	Innovative
	d)	Unable to say
(What) I liked Most :		
(What) I don't liked:		
Your General Comments (About Instructor, Teaching-learning process, Remarks/ Improvements, Suggestions...):		

●●●●●●◆◆◆◆◆◆**HOPE ENJOYED THE LESSON**◆◆◆◆◆

APPENDIX – C

PLAN FOR
CHAPTER – 8 QUADRILATERALS

- **Unit Plan For A Chapter**
- **Achievement Test (Post-test) For A Chapter**
- **Reaction-Reflection Sheet For A Chapter**

Appendix – C(i)

S.O.L.O. TAXONOMY BASED INSTRUCTIONAL STRATEGY

UNIT PLAN - 3

CHAPTER – 8 QUADRILATERALS

■ Topics Of A Chapter In A Mathematics Class-IX Textbook

- Introduction
- Angle Sum Property of a Quadrilateral
- Types of Quadrilaterals
- Properties of a Parallelogram
- Another Condition for a Quadrilateral to be a Parallelogram
- The Mid-point Theorem
- Summary

■ SOLO Level-wise Concept/ Conceptual Mapping

SOLO Levels	Learning Points / Concepts / Topics
 Pre-structural	• Previous knowledge about Triangles as diagram made from three points, properties of Triangles • To get the ideas about various diagrams made by using four end points, four straight lines and having four angles as well sum of the measure of all the angles is 360° • Examples /Activities
 Uni-structural	• To identify the Quadrilateral as closed figure made with four vertices, four sides and four angles. • To learn about various types of Quadrilaterals • More Examples / Activities
 Multi-structural	• To get more understanding on various types of Quadrilaterals based on various Properties of sides, diagonals and angles • To differentiate the Quadrilaterals as family of Parallelogram and Non-Parallelogram– with the statements of Theorems 8.1 & 8.8 • More Examples / Exercises / Activities
 Relational	• To Understand the Theorems - 8.2 to 8.10 • To Calculate the areas of Square & Rhombus ; Rectangle & Parallelogram etc. • Examples / Exercises / Activities
 Extended Abstract	• To understand the area-differences of Square & Rhombus; Rectangle & Parallelogram etc. • Quadrilaterals based Tangrams • To know about other Quadrilaterals like Concave and Crossed Quadrilaterals • Activity / Examples

■ SOLO Level-wise Instructional Objectives

Pre-structural

1) Students having knowledge about the basic geometrical shapes.
2) Students having understanding about the triangles and its properties.
3) Students know how to make closed figures using four vertices and four lines.

Uni-structural

1) Students will be able to recognise a Quadrilateral as a closed figure made with four vertices, four sides and four angles.
2) Students will be able to identify several types of Quadrilaterals.
3) Students will be able to state the name of various Quadrilaterals
4) Students will be able to tell some real life examples of Quadrilaterals.

Multi-structural

1) Students will be able to examine the various Quadrilaterals with respect to its sides, angles and diagonals.
2) Students will be able to construct various Quadrilaterals based on their properties.
3) Students will be able to explain about the two families of the Quadrilaterals as parallelograms and non-parallelograms.

Relational

1) Students will be able to demonstrate their understanding on the properties of the parallelograms and non-parallelograms.
2) Students will be able to observe and relate the Quadrilaterals with triangles as sub-parts of it.
3) Students will be able to apply the knowledge of diagonals to divide a quadrilateral into triangular sub-parts.
4) Students will be able to analyse the differences between the shapes of square and rhombus as well as rectangle and parallelogram.

Extended Abstract

1) Students will be able to visualize the differences between the calculated areas of a square and rhombus as well as a rectangle and parallelogram.
2) Students will be able to judge the applications of Quadrilaterals in creating figures of Tangram.
3) Student will be able to invent knowledge at their level about the Concave and Crossed Quadrilaterals.

■ METHODOLOGY

Method : Activity based and Heuristic Method

Approach : Inductive and Inducto-deductive

Media : Chalk/White board, Roller board, Charts (as shown below), Tablet-PC

Materials : SOLO Worksheets, Card boards, Thread, Geometrical box, other materials were used as shown in the figures of Photo-gallery-1(Appendix-G).

■ LESSON - PLAN

Day No.	Date	Day	Time (am)	Content Details	Settings	SOLO Level
1.	25/11/2014	Tue	08:30 – 09:10	**Activity – 1 Diagrams with four lines** **Activity–2 Identifying (Types of) Quadrilaterals** **Discussion** **(In worksheet, places with dots given to draw the figures having four end-points and four sides then name it)** **(In worksheet, a picture made of quadrilaterals given in terms to identify quadrilaterals)**	Individual	
				Topics Covered: Closed figures with four lines-Quadrilaterals Various types of Quadrilaterals		
				Questioning & Probing: a) From the figures, which are the things you have observed in terms of shapes, sides and angles?		
				Home Task: List the quadrilateral objects in our day to day life		
2.	02/12/2014	Tue	08:30 – 09:10	**Activity – 3 Who am I?** **Discussion** **(Cut & paste activity-in worksheet, properties of various quadrilaterals given. Then to identify it and accordingly cut the quadrilaterals from coloured papers and paste it at the appropriate place)**	Individual	
				Topics Covered: Properties of various quadrilaterals		
				Questioning & Probing: b) How many quadrilaterals we took to study? Name it? c) Discuss the properties of the quadrilaterals. d) Which are the similarities and differences in the properties have you find in various quadrilaterals? e) How can we segregate the quadrilaterals in terms of any criteria?		

				Home Task: Read this chapter from a textbook		
3.	03/12/2014	Wed	08:55 – 09:35	**Activity – 4 Is it a Parallelogram?** **(Cut & Paste activity- A colourful sheet with figures of quadrilaterals given to cut the quadrilaterals into two triangles to check whether two triangles are congruent or not and paste it as per the instructions at appropriate places)** Topics Covered: Quadrilaterals as parallelograms and non-parallelograms; properties of the parallelograms; and Diagonals of Quadrilaterals Questioning & Probing: f) How was this practical activity? g) In which two categories have you divided the quadrilaterals? h) What was the base or basic criteria to categorise the quadrilaterals? i) Derive the properties of the parallelograms. Home Task: Read the theorems from 8.1 to 8.8 and write down the statements of all the theorems.	Individual	
4.	04/12/2014	Thurs	08:30 – 09:10	**Class Worksheet – 1 Venn Diagram1** **Class Worksheet – 2 Venn Diagram2** Topics Covered: Differentiating parallelogram and non-parallelogram according to various properties; Families of Quadrilaterals Questioning & Probing: j) Discussion on queries raised by the students Home Task: Write down all the properties of both kind of quadrilaterals	Individual	
5.	05/12/2014	Fri	08:30 – 09:10	**Class Work – Finding Areas and Perimeter; Discussion on Formulas and Heron's Formula** **(Worksheet given with examples in term to find the area and perimeter of given quadrilaterals, Revision on the**	Class And Group	

				application of Heron's Formula that previously learnt in chapter-12)		
				Topics Covered: Diagonals of the quadrilaterals, Dividing Quadrilaterals into small triangular or other shaped parts, To find the area and perimeter of any Quadrilateral by using various formulas, Heron's formula for finding the area of Quadrilaterals		
				Questioning & Probing: k) Discussion on various formulas as well how and when to use in terms to find the area of Quadrilaterals.		
				Home Task: Solve exercise-8.1		
6.	06/12/ 2014	Sat	08:30 – 09:10	**Activity – 5 Comparisons** **(Worksheet to solve based on the comparisons for several aspects like sides, angles, diagonals and shapes on several Quadrilaterals)**	Individual	
				Topics Covered: More about Quadrilaterals based on properties and Theorems		
				Questioning & Probing: l) Discuss about an activity you did now.		
				Home Task: Solve exercise-8.1		
7.	09/12/ 2014	Tue	08:30 – 09:10	**Discussions on other types of Quadrilaterals;** **Class work – Finding Areas and Perimeter of same sized** **(Worksheet given to study Concave and crossed type of quadrilaterals. Also to discuss about isosceles trapezium)**	Class And Individual	
				Topics Covered: Concave and crossed Quadrilaterals, Trapeziums, Area differences of same sized square & rhombus as well rectangle & parallelogram		
				Questioning & Probing: m) What to say about other figures closed with four lines?		

				n) Discuss the differences between trapezium and isosceles-trapezium. o) Discuss about the conclusion derived on differences in area and perimeter of said quadrilaterals.		
				Home Task: Complete Exercise-8.1 and 8.2		
8.	10/12/2014	Wed	08:55 – 09:35	**Activity – 6 Craft Activity** **Class-Activity: Concept Arrangement** **(Activity on concept arrangement using hexagonal shaped toy-alphabets)**	Class & Individual	
				Topics Covered: Recap on all concepts of the chapter-Quadrilaterals; Activity on Quadrilaterals based 'Tangram'		
				Questioning & Probing: p) Probing related to class activity on concept arrangement.		
				Home Task: Complete the Exercise-8.2		
9.	12/12/2014	Fri	08:30 – 09:10	**Achievement Test For Chapter – 8**		
				Feedback using SOLO Reflective-Reaction Sheet		

■ IMPORTANT POINTS FOR EXPLANATION & LEARNING

Theorems in a chapter:

Theorem 8.1: A diagonal of a parallelogram divides it into two congruent triangles.

Theorem 8.2: In a parallelogram, opposite sides are equal.

Theorem 8.3: If each pair of opposite sides of a quadrilateral is equal, then it is a parallelogram.

Theorem 8.4: In a parallelogram, opposite angles are equal.

Theorem 8.5: If in a quadrilateral, each pair of opposite angles is equal, then it is a parallelogram.

Theorem 8.6: The diagonals of a parallelogram bisect each other.

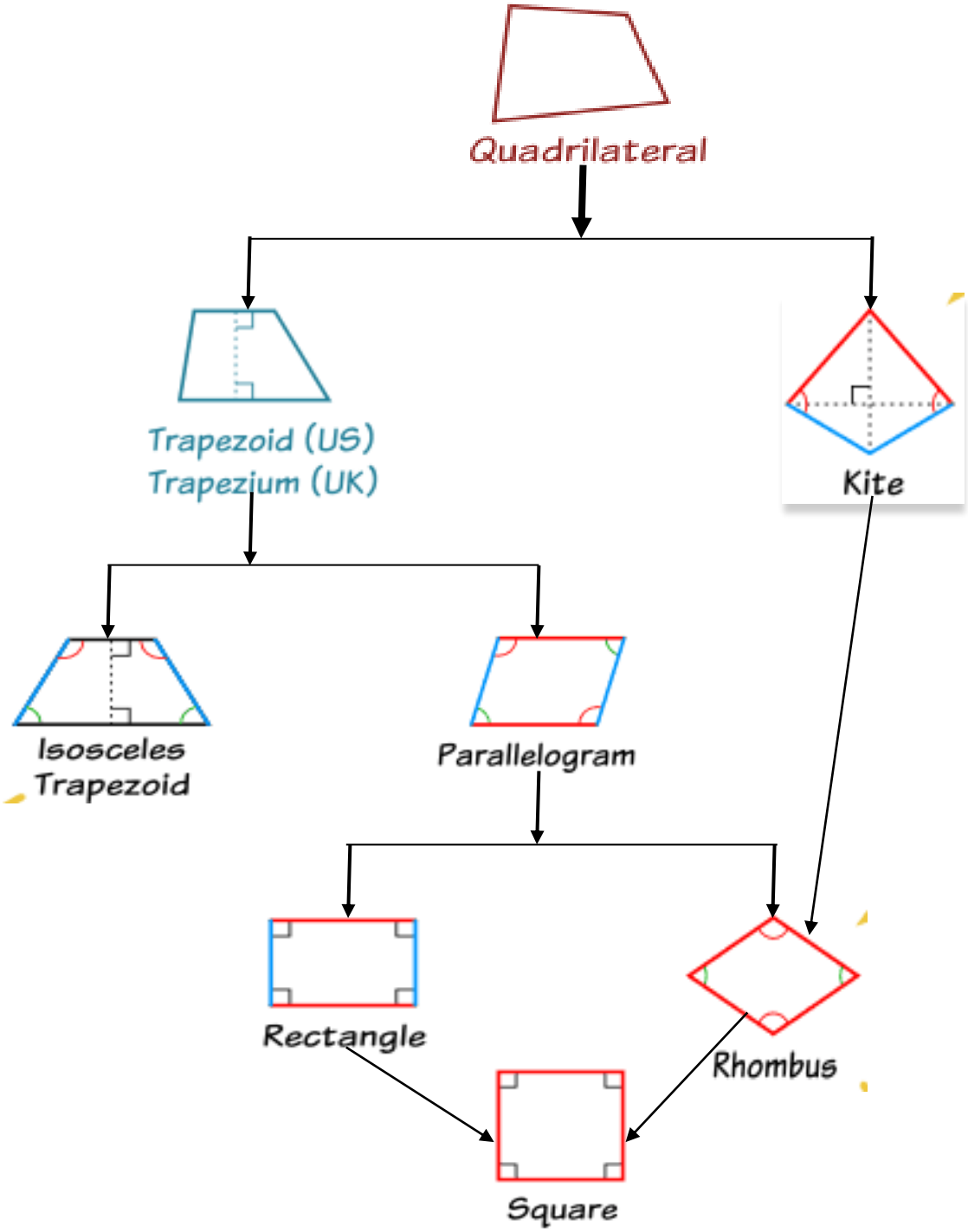
Theorem 8.7: If the diagonals of a quadrilateral bisect each other, then it is a parallelogram.

Theorem 8.8: A quadrilateral is a parallelogram if a pair of opposite sides is equal and parallel.

Theorem 8.9: The line segment joining the mid-points of two sides of a triangle is parallel to the third side.

Theorem 8.10: The line drawn through the mid-point of one side of a triangle, parallel to another side bisects the third side.

CHART PAPER: FLOW CHART FOR FAMILY OF QUADRILATERALS



Formulas:

- Rectangle
  - (a) Area = length × breadth
  - (b) Perimeter = 2 × (length + breadth)
  - (c) Diagonal = $\sqrt{(\text{length})^2 + (\text{breadth})^2}$
- Square
  - (a) Area = $(\text{side})^2$
  - (b) Perimeter = 4 × side
  - (c) Diagonal = $\sqrt{2}$ × side

- Triangle with base (b) and altitude (h)

  Area = ½ × b× h
- Triangle with sides as a, b, c

  (a) Semi-perimeter = (a+b+c) / 2 = s

  (b) Area = $\sqrt{s(s-a)(s-b)(s-c)}$ (Heron's Formula)
- Isosceles triangle, with base a and equal sides b

  Area of isosceles triangle = a/4 × $\sqrt{4b^2 - a^2}$
- Equilateral triangle with side a

  Area = $\sqrt{3}$/4 × a^2
- Parallelogram with base b and altitude h

  Area = b×h
- Rhombus with diagonals d_1 and d_2

  (a) Area = ½ × d_1× d_2

  (b) Perimeter = $\sqrt{d1^2 + d2^2}$
- Trapezium with parallel sides a, b and the distance between two parallel sides as h.

  Area = ½ ×(a + b) × h
- Regular hexagon with side a

  Area = 6 × Area of an equilateral triangle with side a

  = 6×$\sqrt{3}$/4 × a^2 = 3/2 ×$\sqrt{3}$×a^2

Quadrilateral Properties

D I A G O N A L S	Isosceles Trapezoid	Kite	Parallel ogram	Rhombus	Rectangle	Square
Diagonals Bisect Each Other	--	--	Y E S	Y E S	Y E S	Y E S
Diagonals Are Equal	Y E S	--	--	--	Y E S	Y E S
Diagonals Meet At Right Angles	--	Y E S	--	Y E S	--	Y E S
P A R A L L E L S I D E S	Isosceles Trapezoid	Kite	Parallel ogram	Rhombus	Rectangle	Square
Only 2 Sides Are Parallel	Y E S	--	--	--	--	--
No Sides Are Parallel	--	Y E S	--	--	--	--
Both Pairs of Opposite Sides Are Parallel	--	--	Y E S	Y E S	Y E S	Y E S
E Q U A L S I D E S	Isosceles Trapezoid	Kite	Parallel ogram	Rhombus	Rectangle	Square
Only 2 Sides Are Equal	Y E S	--	--	--	--	--

Both Pair of Adjacent Sides Are Equal But No Opposite Sides Are Equal	--	Y E S	--	--	--	--
Both Pair of Opposite Sides Are Equal	--	--	Y E S	Y E S	Y E S	Y E S
All Four Sides Are Equal	--	--	--	Y E S	--	Y E S
A N G L E S	Isosceles Trapezoid	Kite	Parallel ogram	Rhombus	Rectangle	Square
Both Pairs of Base Angles Are Equal	Y E S	--	--	--	--	--
Non-Vertex Angles Are Equal	--	Y E S	--	--	--	--
Only Opposite Angle Pairs Are Equal	--	--	Y E S	Y E S	--	--
All Four Angles Are Right Angles	--	--	--	--	Y E S	Y E S

(Source:

■ BLUEPRINT FOR ACHIEVEMENT TEST

BLUEPRINT **SOLO Level wise structure for Achievement Test** **For the Chapter – 8 Quadrilaterals; MM – 25 Time – 30 minutes**			
SOLO Level	**About Content**	**Q. No. & Marks/Q**	**Total Mark**
 **Pre-structural**	Diagrams closed with four end points, four straight lines	Q-1 [M-2]	2
 **Uni-structural**	Various types of Quadrilaterals	Q-2 [M-2½] Q-3 [M-3]	5½
 **Multi-structural**	Types of Quadrilaterals based on Properties of sides, diagonals & angles; Quadrilaterals as Parallelogram and Non-Parallelogram	Q – 4 [M-2½] Q-5 [M-5]	7½
 **Relational**	Diagrammatic presentation of Theorems	Q-6 [M-3]	3
 **Extended Abstract**	Area-differences of Square & Rhombus; Rectangle & Parallelogram and Concept Arrangement	Q-7 [M-4] Q-8 [M-3]	7
		Total	**25**

Instructions For Test:

1. First write down your name, your roll number, name of school, date and standard in appropriate place given on the sheet.
2. First read all the questions carefully.
3. All the questions are compulsory. Write it with good handwritings.
4. It's a question cum answer sheet, so all the answers you have to write in this sheet at appropriate place.
5. Ask for the separate sheet for the rough work or as supplementary.
6. Draw neat and clean figures wherever it is required.

■ ACTIVITIES ARE AS FOLLOWS (from next page):

●●●●●●END OF UNIT PLAN -3 ●●●●●●

References

1) http://www.cimt.plymouth.ac.uk/projects/mepres/book9/bk9i5/bk9_5i2.html
2) http://www.educationplanner.org/students/self-assessments/kind-of-student.shtml
3) http://www.superteacherworksheets.com/probability.html
4) https://stsampsonshigh.files.wordpress.com/.../probability-tree-diagrams....
5) On What is Less Certain: The Probability Scale and Hypothetical Meaning, CC3479: The Structure of Modern English http://www.cbs.polyu.edu.hk/ctyjiang/_file/notes_new/_3479/8.htm
6) http://www.mathsisfun.com/data/probability-tree-diagrams.html
7) http://www.onlinemathlearning.com/theoretical-probability.html
8) http://www.superteacherworksheets.com/probability.html
9) Probability Tree Diagrams (http://www.mathsisfun.com/data/probability-tree-diagrams.html)
10) The Basic Counting Principle, http://www.mathsisfun.com/data/basic-counting-principle.html

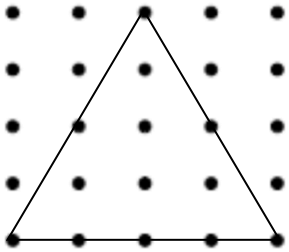
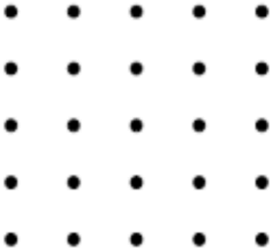
MATHEMATICS
CHAPTER – 8: QUADRILATERALS

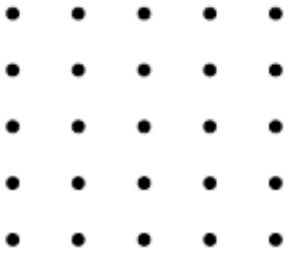
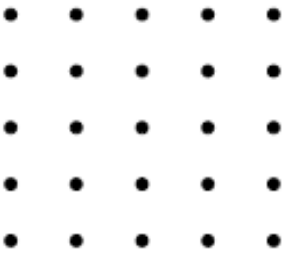
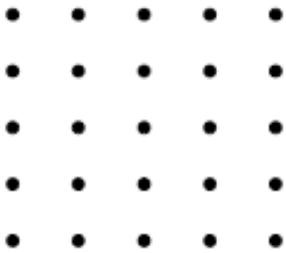
ACTIVITY – 1: DIAGRAMS WITH FOUR LINES
(Making Closed Figures With Four Lines - Quadrilaterals)

Name & Roll no. of Student : _____

Date: _____ **Std. :** _____ **School :** _____

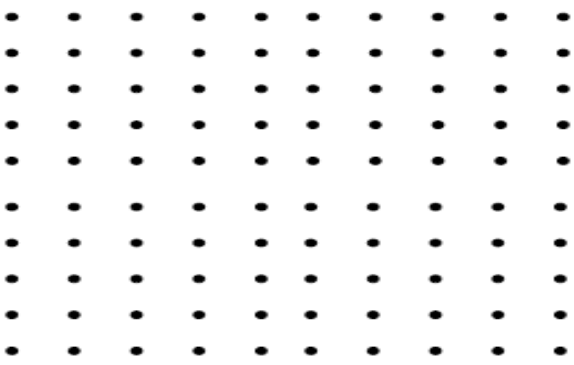
Quadrilateral : Is a closed figure/diagram consisting of four straight lines, four end points, four angles and sum of all angles is 360 degree. Draw any five Quadrilaterals using following dots & write the correct name of Quadrilateral below the respective figure.

		
TRIANGLE (Figure with three Lines)		

Activity – 1 (b) : RANGOLI

Here 10x10 Dots matrix is given. Using this matrix as well using only Quadrilaterals, make your favourite & good Rangoli design.



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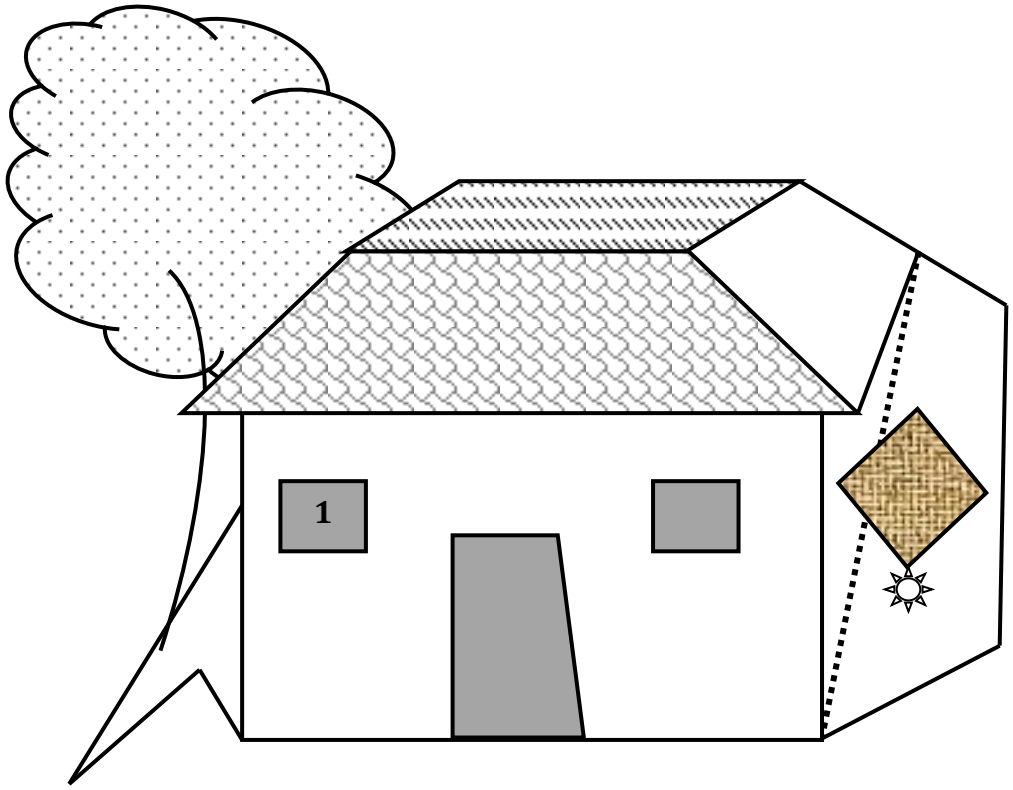
MATHEMATICS
CHAPTER – 8: QUADRILATERALS

ACTIVITY – 2 : IDENTIFYING QUADRILATERALS
(Learning Various Types Of Quadrilaterals)

Name & Roll no. of Student : _____

Date: _____ **Std. :** _____ **School :** _____



Activity: Above figure is designed with various types of Quadrilaterals. Identify those Quadrilaterals, assign appropriate numbers in the figure and write down the name of Quadrilaterals besides the following numbers as below.

1. Square	**8.**
2.	**9.**
3.	**10.**
4.	**11.**
5.	**12.**
6.	**13.**
7.	**14.**

****

MATHEMATICS
CHAPTER – 8: QUADRILATERALS

ACTIVITY – 3: WHO AM I ?
(Knowing Properties of Various Quadrilaterals)

Name & Roll no. of Student : _____

Date: _____ **Std. :** _____ **School :** _____

Do as directed by the Instructor:

Properties : ▪ My both the pairs of opposite sides are equal/congruent ▪ My both the pairs of opposite sides are parallel ▪ My all the angles are right angle **Who am I?** _____ **My shape is used in (any/only one item) :** _____	

	Properties : ▪ My all the sides are equal/ congruent ▪ My both the pairs of opposite sides are parallel ▪ My all the angles are right angle **Who am I?** _____ **My shape is used in (any/only one item) :** _____

Properties : ▪ My both the pairs of adjacent sides are equal/congruent **Who am I?** _____ **My shape is used in (any/only one item) :** _____	

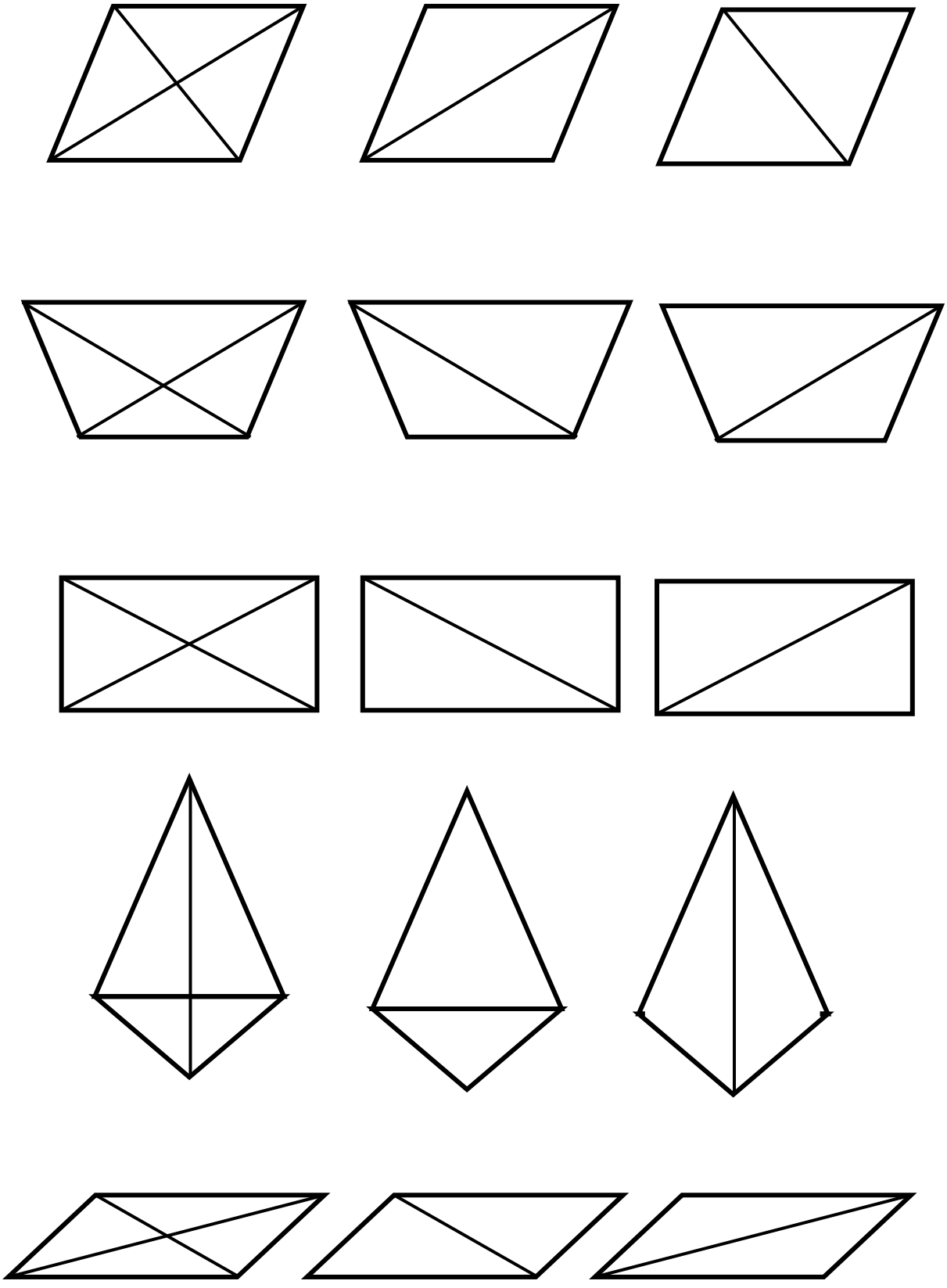
	Properties : ▪ My both the pairs of opposite sides are congruent ▪ My both the pairs of opposite sides are parallel ▪ My both the pairs of opposite angles are congruent **Who am I? _____** **My shape is used in (any/only one item) :** _____

Properties : ▪ My all the sides are equal/congruent ▪ My both the pairs of opposite sides are parallel ▪ My both the pairs of opposite angles are congruent **Who am I? _____** **My shape is used in (any/only one item) :** _____	

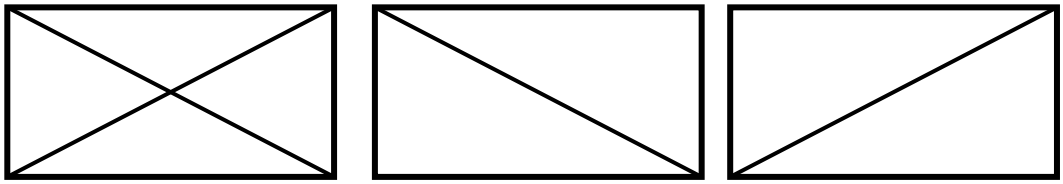
	Properties : ▪ My only one pair of opposite sides is parallel ▪ My other pair of opposite sides is not parallel **Who am I? _____** **My shape is used in (any/only one item) :** _____

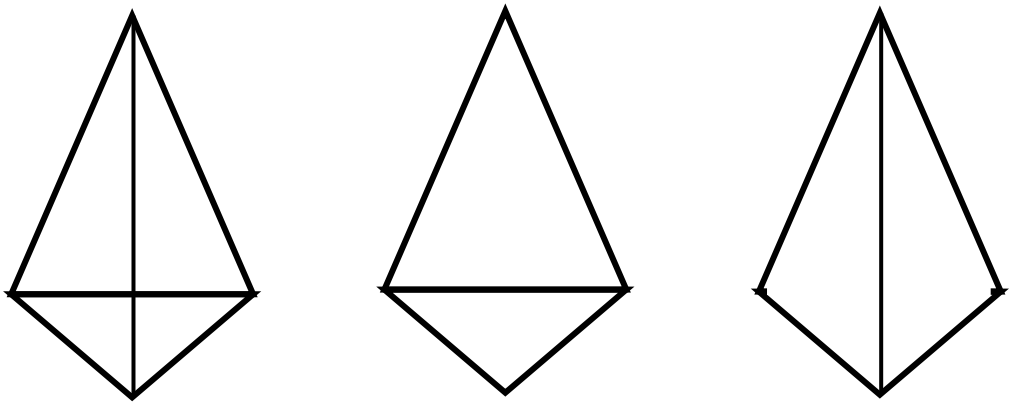
♣♣♣♣♣♣♣♣♣

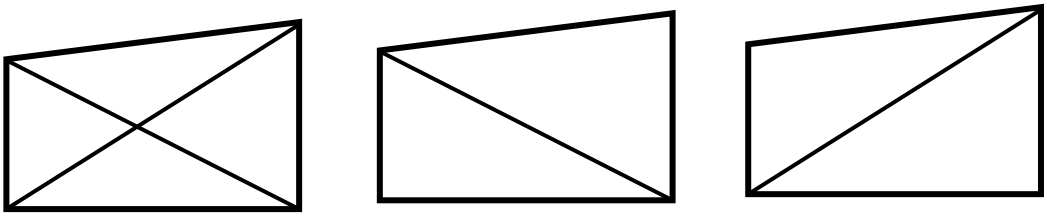
Sheet-1

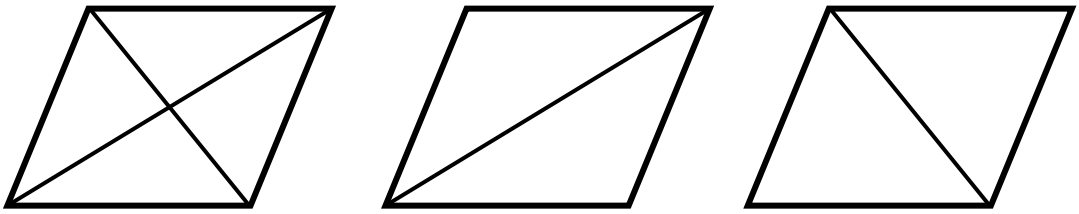


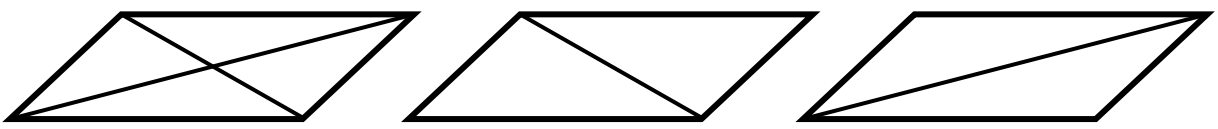
Sheet-2











MATHEMATICS
CHAPTER – 8: QUADRILATERALS |||

ACTIVITY – 4: IS IT PARALLELOGRAM?
(Testing Quadrilaterals As Parallelograms & Non-Parallelograms)

Name & Roll no. of Student: _____

Date: _____ Std.: _____ School: _____

Properties of a Parallelogram:

Theorem–8.1: A Diagonal of a Parallelogram divides it into two congruent triangles.

Theorem–8.8: A Quadrilateral is a Parallelogram if a pair of opposite sides is equal and parallel

Quadrilaterals: As Parallelograms

Draw Figure and write name of a Quadrilateral	Cut & Paste for Diagonal – 1	Cut & Paste for Diagonal – 1
	Both the Triangles are Congruent ? **…….**	**Both the Triangles are Congruent?** **……**

Draw Figure and write name of a Quadrilateral	Cut & Paste for Diagonal – 1	Cut & Paste for Diagonal – 1
	Both the Triangles are Congruent ? **…….**	**Both the Triangles are Congruent?** **…….**

Draw Figure and write name of a Quadrilateral	Cut & Paste for Diagonal – 1	Cut & Paste for Diagonal – 1
	Both the Triangles are Congruent ? …….	Both the Triangles are Congruent ? …….

Quadrilaterals: As Non-Parallelograms

Draw Figure and write name of a Quadrilateral	Cut & Paste for Diagonal – 1	Cut & Paste for Diagonal – 1
	Both the Triangles are Congruent ? …….	Both the Triangles are Congruent ? …….

Draw Figure and write name of a Quadrilateral	Cut & Paste for Diagonal – 1	Cut & Paste for Diagonal – 1
	Both the Triangles are Congruent? …….	Both the Triangles are Congruent ? …….

♦♦♦♦♦♦♦♦

MATHEMATICS
CHAPTER – 8: QUADRILATERALS |||

CLASS WORKSHEET -1: VENN DIAGRAM-1

(Differentiating Parallelogram & Non-Parallelogram Based On Properties)

Name & Roll no. of Student: _____

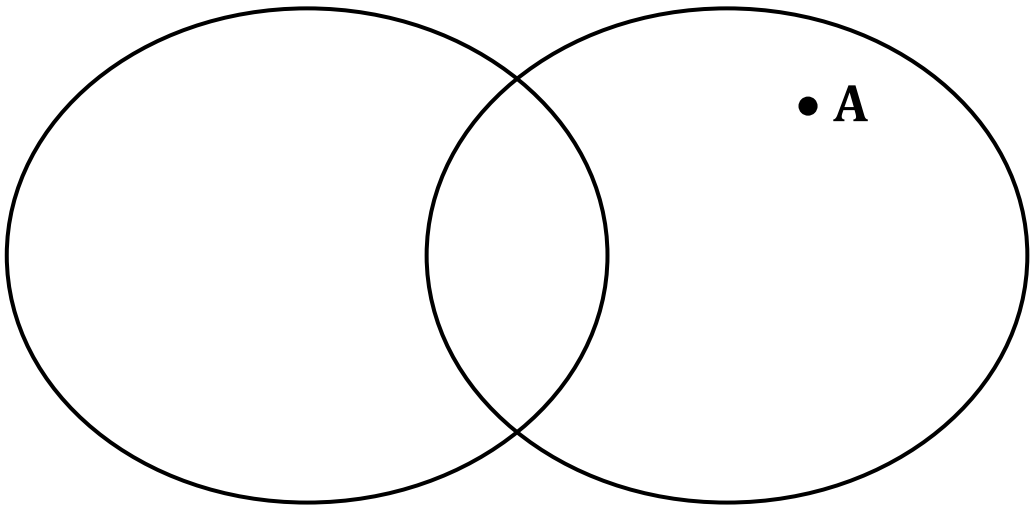
Date: _____ Std.: _____ School: _____

Instruction: Venn Diagram for two sets as P = {Parallelograms} and set R = {Non-Parallelograms} is given. Properties/keywords are given as A, B, C….etc.in a table. Fill the circles of Venn Diagram with appropriate alphabets.

A.	Kite	I.	Pair of opposite sides are parallel
B.	Its having four sides	J.	Sum of all the angles are 360°
C.	Its all the angles are of 90°	K.	Tiles
D.	Both the diagonals do not divide into two congruent triangles	L.	Trapezium
E.	Rhombus	M.	Its having four vertices
F.	Its having four angles	N.	Diamond
G.	Blackboard	O.	Only one pair of opposite sides is parallel
H.	Both the pairs of opposite angles are congruent	P.	Rectangle

Quadrilaterals

P = Parallelograms **R = Non-Parallelograms**



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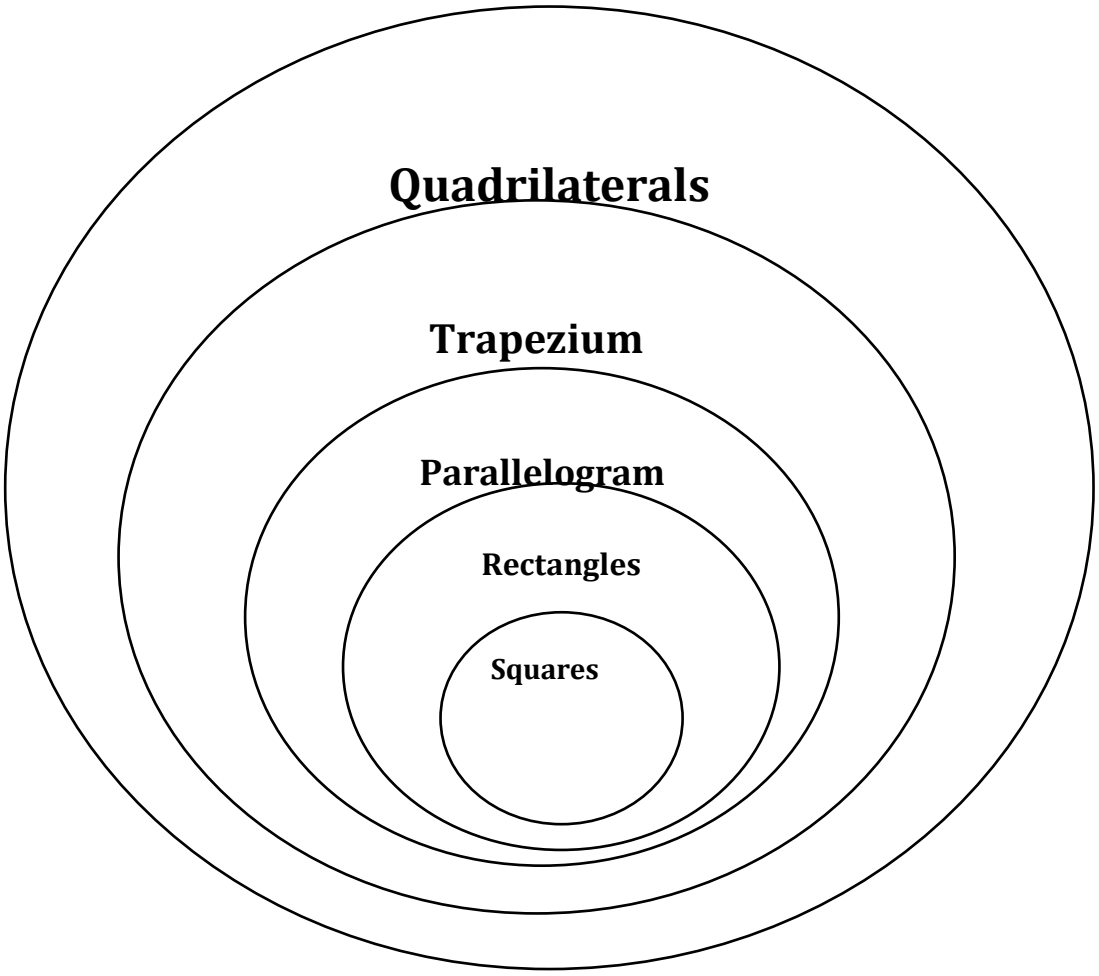
MATHEMATICS
CHAPTER – 8: QUADRILATERALS

CLASS WORKSHEET-2: VENN DIAGRAM-2
(Families Of Quadrilaterals)

Name & Roll no. of Student: _____

Date: _____ Std.: _____ School: _____

Instructions: Observe the following Venn Diagram carefully and then answer the true-false statements followed by it.



State whether the given statement is True or False:

1) Every Parallelogram is a Square. True☐ False☐

2) Every Trapezium is a Parallelogram. True☐ False☐

3) Every Square is a Rectangle. True☐ False☐

4) Every Rectangle is a Quadrilateral. True☐ False☐

5) Every Parallelogram is a Trapezium. True☐ False☐

****

MATHEMATICS
CHAPTER – 8: QUADRILATERALS

ACTIVITY – 5: COMPARISONS
(More about Properties/Theorems of Quadrilaterals)

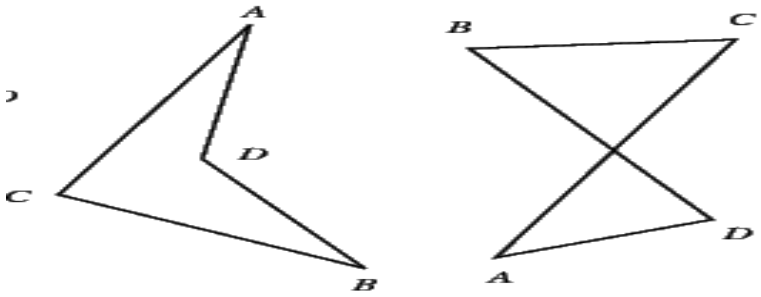
Name & Roll no. of Student: _____

Date: _____ Std.: _____ School: _____

A) Instruction: With the help your Mathematics text-book, (read the Chapter-8 'Quadrilaterals') complete the following table.

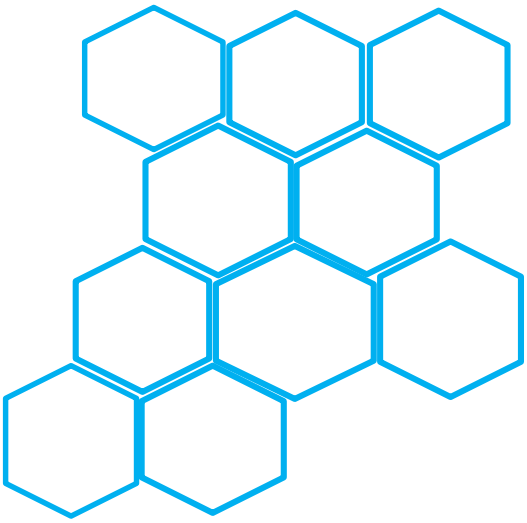
SN.	Property	Square	Rhombus	Rectangle	Trapezium	Parallelogram
1.	**Opposite sides are Equal**	√	√	√	**X**	√
2.	**At least One pair Opposite sides are Parallel**					
3.	**Pair of Adjacent sides are Equal**					
4.	**All angles are of 90°**					
5.	**Diagonals bisect each other**					
6.	**Diagonals bisect at 90°**					
7.	**Opposite angles are equal**					
8.	**Diagonals divide it into two Congruent Triangles**					
9.	**Diagonals are Equal in Length**					

B) Express your thoughts on the following diagrams/figure as whether they are considered into the family of Quadrilaterals or not? Justify your answer with appropriate reasons - by using the Properties of Quadrilaterals.



C) Concept Arrangement

A. Parallelogram	**F.** Kite
B. Trapezium	**G.** Rectangle, Square, Rhombus
C. Sum of all angles is 360°	**H.** Non-Parallelogram
D. Quadrilaterals	**I.** Diagonals bisect each other
E. Two pairs of adjacent sides are equal	**J.** Only one pair of opposite sides is parallel



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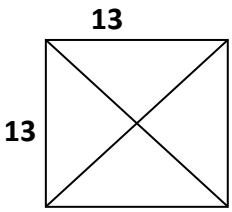
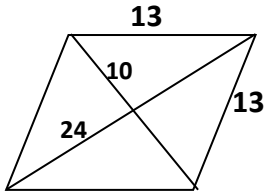
MATHEMATICS
CHAPTER – 8: QUADRILATERALS

CLASS WORK: FINDING AREAS
(Area Differences Between Square & Rhombus; Rectangle & Parallelogram)

Instruction: Calculate the Area and Perimeter of given figures by using Formulas. Observe the differences of Area as well Perimeter of Square & Rhombus having the same side-measurements. Similarly, for Rectangle & Parallelogram. (Use formula for Area A = base x height and Perimeter P = Summation of all side-measurements. Also if possible then use Heron's formula)

SQUARE	**RHOMBUS**
	

RECTANGLE	**PARALLELOGRAM**
	

♠♠♠♠♠♠♠

MATHEMATICS
CHAPTER – 8: QUADRILATERALS

ACTIVITY –6: CRAFT ACTIVITY
(Tangram - Extending Creativity on Quadrilaterals)

Name & Roll no. of Student: _____

Date: _____ Std.: _____ School: _____

TANGRAM: A Chinese Puzzle activity which is made of pieces of basic-Geometrical shapes which can then reassembled to make various kinds of designs. (Try to cut paper pieces into any kind of Quadrilaterals only)

Name of Figure: _____

Name and number of the shapes used (e.g. Squares = 2): _____

_____

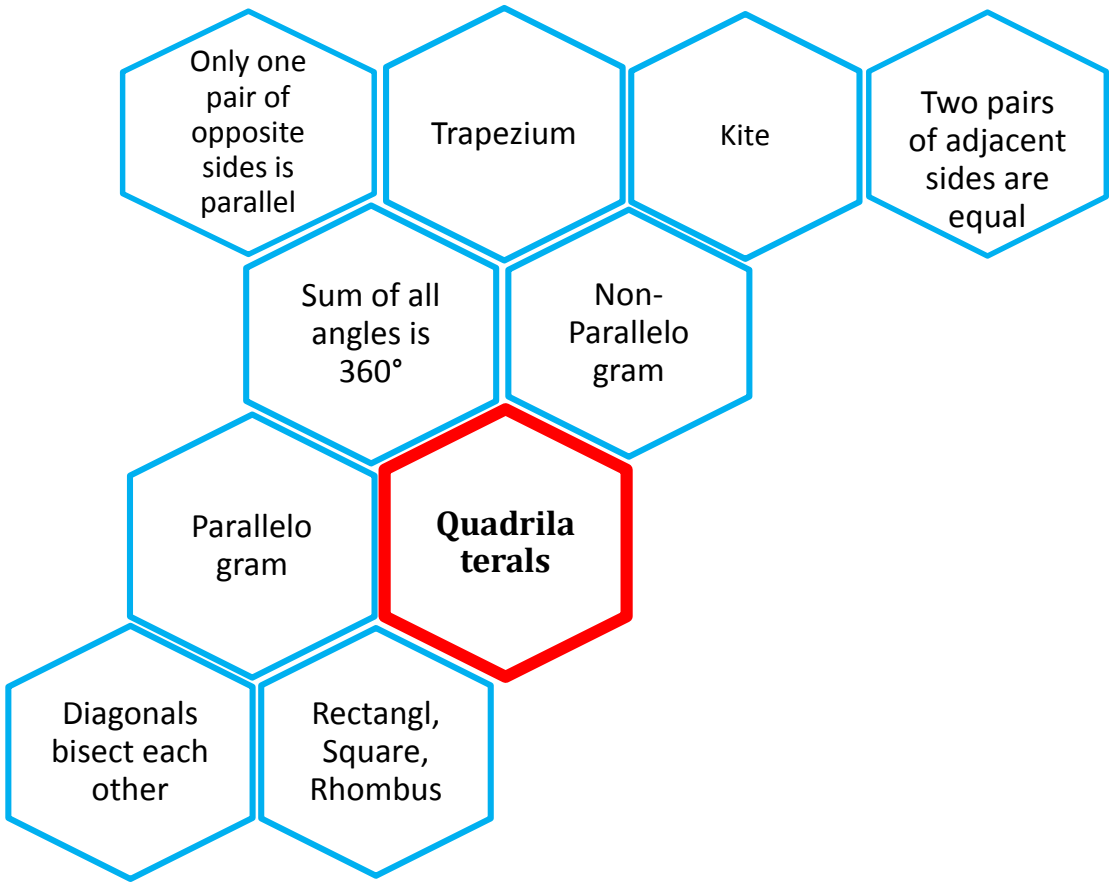
****

MATHEMATICS
CHAPTER – 8: QUADRILATERALS

Concept Arrangement

Observe the key-terms of the concepts related to Quadrilaterals and discuss about it in the class with relevant examples and justifications.

A. Parallelogram	**F.** Kite
B. Trapezium	**G.** Rectangle, Square, Rhombus
C. Sum of all angles is 360°	**H.** Non-Parallelogram
D. Quadrilaterals	**I.** Diagonals bisect each other
E. Two pairs of adjacent sides are equal	**J.** Only one pair of opposite sides is parallel



✶✶✶✶✶✶✶✶✶✶ **END OF ACTIVITIES** ✶✶✶✶✶✶✶✶✶✶

Appendix – C(ii)

Final Draft: POST – TEST

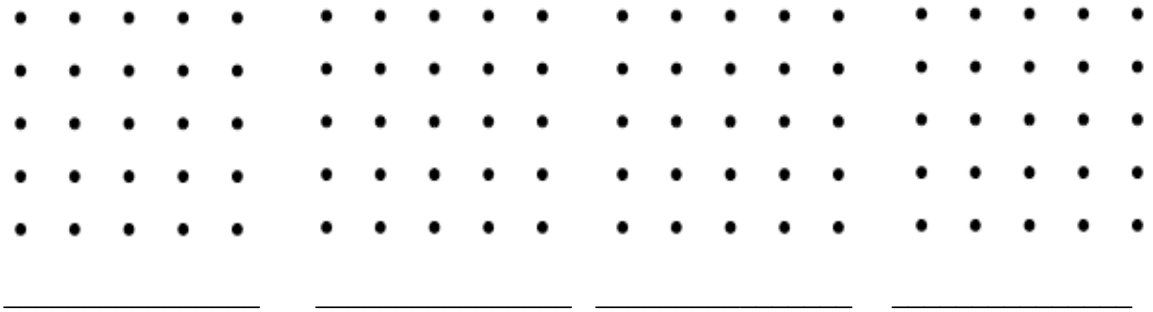
Mathematics Achievement Test: 2014 - 2015

CHAPTER – 8 QUADRILATERALS

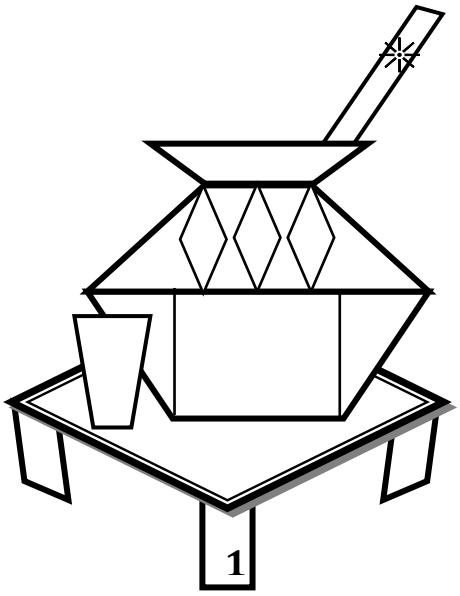
Std. :IX **MM : 25 Marks** **Time : 30 minutes** **Date:**

Name of School: **Name of Student:** **Roll No. :**

Q-1 Draw diagrams (neat & clean) of Quadrilaterals using following dots. (2)

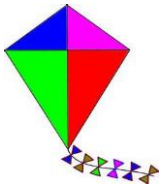
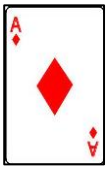


Q-2 Identify at least 10 various Quadrilaterals from the given picture. (2½)
(assign the numbers with respect to various Quadrilaterals in a given picture and then write down the names along with the assigned-numbers in the given box)



1. Rectangle (for example)

Q-3 Categorise the real life objects based on Quadrilaterals shown in the following pictures and write down in the followed blank lines. (3)



Kite – 1 | Shape in Mobiles | Musical Keyboard | Cricket Pitch | Chess Board

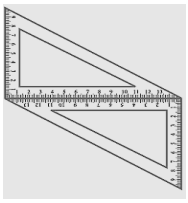

Toy Cube


Back glass

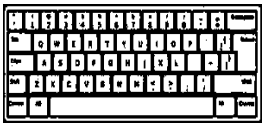

Fencing Design

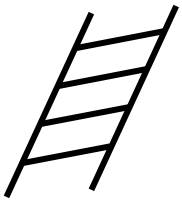

Sign Board

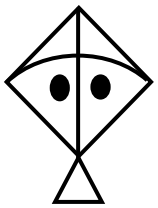

Indian Flag


Geometrical Tool


Shield


keys in keyboard


Ladder


Kite - 2

1) Rectangle : _____

2) Square : _____

3) Rhombus : _____

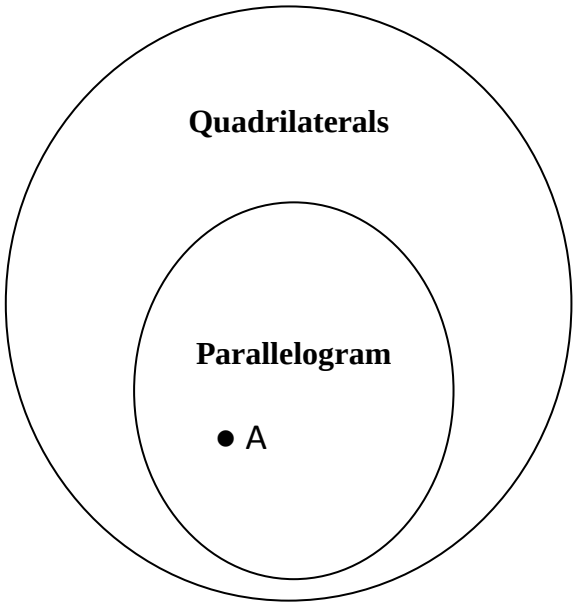
4) Parallelogram : _____

5) Trapezium : _____

6) Kite : _____

Q-4 Venn Diagram for two sets as P = {Parallelograms} & set Q = {Quadrilaterals} is given. Properties/keywords are given as A, B, C….etc. in a box. Fill the Venn circles with appropriate alphabets: (P is a subset of Q) **(2½)**

A. All the angles are of 90°
B. Both the diagonals do not divide it into two congruent triangles
C. Door
D. Its having four angles & four sides
E. Kite
F. Both the pairs of opposite angles are congruent
G. Trapezium
H. Pair of opposite sides are parallel
I. Sum of all the angles are 360°
J. Diamond
K. Only one pair of opposite sides is parallel



Q-5 Fill in the following entries (with Yes / No OR √ or X) : (5)

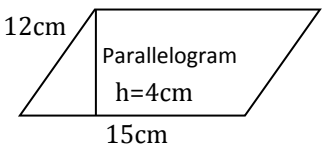
SN.	Property	Parallelogram	Trapezium	Rectangle	Rhombus	Square
1.	Pair of Adjacent sides are Equal					
2.	Diagonals bisect at 90°					
3.	Opposite angles are equal					
4.	Diagonals divide it into two Congruent Triangles					
5.	Diagonals are Equal in Length					

Q-6 Show the appropriate diagrammatic presentation (with all names, signs & labels) for each of the following Theorem-statements as well proof (not complete but at some extent using symbols/signs in the diagrams): (3)

1. The line segment joining the mid-points of two sides of a triangle is parallel to the third side. (The Mid-point theorem)

2. If each pair of opposite sides of a Quadrilateral is equal, then it is a Parallelogram.

Q-7 Calculate the Area and Perimeter of the figures by using base & height. (4)

	AREA	**PERIMETER**
		

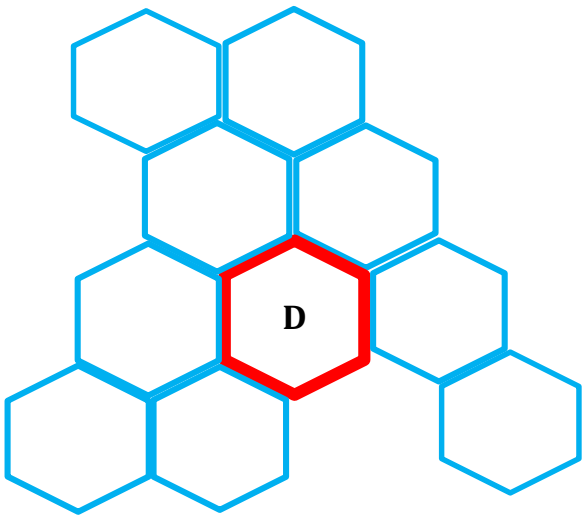
12cm Rectangle 15cm		
Rhombus h=7cm 10cm		
Square 10cm		

Remark : _____

_____

Q-8 Fill the hexagonal shapes with appropriate key-words given below: (3)

A. Parallelogram
B. Trapezium
C. Sum of all angles is 360°
D. Quadrilaterals
E. Two pairs of adjacent sides are equal
F. Kite
G. Rectangle, Square, Rhombus
H. Non-Parallelogram
I. Diagonals bisect each other
J. Only one pair of opposite sides is parallel



●●●●●●ALL THE BEST ●●●●●●

Appendix – C(iii)

Final Draft

REACTION - REFLECTION SHEET

2014 – 2015

Name of Student: _____ **IX** Roll No

Name of School: _____

► **Put tick-marks at appropriate option/s (a, b, c, or d):**

Chapter – 8 Quadrilaterals		
SOLO Levels	**Item No.**	**Item-Statements About My Learning Experiences and Achievements**
	I-1)	**Whether I have participated in an Activity-1 on making figures with four sides using given dots?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	I-2)	**I found an Activity-1 (in general) is as:**
	a)	Very basic activity to get idea about various Quadrilaterals
	b)	Rubbish activity
	c)	Fun activity but not appropriate for the level of grade-IX
●	d)	Fun activity but appropriate for introducing such chapter like Quadrilaterals
	I-3)	**How was an Activity-1 for me ?**
	a)	Confused with Dots as how many dots to be used to make figure/s with four sides
	b)	Interesting and I was remembering my pre-primary school days
	c)	Creative to draw various figures of having four sides, four end points & Rangoli
	d)	Learning with fun
	I-4)	**Whether I was present for an Activity–2 on "Identifying Types of Quadrilaterals" in a given picture (of hut/house) ?**
	a)	Yes
	b)	No as I was absent in school/engaged with other school-activity
	I-5)	**I can say about an Activity-2 (in general) as:**
	a)	Time-pass activity
	b)	Given picture was not appropriate
	c)	Known picture given so it became easy to identify the various Quadrilaterals
	d)	Suitable for the learning from 'known to unknown' in order to narrow down the focus to the types of Quadrilaterals only from a very familiar picture
	I-6)	**The Activity - 2 for me was :**
	a)	Liked as puzzling way of learning about the types of Quadrilaterals
▌	b)	I was confused with this activity as well with some types of the Quadrilaterals
	c)	Just did the activity as I was thorough with all types of Quadrilaterals
	d)	Helped me to make clarity and also learning on various Quadrilaterals as well how such shapes arranged/utilized in a given picture

	I-7)	**Whether I did an Activity–3 "Who am I?"–cut & paste activity?**
	a)	Yes
	b)	No
	I-8)	**How was an Activity - 3 for me ?**
	a)	I don't like such cut & paste kind of activity
	b)	Not a new for me as I am used to do and learn with such activity
	c)	Liked a Crafting way of learning about the properties of various Quadrilaterals
	d)	Different approach enjoyed for understanding the properties of Quadrilaterals
	I-9)	**Whether I have solved the Class Worksheets–1 & 2 on "Venn Diagrams" to understand the families of Quadrilaterals as well about the Parallelograms & Non-Parallelograms?**
	a)	Yes
	b)	No as I was absent in school/ engaged with other school-activity
	I-10)	**What I have learnt or understood from the Class Worksheets? Let me put tick.**
	a)	Easy & Venn diagrams helped me to understand the families of Quadrilaterals and also characteristics of the Parallelograms & Non-Parallelograms
	b)	Found difficulties in completing the worksheets
	c)	Easy & diagrammatic way of learning to provide ease understanding about the said concept
	d)	No Comments
	I-11)	**Whether I have participated in an Activity-4 "Parallelograms"- a cut & paste activity to differentiate the Quadrilaterals as Parallelograms or Non-Parallelograms?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	I-12)	**How I found this Activity-4 for me ?**
	a)	Interesting and practical activity for testing/ differentiate the Parallelograms and Non-Parallelograms
	b)	Good activity but it has not given clear understanding on a desired concept
	c)	Appreciate such activity which really develops the understanding on desired concept
	d)	Unable to comment
	I-13)	**Whether I was present for an Activity – 6 that is "Craft Activity" on "Tangram"?**
	a)	Yes
	b)	No
	I-14)	**My Learning experience from an Activity –6 on "Tangram" was :**
	a)	Non-interesting
	b)	I found Very Creative activity & I have enjoyed as a different learning-experience
	c)	No clear objectives of this activity and I found non-relevance of it with the concept of the Quadrilaterals
	d)	New knowledge for me and helped to develop critical & creative thinking on Quadrilaterals to be utilised as to make/create innovative or creative designs/ figures/patterns

	I-15)	**'Concepts / topics arrangement through Hexagonal shapes', I found this exercise in order to understand thoroughly the concepts of Quadrilaterals as:**
	a)	Don't' know
	b)	Its beyond my understanding level
	c)	Yes it's a good exercise to summarise the major topics/concepts of a chapter
	d)	This arrangement helps to give quick view on the Quadrilaterals and recall the learning
	I-16)	**Whether my Knowledge/Understanding on Quadrilaterals have been improved because the way of such teaching-learning?**
	a)	Yes but little
	b)	Yes and more
	c)	Unable to say
	d)	No/Not much
What I liked Most?		
What I not liked?		
Your General Comments (About Instructor, Teaching-learning process, Remarks/ Improvements, Suggestions...):		

●●●●●●●

◆◆◆◆◆◆HOPE ENJOYED THE LESSON◆◆◆◆◆

APPENDIX – D

PLAN FOR
CHAPTER – 14 STATISTICS

- **Unit Plan For A Chapter**
- **Achievement Test (Post-test) For A Chapter**
- **Reaction-Reflection Sheet For A Chapter**

Appendix – D(i)

S.O.L.O. TAXONOMY BASED INSTRUCTIONAL STRATEGY

UNIT PLAN - 4

CHAPTER – 14 STATISTICS

■ **Topics Of A Chapter In A Mathematics Class-IX Textbook**

- Introduction
- Collection of Data
- Presentation of Data
- Graphical Representation of Data
- Measures of Central Tendency
- Summary

■ **SOLO Level-wise Concept/ Conceptual Mapping**

SOLO Levels	Learning Points / Concepts / Topics
 Pre-structural	• The meaning as well means of Information and Various sources for collecting Information (TV, Newspapers, Internet, Phones, Books, Magazines, Social interactions etc...) • Meaning of Datum and the Data as well Data Handling • Meaning of Ascending or Descending Order, identifying the Minimum or Maximum values, Calculations for Total Sum and Average value • Examples /Activities
 Uni-structural	• To understand the meaning of Information, Datum and Data in the context of Statistics • To understand the meaning of Statistics as well as Singular and Plural sense of Statistics • Learning with Numerical Data about the terms like Range, Mean (as average), Median (middle/central value), Mode(as Repeated numbers), Frequencies & Class-intervals • Examples / Activities
 Multi-structural	• Understanding about the Collection of meaningful Data • Understanding on the means of Primary and Secondary Data/sources • Knowing about Organization as well Presentation of Data, Ungrouped as well Grouped Data and also the use of Tally Marks • Examples / Activities
	• Understanding the Graphical Representations of Data - Bar Graph, Histogram and Frequency Polygon

Relational	• Examples / Activities • Understanding the meaning and Practice with Measures of Central Tendency – Mean, Median, Mode • Examples / Activities
 Extended Abstract	• Few Research based Applications of Measures of Central Tendency • Activity / Examples

■ SOLO Level-wise Instructional Objectives

Pre-structural

1) Students know the meaning of 'Information'.
2) Students have learnt about to differentiate the information which is useful or meaningful and which is not useful.
3) Students having knowledge for the sources from where to collect the information.
4) Students having knowledge to identify the maximum or minimum value of the numerical data.
5) Students know how to calculate the total-sum and the average value of numerical data.

Uni-structural

1) Students will be able to recall the meaning of information, datum and the data.
2) Students will be able to recall and identify the meaning of Statistics in a singular and plural sense.
3) Students will be able to state about the components like range, mean, median, mode of the numerical data.as well to derive the frequencies and form the class-intervals.

Multi-structural

1) Students will be able to clarify about the collection of meaningful data.
2) Students will be able to examine the sources of data as primary or secondary source.
3) Students will be able to rework on the organisation of the data to make it presentable.
4) Students will be able to construct the tables of organised data with ungrouped or grouped frequency distributions and with tally marks.
5) Students will be able to explain about the calculations performed on ungrouped or grouped data in terms of measures of central tendency.

Relational

1) Students will be able to demonstrate their understanding on proper applications of graphs to present the data.
2) Students will be able to classify the ungrouped or grouped data in the forms of graphs as bar-graph, histogram or frequency polygon.
3) Students will be able to observe and relate the graphs with the meaning and nature of the data.
4) Students will be able to apply the measures of central of tendency to analyse the data.

5) Students will be able to analyse the outcomes of the data to make predictions about the situations for which the data has been collected.

Extended Abstract

1) Students will be able to visualize various data of the investigative studies.
2) Students will be able to judge on the applications of measures of central tendency.
3) Students will be able to reflect on need and derivation of the outcomes of data and graphical presentations of the data.
4) Students will be able to theorise the relation between the concepts of measures of central tendency in terms to analyse the research studies.
5) Student will be able to invent knowledge on the analysis of the data.

■ METHODOLOGY

Method : Activity based and Heuristic Method

Approach : Inductive and Inducto-deductive

Media : Chalk/White board, Roller board, Charts, Tablet-PC

Materials : SOLO Worksheets, Card boards, Thread, Geometrical box, other materials were used as shown in the figures of Photo-gallery-1(Appendix-G).

■ LESSON - PLAN

Day No.	Date	Day	Time (am)	Content Details	Settings	SOLO Level
1.	27/01/ 2015	Tue	08:30 – 09:10	**Activity-1 With Play cards Discussion** Topics Covered: Introduction with terms like range, mean, median, mode Questioning & Probing: a) Discussion on the Meaning of information and data as well sources of the data as primary or secondary b) Define a Range in the context of numerical data. c) Define a Range in general (e.g. in the context of distance, varieties etc.) Home Task: Find examples based on distance, speed, petrol usage, prices & expenses in terms to understand the components like range, mean, mode and median.	Group	● ▌
2.	28/01/ 2015	Wed	08:55 – 09:35	**Examples and Exercises on Measure of Central Tendency** Topics Covered:	Class	▌

				Calculation with range, mean, median, mode; Questioning & Probing: d) Explore on your understanding about the terms viz. range, mean, mode and median. e) Discussion on various examples Home Task: ---		
3.	29/01/2015	Thurs	08:30 – 09:10	**Activity-2 Frequency Distribution Discussion** Topics Covered: Frequencies & Class-intervals (continuous and discrete); Understanding on ungrouped & grouped frequency distribution Questioning & Probing: f) What you have understood from this activity. g) (further probing to be based on the responses of the respondents) Home Task: Exercise-14.1 from textbook	Group	
4.	30/01/2015	Fri	08:30 – 09:10	**Activity-3 A.M. food/Breakfast habits Discussion** Topics Covered: Collection of meaningful data and organization of data, tally marks Questioning & Probing: h) Discuss on the understanding and the learning from this activity. i) Which type of data have you collected, primary or secondary? j) What are the indications you are getting from your data and outcomes of the analysis. Home Task: Exercise-14.2 from textbook (examples 1 to 6)	Group	
5.	31/01/2015	Sat	08:30 – 09:10	**Activity-4 Statistical Graphs Discussion** Topics Covered: Graphical presentation of Statistical data (Bar graph, histogram and frequency polygon) (Chart paper presentation on Statistical Graphs)	Class And Pair	

				Questioning & Probing: k) Just a interactions with students as doing a class activity.		
				Home Task: Exercise-14.2 from textbook (examples 7 to 9) Exercise-14.3 from textbook (examples 1 to 3)		
6.	03/02/ 2015	Tue	08:30 – 09:10	**Class / Practice Worksheet**	Indivi dual	
				Topics Covered: Practice for Measures of Central tendency as well for graph		
				Questioning & Probing: l) Discussion on examples of worksheet as well examples from textbook exercises.		
				Home Task: Exercise-14.3 from textbook (examples 4 to 9)		
7.	04/02/ 2015	Wed	08:55 – 09:35	**Class/Practice Worksheet (cont.)**	Indivi dual	
				Topics Covered: Practice for Measures of Central tendency as well for graph		
				Questioning & Probing: m) Discussion on examples of worksheet as well examples from textbook exercises.		
				Home Task: Exercise-14.4 from textbook		
8.	05/02/ 2015	Thurs	08:30 – 09:10	**Activity-5 What is my Learning Style? Discussion on Interpretations**	Indivi dual	
				Topics Covered: Means of collection of data, frequency calculations, drawing percentages and conclusion/ predictions based on percentages		
				Questioning & Probing: n) Discussion about the feelings and experiences of doing this activity and conclusions at individual level.		
				Home Task: Exercise-14.4 from textbook		
9.	06/02/ 2015	Fri	08:30 – 09:10	**More Exercises from Textbook** **Class-Activity: Concept Arrangement** **(**Recapitulation of a chapter)	Class	

10.	07/02/ 2015	Sat	08:30 – 09:10	**Achievement Test (of present students) For Chapter -14**
11.	09/02/ 2015	Mon	08:30 – 09:10	**Achievement Test (of rest of the students)**
				Feedback using SOLO Reflective-Reaction Sheet

■ BLUEPRINT FOR ACHIEVEMENT TEST

BLUEPRINT **SOLO Level wise structure for Achievement Test** **For the Chapter – 14 Statistics; MM – 25 Time – 30 minutes**			
SOLO Level	**About Content**	**Q. No. & Marks/Q**	**Total Mark**
● **Pre-structural**	---------	-----	0
I **Uni-structural**	Understanding on terms used in Statistics	Q-1 [M-2]	2
III **Multi-structural**	Means of Primary & Secondary Data/ sources; Organization & Presentation of Data, Ungrouped as well Grouped Data and also the use of Tally Marks	Q – 2 [M-2] Q-3A [M-3½] Q – 4 [M-3]	8½
Relational	Graphical Representations of Data - Bargraphs, Histogram, Frequency polygon Measures of Central Tendency – Mean, Median, Mode	Q – 3B [M-2] Q – 4B [M-4] Q-5 [M-6]	12
Extended Abstract	Concept Arrangement	Q-6 [M-2½]	2½
		Total	**25**

Instructions For Test:

1. First write down your name, your roll number, name of school, date and standard in appropriate place given on the sheet.
2. First read all the questions carefully.
3. All the questions are compulsory. Write it with good handwritings.
4. It's a question cum answer sheet, so all the answers you have to write in this sheet at appropriate place.
5. Ask for the separate sheet for the rough work or as supplementary.
6. Draw neat and clean figures wherever it is required.

■ ACTIVITIES ARE AS FOLLOWS (from next page):

●●●●●END OF UNIT PLAN - 4 ●●●●●

MATHEMATICS
CHAPTER – 14: STATISTICS

ACTIVITY – 1: WITH PLAY - CARDS
(Introduction with the Terms like Range, Mean, Median, Mode)

Name & Roll no. of Students: (1) _____

(2) _____ (3) _____

Date: _____ Std. : _____ School : _____

Note - Read Carefully:

Data – The fact or figures, which are Numerical or otherwise collected with a Definite purpose are called Data.(plural form)

Datum – It's a Latin word and is the singular form

Status – It's a Latin word meaning 'A (Political) State'

Statistics Derived from the word 'Status'. Meaning is 'The Study about the Extraction of Meaningful Information'. It is used in Singular sense as Subject that deals with Collection, Organisation, Presentation, Analysis and Interpretation of Data. While meaning in Plural sense as the (collections of) Numerical Data.

Do as Directed:

- It's a group (of 3 students) activity and you have been given a set of some play-cards.
- Count the total play-cards. Write down the number / alphabet given on each play-card (in the random form only) in the following table (Don't arrange the cards now).

Raw Data:

i.	ii.	iii.	iv.	v.	vi.	vii.	viii.	ix.	x.	xi.	xii.	xiii.	xiv.	xv.

- Arrange the play-cards according to the numbers given on each card. Please note to consider that **A=1; J=11; Q=12; K=13** and write down the number of each play-card in the given table. Further, based on the arranged play-cards, answer the following questions/ give the information.

Arranged Data: Ascending / Descending Order

i)	ii)	iii)	iv)	v)	vi)	vii)	viii)	ix)	x)	xi)	xii)	xiii)	xiv)	xv)

(continue…..)

Provide the following Data based on your set of Arranged play- cards:

a) The number on first play-card is : _____
(is Smallest Value / **Minimum** Value of **Range** of your set)

b) The number on last play-card is : _____
(is Largest Value / **Maximum** Value of **Range** of your set)

∴ **Range :** Min. _____ to Max. _____

Range Value : = Max. Value – Min. Value = _____

c) The number on middle-positioned (at 7th position) play-card is : _____
(is Middle Value / Centre or Central Value called **Median**)

∴ **Median :** _____

d) The numbers repeated (frequency) in your set (irrespective of symbols /colours) :
_____; _____; _____; _____; _____
(The most duplicated / repeated Data-value is called **Mode**)

∴ **Mode :** _____

e) Total of all the numbers given on cards of your set : _____
(is the Summation - **Σ** of Data-values called **Sum / Total Sum of Data**)

f) Total number of play-cards in your set : _____
(is the **Total number of Data / Total Data**)

g) Find the Average = e) ÷ f) : _____
(is called the **Mean** or **Mean-value)**

∴ **Mean :** Summation / Total Sum of Data = **(___)** = _____
Total number of Data = **( )**

♣♣♣♣♣♣

MATHEMATICS
CHAPTER – 14: STATISTICS

ACTIVITY – 2: FREQUENCY DISTRIBUTION
(Understanding On Ungrouped and Grouped Frequency Distribution)

Name & Roll no. of Students: (1) _____

(2) _____ (3) _____

Date: _____ Std. : _____ School : _____

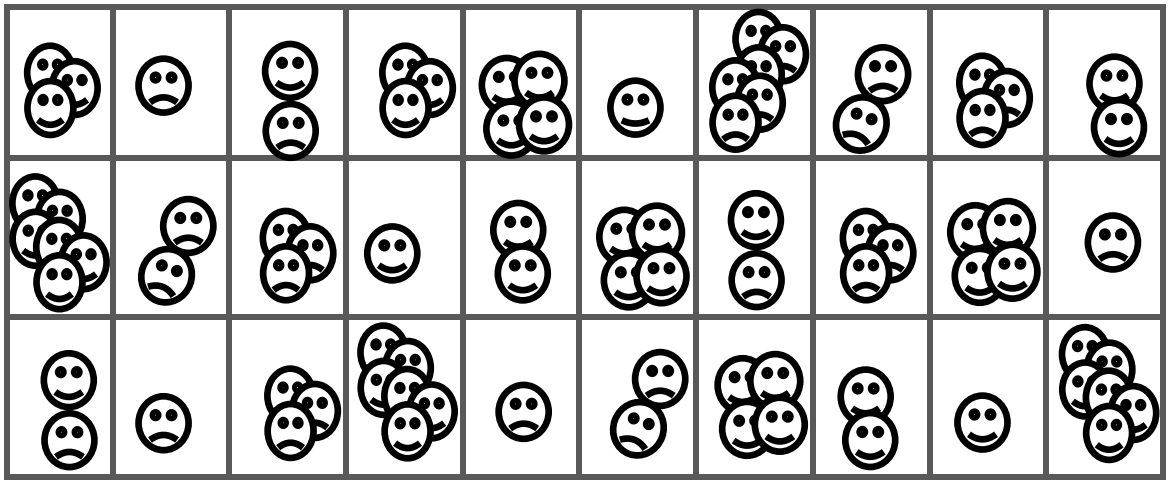
Frequency: (Definition) In Statistics, the Frequency of an event is the number of times the event occurred in an experiment or study.

Ungrouped Frequency Distribution

A) You have given certain numbers of play-cards. Separate play-cards according to the symbols [♣, ♥, ♦, ♠] and count the number of play-cards having similar symbols. Write the details in the following table.

Symbols	**♣ (Clubs)**	**♥ (Hearts)**	**♦ (Diamonds)**	**♠ (Spades)**	**Total**
Total Play-Cards(Frequency)					

B) Total 30 sets of smiley/s are given in the following picture. Each set consisting of 1 to 6 smiley/s. Find out the details from the given picture and write down in the following table.



Number of Smiley/s in a Set	**One**	**Two**	**Three**	**Four**	**Five**	**Six**	**TOTAL**
Number of Set/s (Frequency)							

(continue…..)

Grouped Frequency Distribution

C) Following are the pictures showing the Amount/Bank – balance in the saving account of some of the Clients / Account holders in one of the Bank. Observe it properly then make classes/categories/groups based on Amounts/Bank-balance and count the number of clients fall in each class/category/group.

ABC BANK							
							
□.14,756	**□.21,322**	**□.39,001**	**□.7,567**	**□.19,888**	**□.9,700**	**□.17,664**	**□.42,555**
							
□.13,500	**□.6,009**	**□.35,126**	**□.48,098**	**□. 5,512**	**□.32,000**	**□.19,196**	**□.30,993**
							
□.25,589	**□.40,644**	**□.9,600**	**□.15,470**	**□.31,773**	**□.5,020**	**□.10,131**	**□.15,199**
							
□.44,757	**□.37,089**	**□.12,122**	**□.5,868**	**□.16,005**	**□.31,208**	**□.49,906**	**□.11,333**

Amount in Account/ Bank-balance (Rs.) (Groups)	**No. Of Clients (Frequency)**
00,000 - 05000	
05,001 – 10,000	
10,001 – 15,000	
15,001 - 20,000	
20,001 - 25,000	
25,001 - 30,000	
30,001 - 35,000	
35,001 - 40,000	
40,001 - 45,000	
45,001 - 50,000	
TOTAL	

Amount in Account / Bank-balance (Rs.) (Groups)	**No. Of Clients (Frequency)**
TOTAL	

****

MATHEMATICS
CHAPTER – 14: STATISTICS

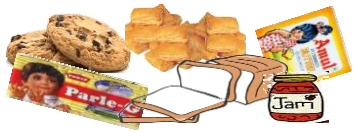
ACTIVITY – 3: A.M. FOOD / BREAKFAST HABITS
(Collection & Organisation of Data)

(Group) Roll no. of Students: _____

Date: _____ Std. : _____ School : _____

Collection of Data : Following table is a tool prepared to collect the Statistical idea about the 'Breakfast Habits ' of the students of class-IX. Items for the Breakfast taken frequently/regular basis are shown with the pictures in the table. Roll numbers wise responses of the students will be taken in the form of **Y = Yes & N = No.**

Study of A.M. Food / Breakfast Habits of assigned group members:

Sr. No.	A.M. FOOD / BREAKFAST ITEMS	Ans	ROLL NUMBERS OF STUDENTS (Class – IX)							
										Total
1	 With or Without 	Y								
		N								
2		Y								
		N								
3		Y								
		N								
4		Y								
		N								
5		Y								
		N								
6		Y								
		N								

7		**Y**								
		N								
8		**Y**								
		N								
9		**Y**								
		N								

Organization of Data:

Count the responses given for Y or N and write the total numbers with the Tally marks in the following Table.

Sr. No.	A.M. Food / Breakfast Items	Response = Y		Response = N	
		Total No.	Tally Marks	Total No.	Tally Marks
1.	**Morning / Breakfast Drinks** A glass of Milk with / without Nutritious Powder				
2.	A cup of Tea / Coffee				
3.	A glass of Buttermilk / Lassi or Soup or Juice				
4.	**Morning / Breakfast Eatables** Eggs – Boiled or Omlate or else				
5.	Bread-butter, Jam, Biscuits, Toasts, Khaari etc..				
6.	Sandwich, Roti, Parathaas, Puri-Sabji, Chhole-Bhature etc..				
7.	Rice based items like Dosa, Idly, Wada, Upma, Pauaa etc..				
8.	Noodles, Pizzas, Burger, Samosas, Pakodaas, Cake-Pastry				
9.	A Bowl of Veg. Salad, Fruit Salad, Sprouted items				

♦♦♦♦♦♦♦♦♦

MATHEMATICS
CHAPTER – 14: STATISTICS

ACTIVITY – 4: STATISTICAL GRAPHS
(Graphical Presentation of Statistical - Data)

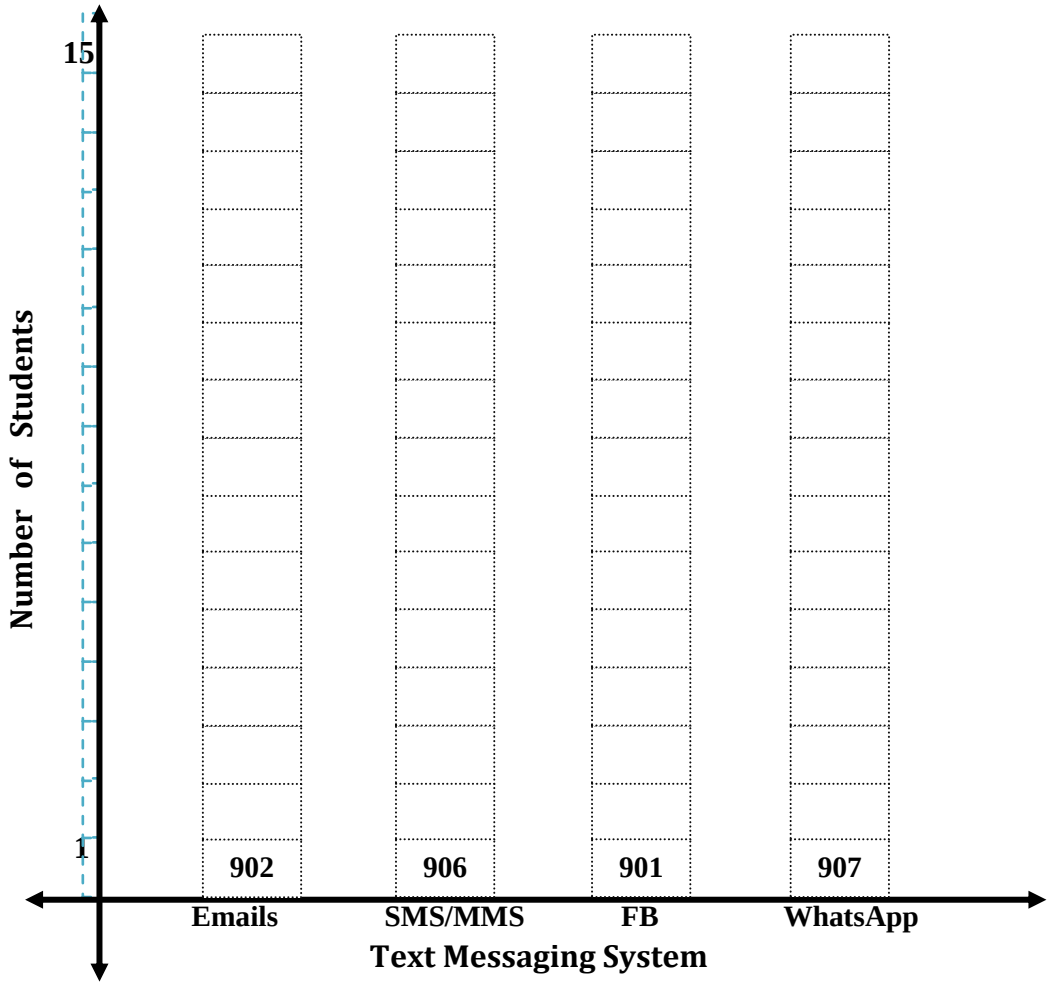
Name & Roll no. of Students: _____

Date: _____ **Std. :** _____ **School :** _____

Graphical Presentation For: Usage of Text Messaging System by the students of Class-IX selected from (a)Emails[EM], (b) Mobile-SMS/MMS[SMS], (c) Facebook[FB], (d) WhatsApp[WA] is given in the following table.

901 FB	902 EM	903 FB	904 FB	905 FB	906 SMS	907 WA	908 WA	909 FB	910 WA	941 EM
911 SMS	912 SMS	913 WA	914 EM	915 FB	916 EM	917 FB	918 EM	919 SMS	920 FB	942 SMS
921 FB	922 EM	923 EM	924 WA	925 WA	926 SMS	927 FB	928 SMS	929 WA	930 EM	943 FB
931 EM	932 FB	933 WA	934 FB	935 SMS	936 FB	937 WA	938 EM	939 EM	940 SMS	944 SMS

Graph – 1: BAR GRAPH



From the Graph-1, fill the details in the following Table-1.

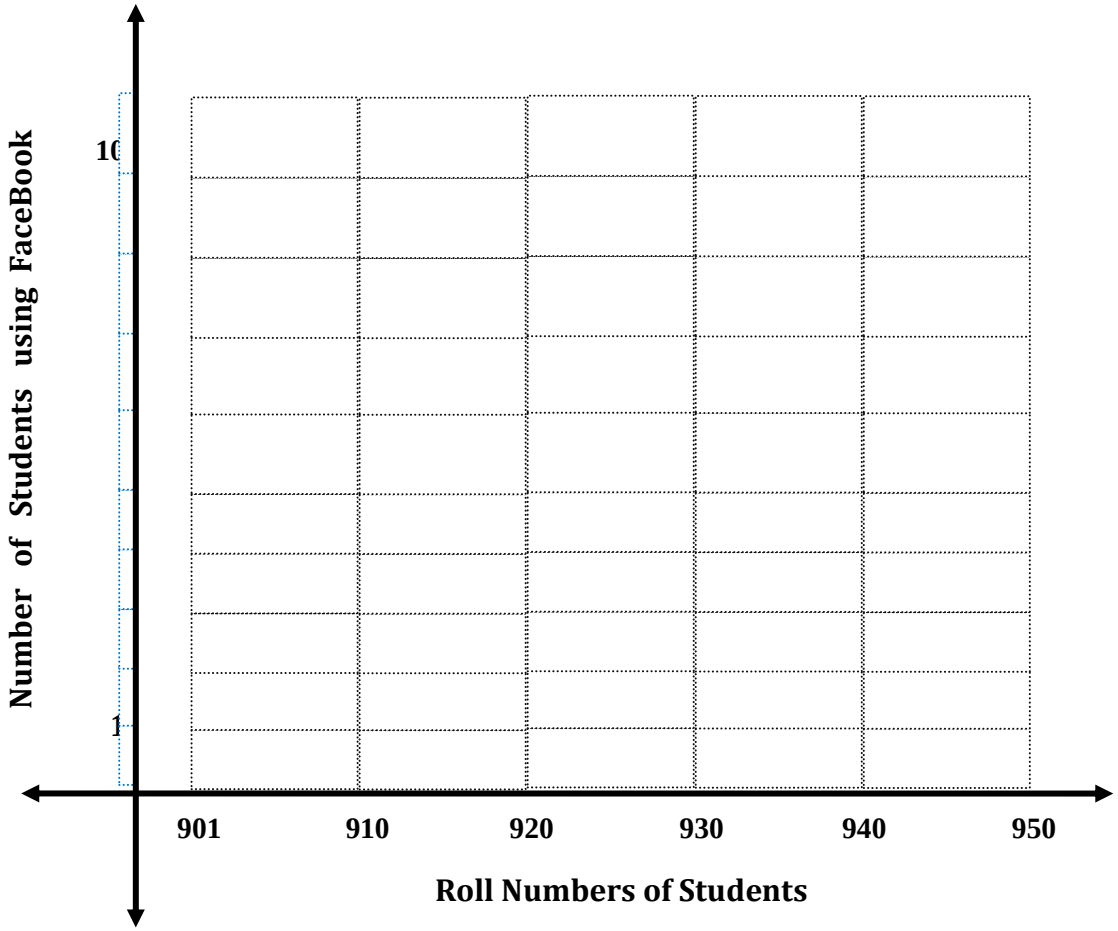
Text Messaging System	Emails	Mobile – SMS / MMS	FaceBook	WhatsApp
Total No. Of Students				

From the Graph-1, fill the details in the following Table-2.

Roll Nos. (Group/Class-Interval)	901-910	911-920	921-930	931-940	941-950
No. of / Total Students using FaceBook (Frequency)					

Based on the Data of Table-2, prepare a Graph-2. For the Graph-3, draw a line by connecting the Mid-points (Class Marks) of the Class-intervals. Observe the differences between the Graph-1, Graph-2 as well Graph-3 and discuss in the class.
[Midpoints or Class-marks = (Upper limit + Lower limit)/2]

Graph – 2: Histogram & Graph – 3: Frequency Polygon



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MATHEMATICS
CHAPTER – 14: STATISTICS

CLASS / PRACTICE WORKSHEET
(Practice for Measures of Central Tendency/Triple M & Graphs)

Name & Roll no. of Students: _____

Date: _____ Std. : _____ School : _____

- **n =** Total number of observations or Data-values
- **Mean ẍ =** Sum of all observations ÷ Total number of observations
- **Median =** The value of the middle-most observation/s
  - If n is Odd then, the value of $[(n+1)/2]^{th}$ observation
  - If n is Even then, mean value of $[n/2]^{th}$ and $[(n+1)/2]^{th}$ observation
- **Mode =** It is the most frequently occurring observation.

For UNGROUPED DATA

Exercise – 1 : Two persons H & K had the following monthly bills for electricity. What are the mean, median and mode of the collection of bills?

Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
H(Rs..)	200	245	300	400	410	356	375	230	280	200	190	195
K(Rs..)	344	289	295	425	425	220	200	305	365	186	205	250

1) Find Mean, Median and Mode for Person-H.
2) Find Mean, Median and Mode for Person-K.
3) Compare Mean, Median and Mode for Persons H & K .
4) Make conclusion based on the Mean-value about who is using more electricity.

H | **K**

Measures of Central Tendency	H	K
Mean Median Mode		

Conclusion: _____

_____

_____

Exercise – 2: Find the Mean salary of 60 workers of a factory from the following table.

Salary (in Rs.) x_i	Number of Workers (frequencies) f_i	$f_i x_i$
3000	16	
4000	12	
5000	10	
6000	8	
7000	6	
8000	4	
9000	3	
10000	1	
TOTAL	$\Sigma f_i =$	$\Sigma f_i x_i =$

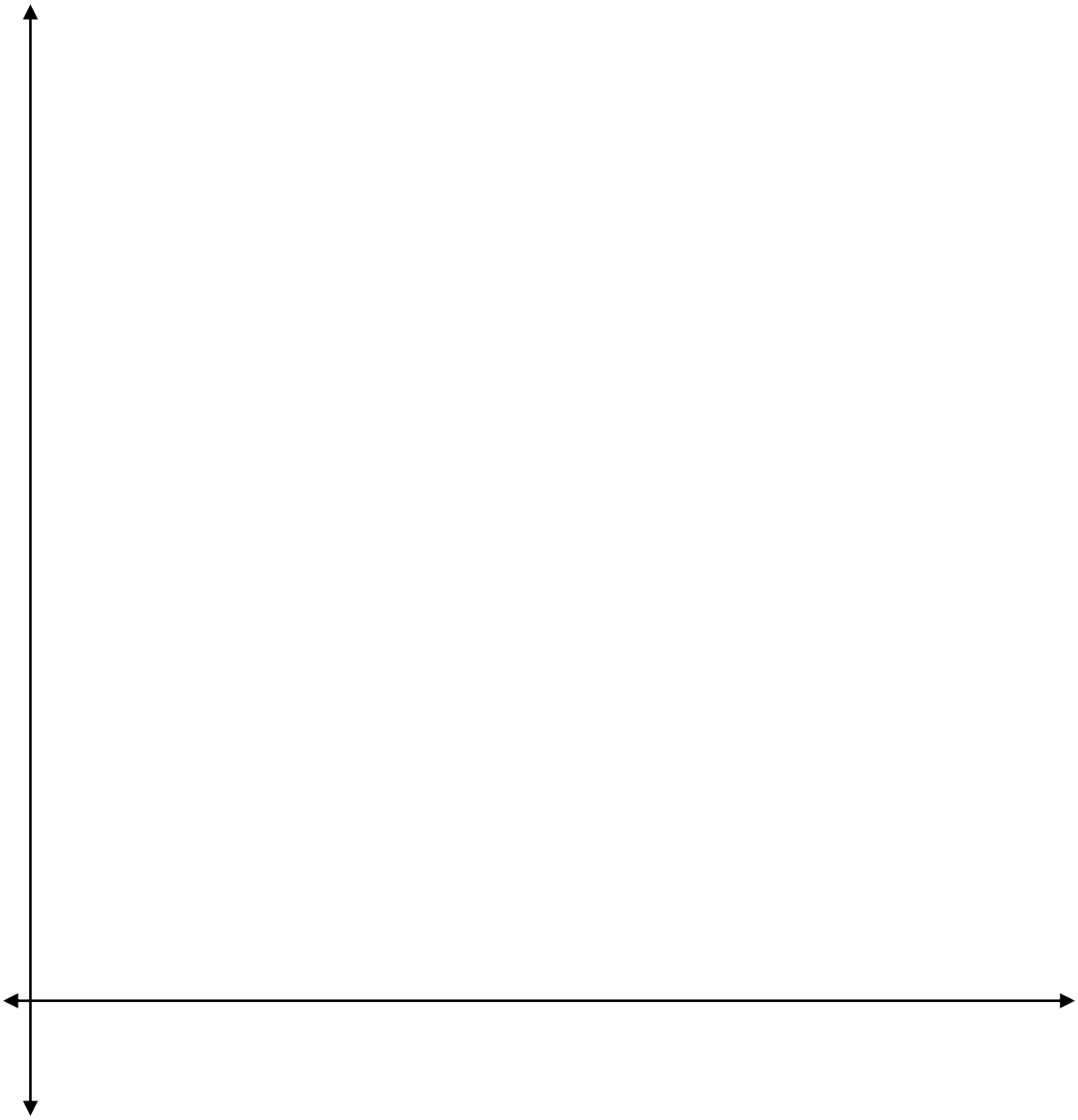
$$\therefore \quad \textbf{Mean} = \Sigma f_i x_i \,/\, \Sigma f_i$$

Space For Rough Work

(continue……)

Exercise – 3: Draw a Bar graph for the data given in the following table (Use two different colors to show two different bars in the graph).
X-axis = Months and Y-axis = Amount in Rs.

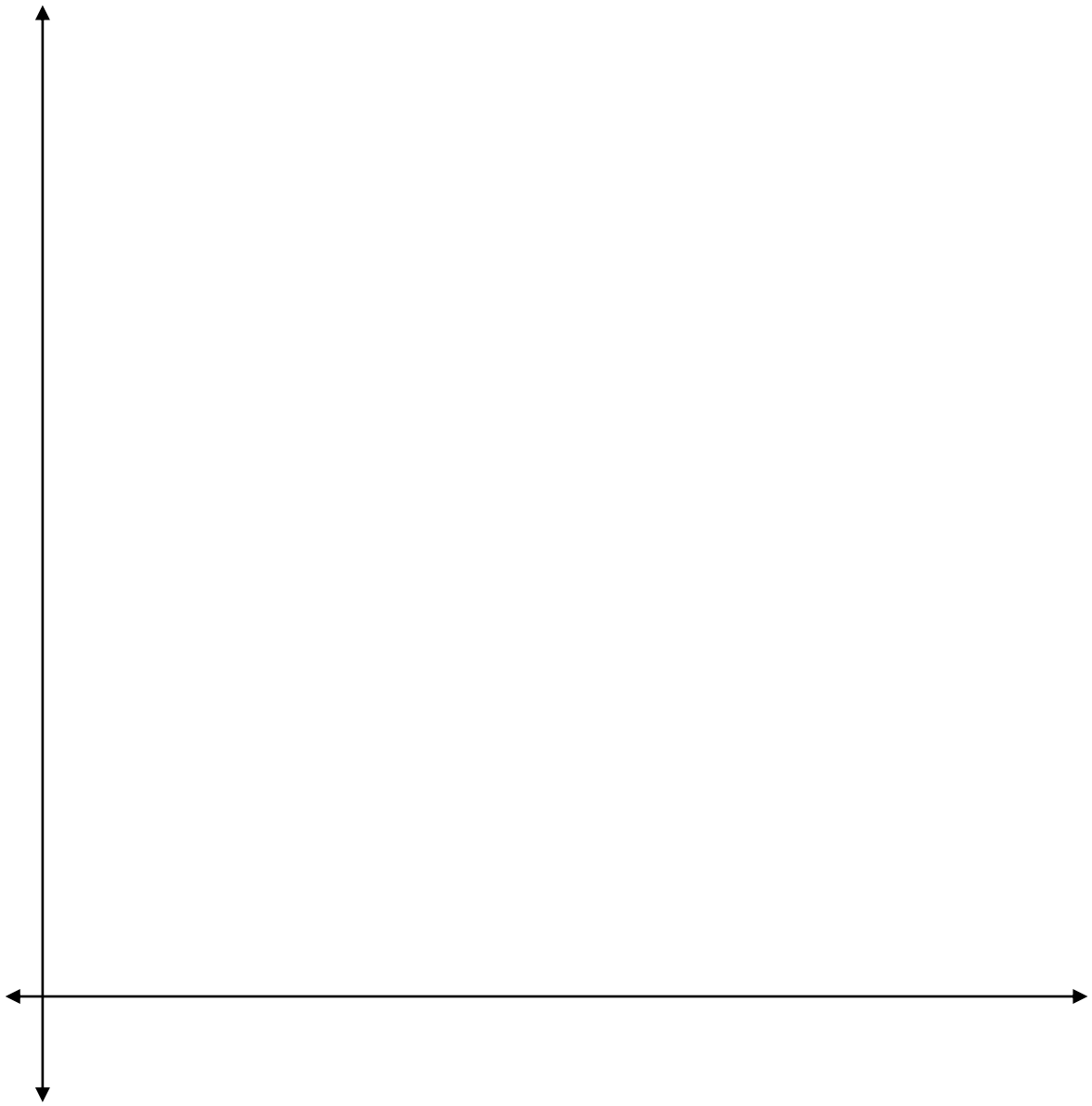
Months	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
H(Rs.)	200	245	300	400	410	356	375	230	280	200	190	195
K(Rs.)	344	289	295	425	425	220	200	305	365	186	205	250



Exercise – 4: Draw a Histogram and a Frequency Polygon for the data given in the following table (Use two different colors for two different type of graph). **Draw the graphs only for the Presidents had working period in between 1960 to 1990.**
X-axis = Years from 1960 to 1990 and Y-axis = Total Days of working. On top of the bars, mention/label with respective Sr. No. of the Presidents instead of writing their names.

(continue……)

Sr. No.	Presidents of India	From	To	Days of Working
1.	Rajendra Prasad	1950	1962	4490
2.	Sarvepalli Radhakrishnan	1962	1967	1826
3.	Zakir Hussain	1967	1969	721
4.	Varahagiri Venkata Giri	1969	1969	78
5.	Muhammad Hidayatullah	1969	1969	35
6.	Varahagiri Venkata Giri	1969	1974	1826
7.	Fakhruddin Ali Ahmed	1974	1977	902
8.	Basappa Danappa Jatti	1977	1977	164
9.	Neelam Sanjiva Reddy	1977	1982	1826
10.	Giani Zail Singh	1982	1987	1826
11.	Ramaswamy Venkataraman	1987	1992	1827
12.	Shankar Dayal Sharma	1992	1997	1826
13.	Kocheril Raman Narayanan	1997	2002	1826
14.	A. P. J. Abdul Kalam	2002	2007	1826
15.	Pratibha Patil	2007	2012	1827



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MATHEMATICS
CHAPTER – 14: STATISTICS

ACTIVITY – 5: WHAT IS MY LEARNING STYLE?

(Analysis & Interpretation: Evaluating Myself as a Learner With Statistical Tool-Questionnaire)

Name & Roll no. of Students: _____

Date: _____ Std. : _____ School : _____

Questionnaire

SELECT (√) ANY ONE OPTION EITHER X or Y or Z FOR THE FOLLOWING QUESTIONS :		
1.	***What kind of book would you like to read for fun?***	
	X	A book with lots of pictures in it
	Y	A book with lots of words in it
	Z	A book with word searches or crossword puzzles
2.	***When you are not sure how to spell a word, what are you most likely to do?***	
	X	Write it down to see if it looks right
	Y	Spell it out loud to see if it sounds right
	Z	Trace the letters in the air (finger spelling)
3	***You're out shopping for clothes, and you're waiting in line to pay. What are you most likely to do while you are waiting?***	
	X	Look around at other clothes on the racks
	Y	Talk to the person next to you in line
	Z	Fidget or move back and forth
4.	***When you see the word "cat," what do you do first?***	
	X	Picture a cat in your mind
	Y	Say the word "cat" to yourself
	Z	Think about being with a cat (petting it or hearing it purr)
5.	***What's the best way for you to study for a test?***	
	X	Read the book or your notes and review pictures or charts
	Y	Have someone ask you questions that you can answer out loud
	Z	Make up index cards that you can review
6.	***What's the best way for you to learn about how something works (like a computer or a video game)?***	
	X	Get someone to show you
	Y	Read about it or listen to someone explain it
	Z	Figure it out on your own
7.	***If you went to a dance school, what would be most likely to remember the next day?***	
	X	The faces of the people who were there
	Y	The music that was played
	Z	The dance moves you did and the food you ate
8.	***What do you find most distracting when you are trying to study?***	
	X	People walking past you
	Y	Loud noises
	Z	An uncomfortable chair
9.	***When you are angry, what are you most likely to do?***	
	X	Put on your "mad" face
	Y	Yell and scream
	Z	Slam doors

10.	***When you are happy, what are you most likely to do?***	
	X	Smile from ear to ear
	Y	Talk up a storm
	Z	Act really hyper
11.	***When in a new place, how do you find your way around?***	
	X	Look for a map or directory that shows you where everything is
	Y	Ask someone for directions
	Z	Just start walking around until you find what you're looking for
12.	***Out of these three classes, which is your favourite?***	
	X	Art class
	Y	Music class
	Z	Dance / Sports / Gym class
13.	***When you hear a song on the radio, what are you most likely to do?***	
	X	Picture the video that goes along with it
	Y	Sing or hum along with the music
	Z	Start dancing or tapping your foot
14.	***What do you find most distracting when in class?***	
	X	Lights that are too bright or too dim
	Y	Noises from the hallway/outside the building (like traffic/someone cutting grass)
	Z	The temperature being too hot or too cold
15.	***What do you like to do to relax?***	
	X	Read
	Y	Listen to music
	Z	Exercise (walk, run, play sports, etc.)
16.	***What is the best way for you to remember a friend's phone number?***	
	X	Picture the numbers on the phone as you would dial them
	Y	Say it out loud over and over and over
	Z	Write it down or store it in your phone contact list
17.	***If you won a game, which of these three prizes would you choose?***	
	X	A poster for the wall
	Y	A music CD or mp3 download
	Z	A game of some kind (or a football or soccer ball, etc.)
18.	***Which would you rather go to with a group of friends?***	
	X	A movie
	Y	A concert
	Z	An amusement park
19.	***What are you most likely to remember about new people you meet?***	
	X	Their face but not their name
	Y	Their name but not their face
	Z	What you talked about with them
20.	***When you give someone directions for a way to your house, what are you most likely to tell them?***	
	X	A description of building and landmarks they will pass on the way
	Y	The names of the roads or streets they will be on
	Z	"Follow me—it will be easier if I just show you how to get there."

STATISTICS:

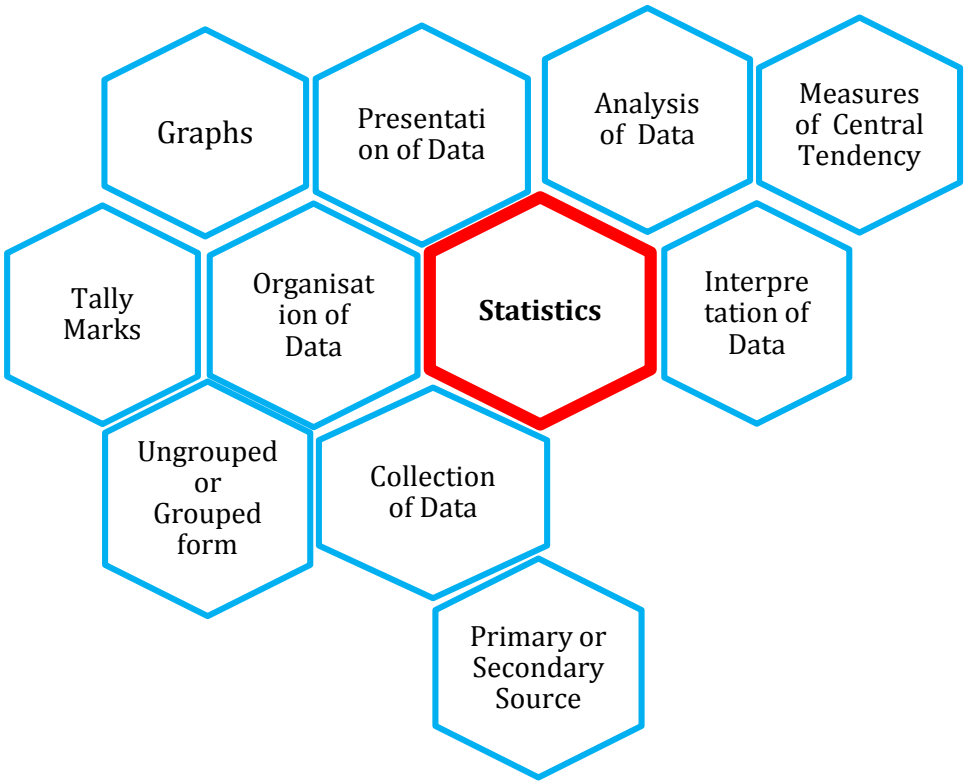
Responses / Answers	**Selected Options**			**HIGHEST**	**My Learning Style is:**
	X	**Y**	**Z**		
Numbers out of 20					
Percentage (%)					

♣♣♣♣♣♣♣♣

MATHEMATICS
CHAPTER – 14: STATISTICS
Class Activity: Concept Arrangement

Fill the hexagonal shapes with appropriate key-words given in a following table.

A. Primary &/or Secondary source	**F.** Collection of Data
B. Presentation of Data	**G.** Measures of Central Tendency(M, M, M)
C. Interpretation of Data	**H.** Ungrouped or Grouped Data
D. Graphs (Bar, Histogram, FP)	**I.** Analysis of Data
E. Tally Marks	**J.** Organisation of Data



★★★★★★★★★★ **END OF ACTIVITIES** ★★★★★★★★★★

Appendix – D(ii)

Final Draft: POST – TEST

Mathematics Achievement Test: 2014 - 2015

CHAPTER – 14 STATISTICS

Std.: IX **MM: 25 Marks** **Time: 30 minutes** **Date:**

Name of School: **Name of Student:** **Roll No.:**

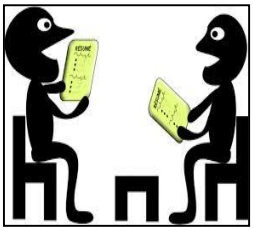
Q-1 Match the terms in Set-1 with their appropriate meanings in Set-2. (2)

Set – 1	Set - 2
A. Data	**1)** Data obtained/collected by the investigator herself or himself with definite objectives
B. Statistics in singular sense	**2)** Average
C. Datum	**3)** Numerical data
D. Primary Data	**4)** Arrangement of values in increasing manner from lower to higher order
E. Statistics in plural sense	**5)** Data obtained/collected from which already had the information stored or collected by others
F. Mean	**6)** A Single piece of information or fact
G. Ascending Order	**7)** A set or pieces of information, values or facts
H. Secondary Data	**8)** A subject deals with collection, presentation, analysis and interpretation of data

Answer: A⇨___; B⇨___; C⇨___; D⇨___; E⇨___; F⇨___; G⇨___; H⇨___

Q-2 Identify the given pictures representing the type of sources which are used for the 'Collection of meaningful Data'. Mention about the respective pictures whether it's a Primary or Secondary source of information. (2)

Taking Interview
1_____



Using Questionnaire
2_____

Newspapers
3_____

Experimentation
4_____

Q-3(A) Organize and present the data in a meaningful form. Also state whether it's a form of 'Ungrouped or Grouped Frequency Distribution'. (3½)

Look at a picture of Computer-Keyboard and prepare a table with the classifications of keys (like Alphabetical keys, Numerical keys, Special-character keys, Functional keys, Navigational (Arrow) keys, Other or Operational or System keys). Also mention the total number of keys (Frequency) fall in the respective classification/class/type.

The kind of Frequency Distribution is: _____

Table – 1: Frequency distribution

No.	Type of Keys (Class)	Total Number of Keys (Frequency)
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		

Q-3(B) Plot a Bar-graph for the data obtained in Table-1 of the Q-3(A) in a given space below. (2)

Q-4(A) The population of India as per the Census-2011 is 1,210,193,422. Following table consists of data about the population of 30 states of India given in the form of percentages of total population of India. Prepare a table for the distribution of population-percentages based class-intervals and show the number of states (frequency) fall under the respective class-intervals. (3)

Table-2: Population – percentage of Indian States

Sr. No.	States of India	(% of Total Population of India)	Sr. No.	States of India	(% of Total Population of India)
1	Andhra Pradesh	4.08%	16	Maharashtra	9.28%
2	Arunachal Pradesh	0.11%	17	Manipur	0.22%
3	Assam	2.58%	18	Meghalaya	0.24%
4	Bihar	8.58%	19	Mizoram	0.09%
5	Chhattisgarh	2.11%	20	Nagaland	0.16%
6	Delhi	1.38%	21	Odisha	3.47%
7	Goa	0.12%	22	Punjab	2.30%
8	Gujarat	5.00%	23	Rajasthan	5.67%
9	Haryana	2.09%	24	Sikkim	0.05%
10	Himachal Pradesh	0.57%	25	Tamil Nadu	5.96%
11	Jammu & Kashmir	1.04%	26	Telangana	2.97%
12	Jharkhand	2.72%	27	Tripura	0.30%
13	Karnataka	5.05%	28	Uttar Pradesh	16.49%
14	Kerala	2.76%	29	Uttarakhand	0.84%
15	Madhya Pradesh	6.00%	30	West Bengal	7.55%

The kind of Frequency Distribution is: _____

Table-3: Class-interval wise frequency distribution

No.	Class – Interval for Population-percentage(PP)	Frequency (Number of Indian States)
1.	**$0.1 \leq$ PP ≤ 2.0**	
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		

Q-4(B) Prepare a neat & clean Histogram as well Frequency Polygon based on the data of Table-3 obtained from table-2 of Q-4(A). Put appropriate labels and write necessary data/ information in the graph. (4)

.

Q-5 Following table shows the data for the matches won by two Teams A & B. Find Mean, Median and Mode for each of the Teams and make some conclusions about the better performance of the Teams based on the Measures of Central Tendency. (6)

Match Series		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. Of matches Won by	Team A	2	1	8	9	4	5	6	10	6	2
	Team B	5	6	2	10	5	6	3	4	8	10

Answer:

Table for Arranged Data

No. Of matches Won by	Team A										
	Team B										

Calculations for Team A

Calculations for Team B

Interpretation:

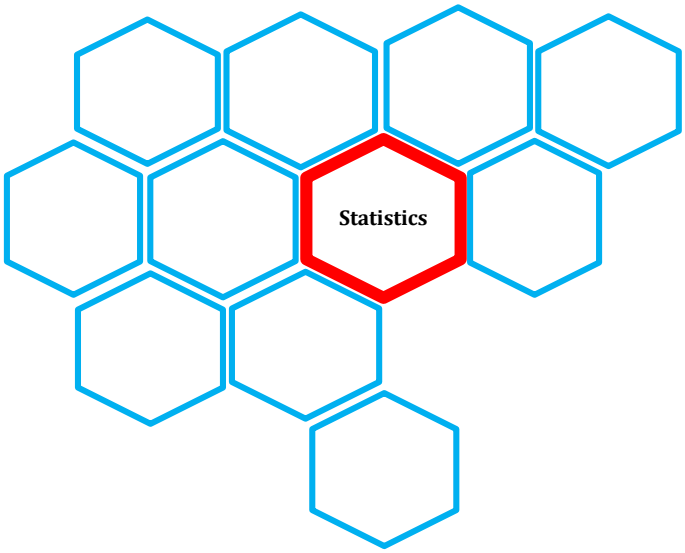
_____

_____

_____

Q-6 Observe the key-terms given in the following table. Arrange all the terms meaningfully with the help of hexagonal shapes. If necessary than add more hexagonal shapes in the following arrangement. (2½)

A. Primary &/or Secondary source	**F.** Collection of Data
B. Presentation of Data	**G.** Measures of Central Tendency(M, M, M)
C. Interpretation of Data	**H.** Ungrouped or Grouped Data
D. Graphs (Bar, Histogram, FP)	**I.** Analysis of Data
E. Tally Marks	**J.** Organisation of Data



Space For Rough Work

●●●●●● **ALL THE BEST** ●●●●●●

Appendix – D(iii)

Final Draft

REACTION - REFLECTION SHEET

2014 – 2015

Name of Student: _____ **IX** Roll No

Name of School: _____

► **Put tick-marks at appropriate option/s (a, b, c, or d):**

Chapter – 14 Statistics		
SOLO Levels	**Item No.**	**Item – Statements About My Learning Experiences and Achievements**
●	**1)**	**Whether I have participated in an Activity-1 which was in small group and with Play-cards ?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	2)	**I found an Activity-1 (in general) as:**
	a)	It was like funny and kid's activity but was having the practical aspect for learning
	b)	Good Activity to introduce the concept of Statistics with a small set of play-cards
	c)	No relevance of this activity of play-cards with Statistics
	d)	Not suitable for the level of grade-IX
	3)	**How was an Activity-1 for me ?**
	a)	I was just a spectator in a group so I don't know much about an activity
	b)	Simple activity of play-cards made easy to learn the concepts / terms of Statistics
	c)	Boring activity as I don't like play-cards
	d)	Appropriate activity to learn with play-cards but I don't like to do in a group
I	**4)**	**I did a small-group Activity–2 "Frequency Distribution" or not?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	5)	**I can say about this Activity-2 (in general) as:**
	a)	Interesting activity
	b)	Pictures of group of 'Smiley' & 'Bank-clients' were quite relevant with the concept/s
	c)	Picture based data were appropriate to differentiate two types of frequency distribution
	d)	Don't like to do such activity in a group as not getting chance to learn/solve activity
	6)	**The Activity - 2 for me was :**
	a)	Enjoyed an activity as given in a small-group
	b)	Really helped me to learn about the meaning of frequency as well two type of Frequency Distribution i.e. Ungrouped & Grouped
	c)	Just did the activity as other group members were actually doing it
	d)	No Comments
III	**7)**	**Whether I was present for an Activity – 3 about "A.M. Food / Breakfast Habits" – the Survey kind of activity ?**
	a)	Yes
	b)	No
	8)	**How was an Activity - 3 for me ?**

	a)	Actually, not understood the activity
	b)	Very appropriate for learning about and through the Survey - the way for 'Collection of Data' in a very practical manner
	c)	Different kind of approach enjoyed for understanding the concepts of Statistics like Collection, Organisation & Presentation of the data as well about the Tally marks
	d)	I don't know what I have learnt
	9)	**Whether I have participated in an Activity-4 for learning about the "Statistical Graphs" ?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	10)	**How I found this activity for me ?**
	a)	Experienced different way of depicting a Bar-graph , Histogram & Frequency Polygon
	b)	Appreciate the easy way of putting data to build the pillars of the graphs which really develops understanding on desired concept
	c)	Such exercises are suitable for primary level and not for the secondary classes
	d)	Unable to comment
	11)	**Whether I have solved a 'Class / Practice Worksheet'?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	12)	**What I have learnt from a Practice Worksheet ?**
	a)	Different kind of examples to solve & Statistical graphs to prepare
	b)	I was confused and found difficulties in solving a worksheet
	c)	Easy Exercises but felt very tedious task to do
	d)	Nothing
	13)	**Whether I did an Activity – 5 on "What is my learning style?" ?**
	a)	Yes
	b)	No
	14)	**My Learning experience about the Statistics, from Activity –5 is :**
	a)	I found it as meaningless activity
	b)	Appropriate exercise was given to understand the concepts of Analysis and Interpretation of the Data
	c)	Activity was not understood by me
	d)	Different way of learning for the essential concepts of Statistics
	**15)**	**According to me an exercise on 'Concepts/topics arrangement through Hexagonal shapes', helps to:**
	a)	Give complete view for the content of a chapter
	b)	Unable to say
	c)	Yet I haven't understood the purpose of doing this exercise
	d)	Gain overall understanding about a chapter with a quick reference
	16)	**Whether my Knowledge / Understanding on Statistics have been improved because of the way of teaching - learning ?**
	a)	Yes but little
	b)	Yes and more
	c)	Unable to decide
	d)	No comment
What I liked Most?		
What I not liked?		
Your General Comments (About Instructor, Teaching-learning process, Remarks/ Improvements, Suggestions...):		

●●●●●

◆◆◆◆◆◆HOPE ENJOYED THE LESSON◆◆◆◆◆

APPENDIX – E

PLAN FOR
CHAPTER – 15 PROBABILITY

- **Unit Plan For A Chapter**
- **Achievement Test (Post-test) For A Chapter**
- **Reaction-Reflection Sheet For A Chapter**

Appendix – E(i)

S.O.L.O. TAXONOMY BASED INSTRUCTIONAL STRATEGY

UNIT PLAN - 5

CHAPTER – 15 PROBABILITIES

■ Topics Of A Chapter In A Mathematics Class-IX Textbook

- Introduction
- Probability - An Experimental Approach
- Summary

■ SOLO Level-wise Concept/ Conceptual Mapping

SOLO Levels	Learning Points / Concepts / Topics
 Pre-structural	• The meaning of commonly used words like Choices, Chances, Certainly, Doubt, Probably, Most Probably etc.. • The meaning of the keywords like Random Selection, Sample, Space, Events, Trials, Outcomes, Favourable & Unfavourable Outcomes • Examples /Activities
 Uni-structural	• To understand the meaning of the word Probability • To understand the Concept of the Probability – An Experimental Approach • Understanding of Probability with Probability Line, Probability Scale & Probability Tree • Examples / Activities
 Multi-structural	• More Understanding about the Concept of the Probability using Probability Tree • Experimental Probability and Theoretical Probability • Knowing the means of the Events, Trials and Outcomes • Experimental Examples / Activities
 Relational	• More Learning on Types of Events – Independent, Dependent & Mutually Exclusive Event/s • Examples / Activities
 Extended Abstract	• Understanding the relevance of Probability with the Statistics • Interdisciplinary Learning – Probability Scale and English Grammar • Activity / Examples

■ SOLO Level-wise Instructional Objectives

Pre-structural

1) Students have learnt about the meanings of the words like chance/s, choice/s, certainly, probably, Events, trials, outcomes experiment, favourable & unfavourable.
2) Students know how to apply these words to make meaningful sentences.

Uni-structural

1) Students will be able to recall and identify the means of terms like choices and chances help to understand the concept of Probability.
2) Students will be able to state the examples or sentences in order to practice the Probability on a Probability Line.
3) Students will be able to recall the concept of tree-diagrams and to form such Probability-tree constituted with all its trials or sub-events of the main event.

Multi-structural

1) Students will be able to rework on the terms like Chances, Events, Trials, and Outcomes to understand the concept of Probability.
2) Students will be able to explain about the means of the Events, Trials and Outcomes of the Probability.
3) Students will be able to examine the Probability line and tree to understand the concept of Probability.
4) Students will be able to construct the Probability tree based on given event or situation.
5) Students will be able to clarify about the Experimental and Theoretical Probability.

Relational

1) Students will be able to classify the Probability based events as Independent, Dependent & Mutually Exclusive Event.
2) Students will be able to observe and relate the given events with appropriate type of event.
3) Students will be able to apply their understanding on the types of events by giving examples of respective events.
4) Students will be able to analyse the derivation of Probability tree/s based on the types of the events.
5) Students will be able to demonstrate their understanding on Probability based events through the Probability trees.

Extended Abstract

1) Students will be able to visualize the relevance of Probability with the Statistics
2) Students will be able to judge on the applications of the Probability and the Statistics.
3) Students will be able to reflect on need and derivation of the conclusions about any event or research study using both the concepts of Probability and Statistics.
4) Students will be able to theorise the relation between the concepts of Probability Scale with English.
5) Student will be able to invent knowledge on learning of Mathematics and English together.

■ METHODOLOGY

Method : Activity based and Heuristic Method

Approach : Inductive and Inducto-deductive

Media : Chalk/White board, Roller board, Charts, Tablet-PC

Materials : SOLO Worksheets, Card boards, Thread, Geometrical box, other materials were used as shown in the figures of Photo-gallery-1(Appendix-G).

■ LESSON - PLAN

Day No.	Date	Day	Time (am)	Content Details	Settings	SOLO Level
1.	24/02/ 2015	Tue	08:30 – 09:10	(Permission and preparation for AV and Computer room)	-	-
2.	25/02/ 2015	Wed	08:55 – 09:35	**PPT1 presentation on Probability** Topics Covered: Given understanding on the topics of Probability (Terms used in Probability, Probability line, some examples) Questioning & Probing: a) Queries will be solved during the explanation and questions will be raised based on the interactions with the students. Home Task: Read the chapter on Probability from textbook.	Class	All
3.	26/02/ 2015	Thurs	08:30 – 09:10	**PPT2 presentation on Probability** Topics Covered: Given understanding on the topics of Probability (Probability tree, experiments, types of events, examples) Questioning & Probing: b) Discussions on various topics of Probability. Home Task: Prepare some examples from day-to-day real life based on Probability	Class	All
4.	27/02/ 2015	Fri	08:30 – 09:10	**Activity-1 Probability Line (Chart Paper and Worksheets)** Topics Covered: Identifying the words giving indications about Probability Arranging statements showing	Class and Individual	

				Probability aspects on a Probability line		
				Questioning & Probing: c) Discussions.		
				Home Task: Frame such sentences in English using terms of the Probability.		
5.	02/03/ 2015	Mon	08:30 – 09:10	**Activity-2 Probability,** **Activity on Chart Paper - 'Choices & Chances'**	Class and Pair	
				Topics Covered: Understanding a meaning of Probability, Probability tree		
				Questioning & Probing: d) Discussions		
				Home Task: Prepare some examples from day-to-day real life based on choices and chances.		
6.	03/03/ 2015	Tue	08:30 – 09:10	**Activity-3 Doing Experiment** **Activity-4 Probability Tree**	Group	
				Topics Covered: Understanding the terms like trials, events, outcomes, experimental probability Theoretical probability, tree-diagram to show probabilities		
				Questioning & Probing: e) Discussion		
				Home Task: Complete Exercise-15.1 (examples 1 to 5)		
7.	04/03/ 2015	Wed	08:55 – 09:35	**Activity-5 Types of Events** **Activity-6 Probability and Statistics** **Class activity: Concept Arrangement**	Class, Group Indivi dual	
				Topics Covered: Independent and Dependent Events and about their Probabilities Use of Probability in Statistics Overview on a chapter		
				Questioning & Probing: f) Discussion on Activities		
				Home Task: Complete Exercise-15.1 (examples 6-13)		
8.	05/03/ 2015	Thurs	08:30 – 09:10	**Achievement Test For Chapter - 15**		
				Feedback using **SOLO Reflective-Reaction Sheet**		

■ BLUEPRINT FOR ACHIEVEMENT TEST

BLUEPRINT SOLO Level wise structure for Achievement Test For the Chapter – 15 Probability; MM – 25 Time – 30 minutes			
SOLO Level	**About Content**	**Q. No. & Marks/Q**	**Total Mark**
 **Pre-structural**	Terms used to give indications for Probability	**Q-1 [M-2½]**	**2½**
 **Uni-structural**	Understanding on Probability (Probability line, random selections, chances for outcomes)	**Q – 2 [M-3]** **Q - 3 [M-2½]** **Q – 4 [M-5]**	**10½**
 **Multi-structural**	Presentation of Probabilities through Probability tree	**Q – 6(a) [M-3]**	**3**
 **Relational**	Types of events in Probability	**Q-5 [M-3]** **Q – 6(b) [M-2]**	**5**
 **Extended Abstract**	Probability and Statistics Concept Arrangement	**Q-7[M-2½]** **Q-8 [M-1½]**	**4**
		Total	**25**

Instructions For Test:

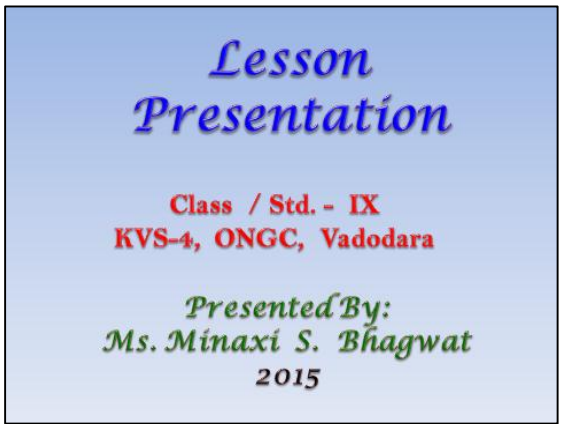
1. First write down your name, your roll number, name of school, date and standard in appropriate place given on the sheet.
2. First read all the questions carefully.
3. All the questions are compulsory. Write it with good handwritings.
4. It's a question cum answer sheet, so all the answers you have to write in this sheet at appropriate place.
5. Ask for the separate sheet for the rough work or as supplementary.
6. Draw neat and clean figures wherever it is required.

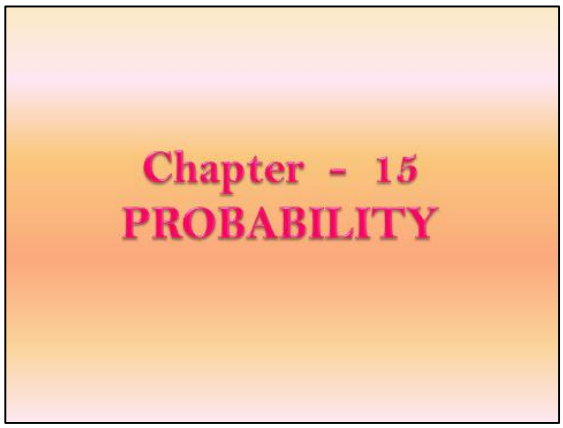
■ ACTIVITIES ARE AS FOLLOWS (from next page):

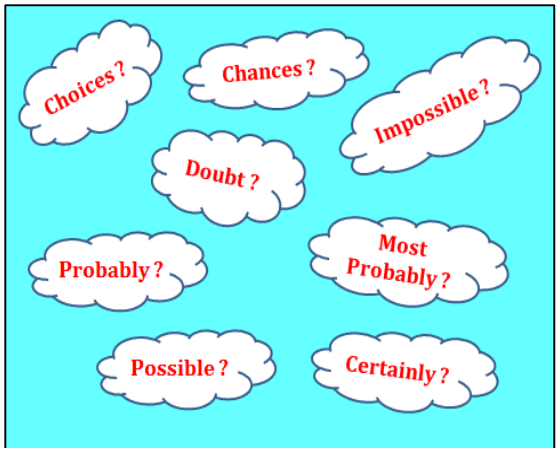
●●●●●●**END OF UNIT PLAN - 5** ●●●●●●

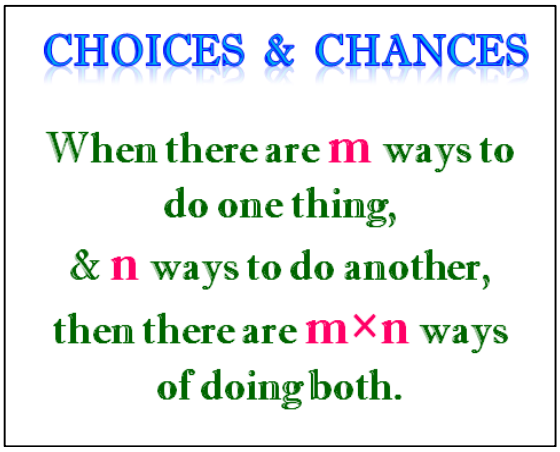
MATHEMATICS
CHAPTER – 15: PROBABILITY

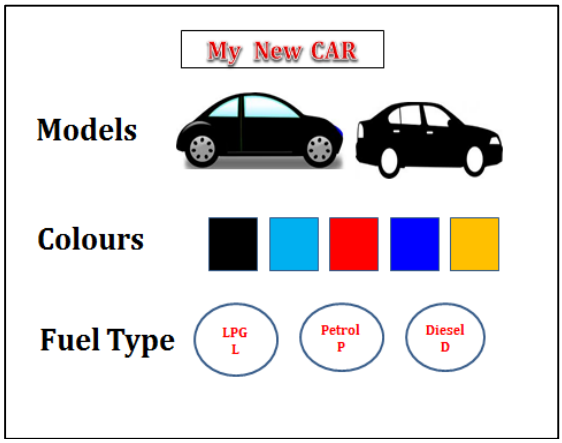
PPT Presentation (SOLO Level-wise)

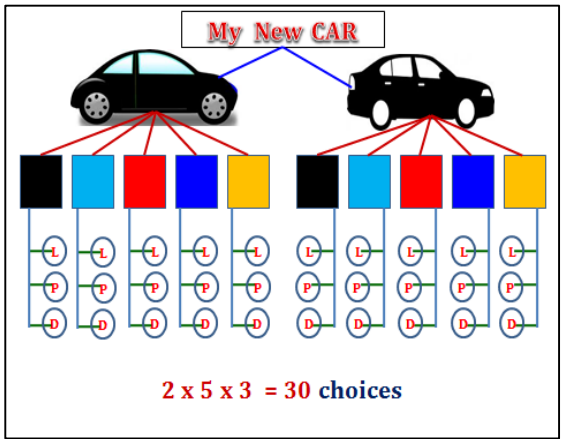




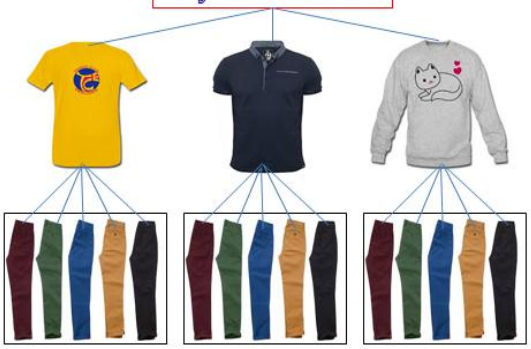








My New Outfit



3 T-shirts x 5 Pants = 15 Outfits choices

PROBABILITY

Probability is the **Chance** that something will happen.

- Theoretical Probability
- Experimental / Empirical Probability

PROBABILITY

Example : Tossing a Coin

A Coin is tossed 1000 times with the Frequencies (times) :

Head : 455 (times)

Tail : 545 (times)

Compute the Probability for each Event.

PROBABILITY

Example : Tossing a Coin

Trials : (Tossing a Coin) 1000 times

Outcomes : Head or Tail (only)

Events(E) : H = Events of getting a Head

T = Events of getting Tail

Probability : P(Events) = P(E)

PROBABILITY

Example : Tossing a Coin

Computing Probability

$$\text{Probability for H} = \frac{\text{Number of Heads (Frequencies)}}{\text{Total number of Trials}}$$

$$P(H) = \frac{455}{1000} = 0.455$$

PROBABILITY

Example : Tossing a Coin

Computing Probability

$$\text{Probability for T} = \frac{\text{Number of Tails (Frequencies)}}{\text{Total number of Trials}}$$

$$P(T) = \frac{545}{1000} = 0.545$$

$\therefore P(H) + P(T) = 0.455 + 0.545 = 1$

PROBABILITY

Formula :

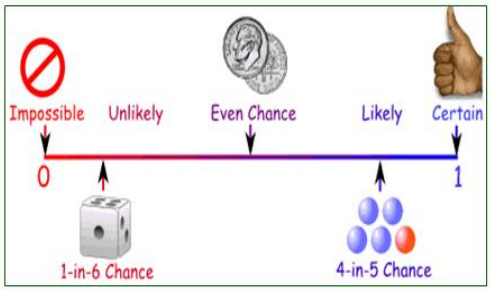
$$P(E) = \frac{\text{No. Of Trials in which E has happened}}{\text{Total no. Of Trials}}$$

Where,

E = Events / Outcomes

P = Probability

PROBABILITY & PROBABILITY LINE



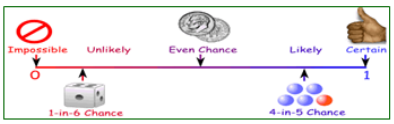
PROBABILITY & PROBABILITY LINE

The probability of an event occurring is somewhere between **Impossible and Certain**.

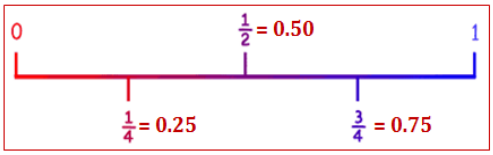
As well as words we can use numbers (such as fractions or decimals) to show the probability of something happening:

- **Impossible is Zero**
- **Certain is One.**

PROBABILITY & PROBABILITY LINE



Here are some fractions on the probability line :

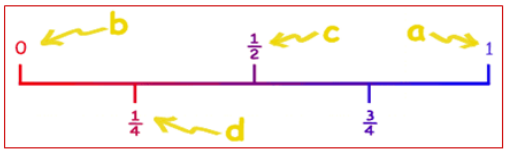


PROBABILITY & PROBABILITY LINE

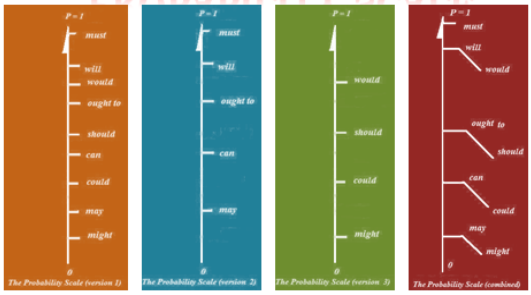
Example :

We can also show the chance that something will happen:

a) The sun will rise tomorrow.
b) I will not have to learn mathematics at school.
c) If I flip a coin it will land heads up.
d) Choosing a red ball from a sack with 1 red ball and 3 green balls



PROBABILITY & PROBABILITY SCALE



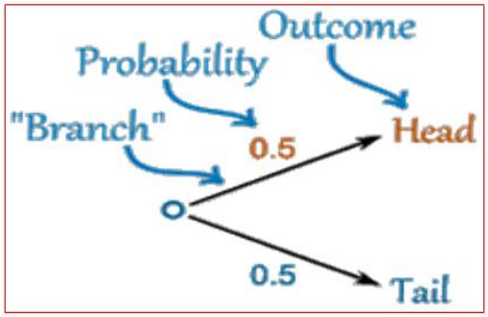
PROBABILITY WITH TREE DIAGRAM

Calculating probabilities can be hard, sometimes we add them, sometimes we multiply them, and often it is hard to figure out what to do ???? ...

Tree Diagrams are the Best Option!

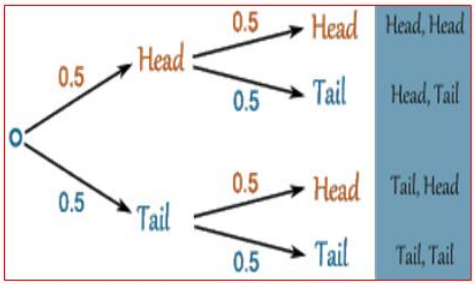
PROBABILITY WITH TREE DIAGRAM

Here is a tree diagram for the toss of a Coin:



PROBABILITY WITH TREE DIAGRAM

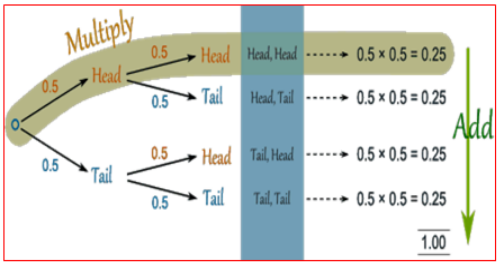
We can extend the tree diagram to Two tosses of a Coin:



PROBABILITY WITH TREE DIAGRAM

How do we calculate the overall probabilities?

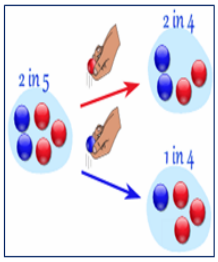
- We **multiply** probabilities **along the branches**
- We **add** probabilities down **columns**



PROBABILITY

Experiment with Marbles In a Bag

PROBABILITY



- **2 Blue** and **3 Red** marbles are in a bag.
- What are the chances of getting a **Blue** marble? The chance is **2 in 5**

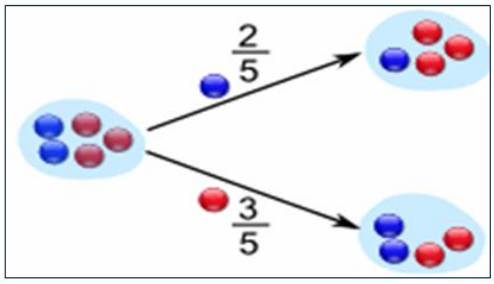
But after taking one out the chances change!

So the next time:

- if we got a **Red** marble before, then the chance of a **Blue** marble next is **2 in 4**
- if we got a **Blue** marble before, then the chance of a **Blue** marble next is **1 in 4**

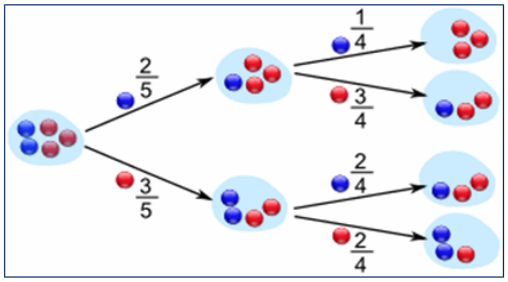
PROBABILITY

There is a 2/5 chance of pulling out a Blue marble, and a 3/5 chance for Red :



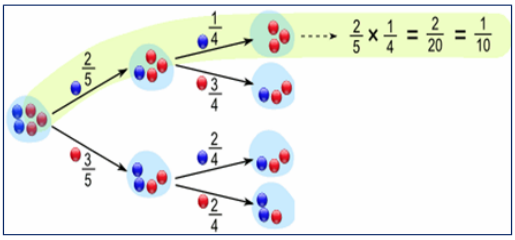
PROBABILITY

We can even go one step further and see what happens when we select a second marble:



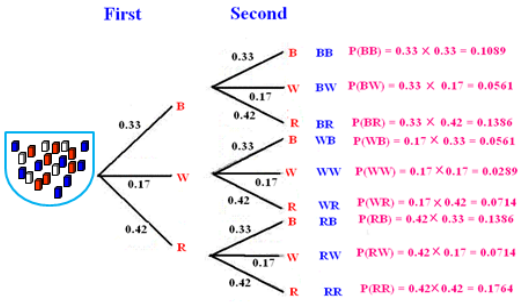
PROBABILITY - CALCULATION

"What are the chances of drawing 2 blue marbles?"
Answer: it is a **2/5 chance** followed by a **1/4 chance**:



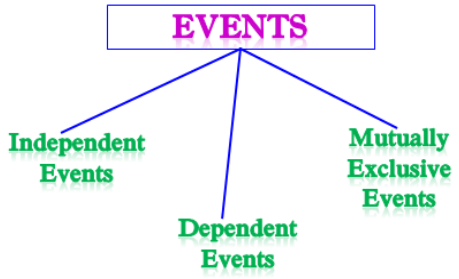
The chances of drawing 2 Blue marbles is 1/10

PROBABILITY - CALCULATION



http://math.tutorvista.com/statistics/tree-diagram.html

EVENTS



EVENTS

When we say "Event" we mean one (or more) outcomes.

Example Events:

- Getting a Tail when tossing a coin is an event.
- Rolling a "5" is an event.

An event can include several outcomes:
Choosing a "King" from a deck of cards (any of the 4 Kings) **is also** an event Rolling an "even number" (2, 4 or 6) is an event

Events can be:

1) **Independent** (each event is **not** affected by other events),
2) **Dependent** (also called "Conditional", where an event **is** affected by other events)
3) **Mutually Exclusive** (events can't happen at the same time)

EVENTS

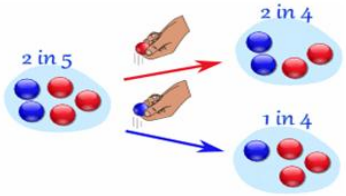
Independent Events

Events can be **"Independent"**, meaning each event is **Not Affected** by any other events.

EVENTS

Dependent Events

Events can also be "dependent"... which means they **can be affected by previous events**...



EVENTS

EXAMPLE : Independent OR Dependent

Let's look at the chances of getting a King.

EVENTS

EXAMPLE : Independent OR Dependent

Let's look at the chances of getting a King.

- For the 1st card the **chance of drawing a King is 4 out of 52**

EVENTS

EXAMPLE : Independent OR Dependent

Let's look at the chances of getting a King.

- But for the 2nd card:
  - If the 1st card was a King, then the 2nd card is **less** likely to be a King, as only 3 of the 51 cards left are Kings.
  - If the 1st card was **not** a King, then the 2nd card is slightly **more** likely to be a King, as 4 of the 51 cards left are King.

This is because we are **Removing Cards** from the deck.

EVENTS

Replacement : (not removing)

When we put each card **back** after drawing it the chances don't change, as the events are **Independent**.

Without Replacement : (after removing)

The chances will change, and the events are **Dependent**.

EVENTS

Mutually Exclusive

Mutually Exclusive means we can't get both events at the same time. It is either one or the other, but **not both.**

Examples:

- Turning left or right are Mutually Exclusive (you can't do both at the same time)
- Heads and Tails are Mutually Exclusive
- Kings and Aces are Mutually Exclusive

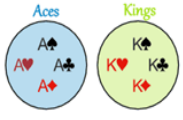
EVENTS

Not Mutually Exclusive

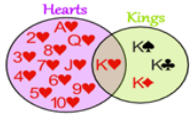
Not Mutually Exclusive means we can get both the events at the same time.

Examples: (Mutually Exclusive & Not Mutually Exclusive)

- Kings and Hearts are **not** Mutually Exclusive, because we can have a King of Hearts!



Aces and Kings are Mutually Exclusive



Hearts and Kings are not Mutually Exclusive

EXERCISE

1. What is the Probability of the Pink color to be pointed by a pointer?

   Answer: 2/7

2. Which color/s is/are least likely to be pointed by a pointer?

   Answer: Red and Blue

3. What is the probability of pointing to the colors which is not blue?

   Answer: 6/7

EXERCISE

4. What is the Probability of the Red color to be pointed by a pointer?

   Answer: 1/7

5. Which color is most likely to be pointed by a pointer?

   Answer: Yellow

6. What is the probability of pointing to the colors which is not Pink?

   Answer: 5/7

Thank You

Reference

http://www.superteacherworksheets.com/probability.html

https://stsampsonshigh.files.wordpress.com/.../**probability-tree-diagrams**....

http://www.cbs.polyu.edu.hk/ctyjiang/file/notes_new/3479/8.htm

http://www.mathsisfun.com/data/probability-tree-diagrams.html

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MATHEMATICS
CHAPTER – 15: PROBABILITY

ACTIVITY – 1: PROBABILITY LINE
(Identifying the Words that giving indications about Probability)

Name & Roll no. of Students: _____

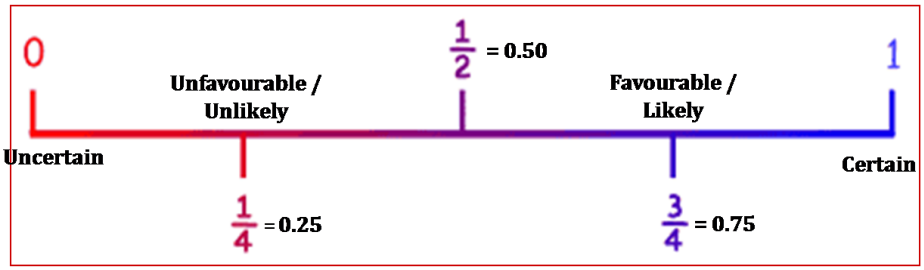
Date: _____ Std. : _____ School : _____

(A) Underline the word/s in the given sentences which gives indication/s about the Probability.

1) I think parents should be able to exercise some choice over what their children see on the Internet.
2) If prices are low, its probably because of lack of demand.
3) Students are given the chance to learn another language.
4) I am not absolutely certain, but I think I am right.
5) I have serious doubts about whether this system will work.
6) Most probably, this time Anita will get a first rank.
7) The meetings are very short, so there are chances for the real discussions.
8) Rohit was facing a difficult choice between studying Science or Commerce.
9) Definitely the given project is going to be completed within a day.
10) We are sure about to attend the function that is arranged for our farewell.

(B) Arrange the following sentences on the given Probability Line.

a) The future of the company is still in doubt.
b) Rolling a dice.
c) On 6th March, there will be a holiday for the Holi-Dhuleti.
d) Five boys are selected for the dance from the group of six boys and nine girls.
e) India now may be a place in the World-cup finals.
f) I have no doubt that he will succeed.
g) Tomorrow will be holiday for the fest of Kite flying.
h) Selection between the north pole or south pole.
i) You are allowed to select any one field of either Engineering or Medical.
j) Rozy took some 4 potatoes from a basket contains 1kg potatoes & 50gm of tomatoes.



♣♣♣♣♣♣♣♣♣♣♣

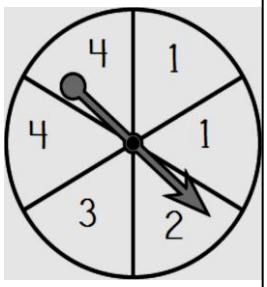
MATHEMATICS
CHAPTER – 15: PROBABILITY

ACTIVITY – 2 : PROBABILITY
(Understanding the Meaning of Probability)

Name & Roll no. of Students: _____

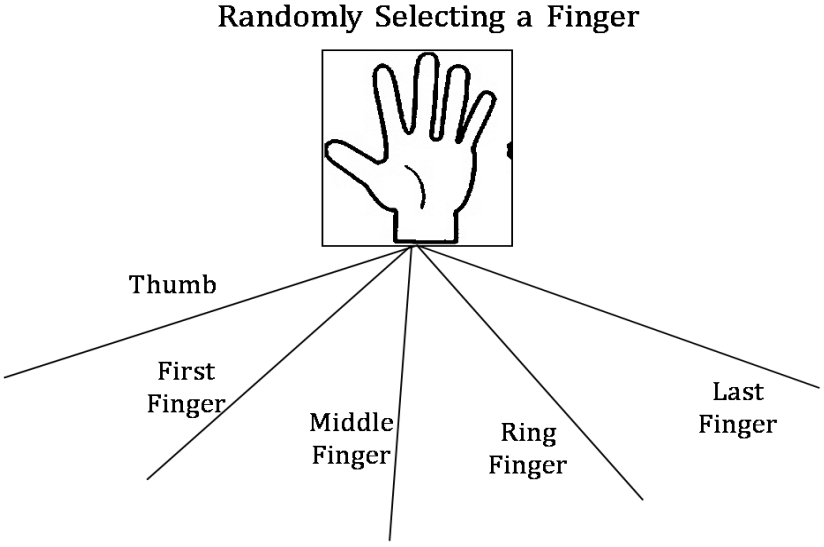
Date: _____ Std. : _____ School : _____

A. Based on the spinner shown in the following figure, answer the questions:



i) What is the Probability of the spinner landing on a 3? _____
ii) What is the Probability of the spinner landing on a 1? _____
iii) What is the Probability of the spinner landing on a 2? _____
iv) What is the Probability of the spinner not landing on a 3? ____
v) What is the Probability of the spinner not landing on a 1? ____
vi) What is the Probability of the spinner not landing on a 2? ____
vii) What is the Probability for Odd numbers and Even numbers?
_____

B. Based on the following Probability Tree, write down the possible probabilities at the end of the branches. Also count the Total Probability. (randomly selecting a finger from total five fingers)



∴ Total Probability = _____

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MATHEMATICS
CHAPTER – 15: PROBABILITY

ACTIVITY – 3: DOING EXPERIMENT

(Learning & Understanding the Terms like Trials, Events and Outcomes From An Experimental / Empirical Probability)

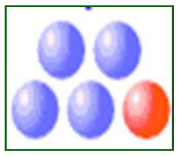
Name & Roll no. of Students: (1) _____

(2) _____ (3) _____

Date: _____ Std. : _____ School : _____

❖ **Tick Mark on the given picture that activity given to your group for the Experiment of Probability.**



- Total number of **Trials (T)** : **25 Times**
- Possible **Outcomes** (in your experiment) **(O)** : _____
- **Event** – (you have to set or decided by you) **(E)** : _____

❖ **In the given table, note down the outcomes that is obtained in each of the trials. (In the Table, T = Trials & O = Outcomes)**

T	O	T	O	T	O	T	O	T	O
1		6		11		16		21	
2		7		12		17		22	
3		8		13		18		23	
4		9		14		19		24	
5		10		15		20		25	

❖ **Find out the Probability P(E) for an Event (E), which is set by your group :**

$$P(E) = \frac{\text{Number of trials in which event E happened}}{\text{The total number of tirals}}$$

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MATHEMATICS
CHAPTER – 15: PROBABILITY

ACTIVITY – 4: PROBABILITY TREE

(Understanding Theoretical Probability & Preparing Probability Tree to show Probabilities)

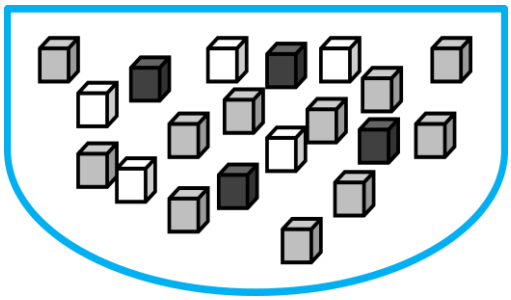
Name & Roll no. of Students: (1) _____

(2) _____ (3) _____

Date: _____ Std. : _____ School : _____

Draw a Probability Tree in the given space for the example:

In a given bowl there are 5 white cubes, 4 black cubes and 11 grey cubes. Randomly, a cube is selected and replaced it in first turn. In second turn also one cube is selected and replaced it. Now draw the Probability tree with all possibilities and also mention about Probabilities.



****

MATHEMATICS
CHAPTER – 15: PROBABILITY

ACTIVITY – 5: TYPES OF EVENTS
(Understanding on Independent & Dependent Events and Learning about the Probabilities)

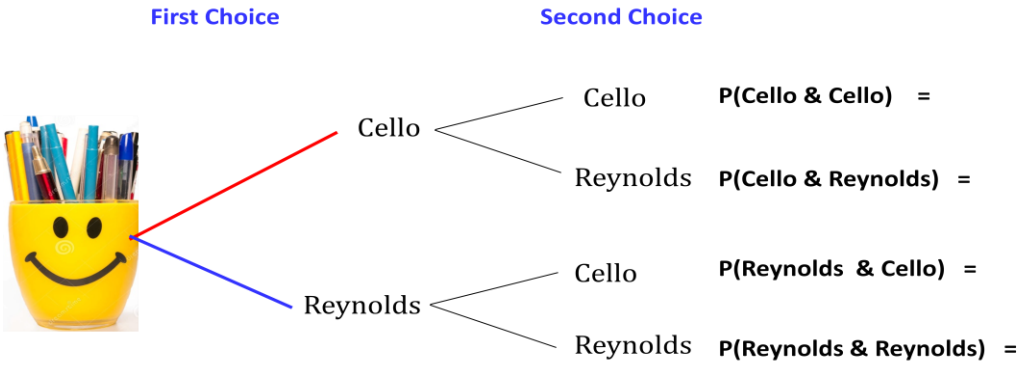
Name & Roll no. of Students: _____

Date: _____ **Std. :** _____ **School :** _____

Meaning:

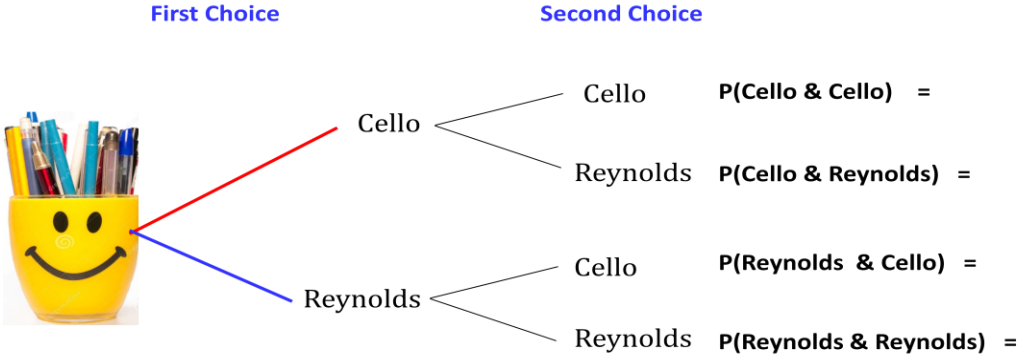
- Independent Events means With Replacements
- Dependent Events means Without Replacement
- Mutually Exclusive Events means two events cannot take place at a time

Example-1: Amit has ten pens of two brands (Cello & Reynolds) in a pen-box. Three of the pens are of Cello and 7 are of Reynolds. He removes a pen at random from the box and notes the brand before **replacing it**. He then chooses a second pen at random. Record the information in a tree diagram.



Count the Total Probability: _____

Example-2: Amit has ten pens of two brands (Cello & Reynolds) in a pen-box. Three of the pens are of Cello and 7 are of Reynolds. He removes a pen at random from the box and notes the brand but **does not replacing it**. He then chooses a second pen at random. Record the information in a tree diagram.



Count the Total Probability: _____

****

MATHEMATICS
CHAPTER – 15: PROBABILITY

ACTIVITY – 6: PROBABILITY & STATISTICS
(Understanding the Use of Probability in Statistics)

Name & Roll no. of Students: _____

Date: _____ Std. : _____ School : _____

(A) Solve the Example: The blood groups of 30 students of class VIII are recorded as Follows.

A, B, O, O, AB, O, A, O, B, A, O, B, A, O, O,
A, AB, O, A, A, O, O, AB, B, A, O, B, A, B, O.

Represent this data in the form of a frequency distribution in a given table.

Blood Groups (Class)							
No. Of Students (Frequency)							

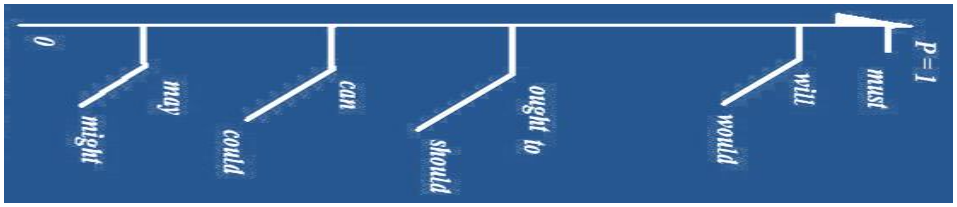
1) Which is the most common blood group among these students? _____

2) Which is the rarest blood group among these students? _____

(B) Use this table to determine the Probability that a student of this class, selected at random, has blood group AB

(C) Arrange / Position the given sentences on the given Probability Scale.

a) If the lights were on, they must have been at home.
b) By next month I should have enough money to buy a car.
c) It may rain this afternoon.

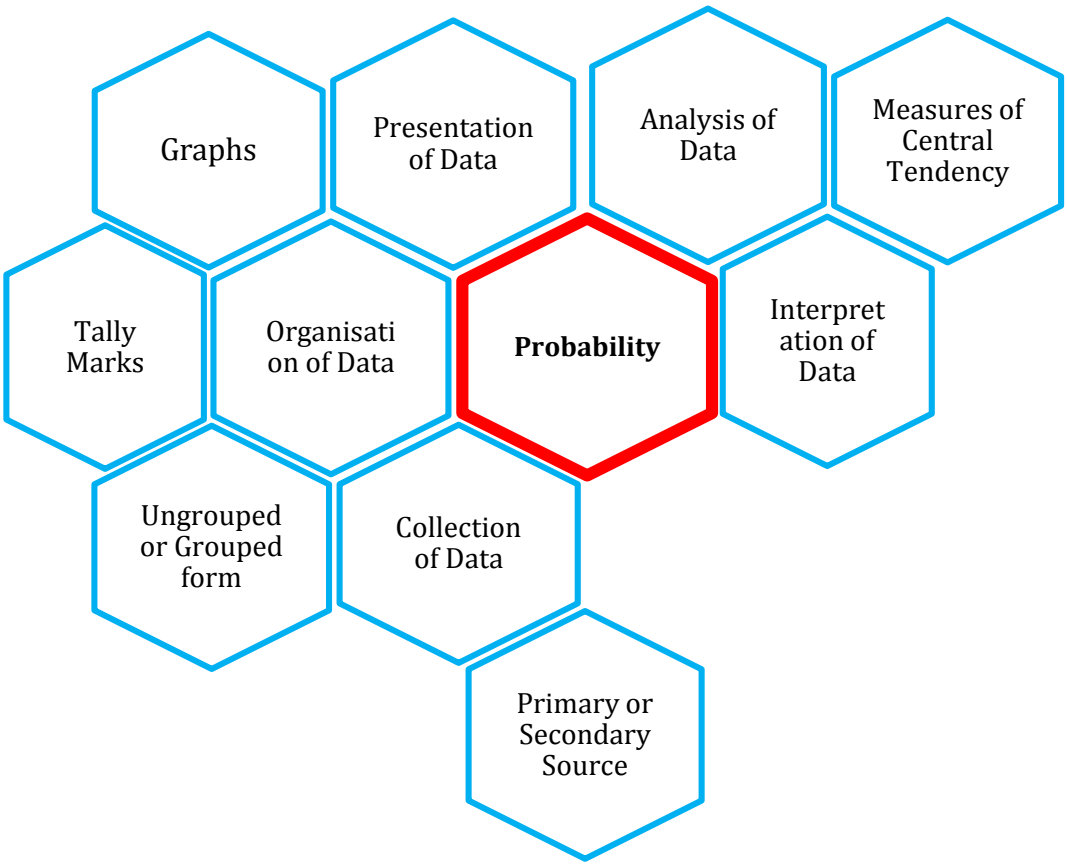


♦♦♦♦♦♦♦♦♦

MATHEMATICS
CHAPTER – 15: PROBABILITY

Concept Arrangement

A. Events	**F.** Dependent Event
B. Outcomes	**G.** Trials
C. Independent Event	**H.** Favourable /Unfavourable Outcomes
D. Experimental Probability	**I.** Mutually Exclusive Event
E. Rolling Dice	**J.** Without Replacement



★★★★★★★★★★ **END OF ACTIVITIES** ★★★★★★★★★★

Appendix – E(ii)

Final Draft: POST – TEST

Mathematics Achievement Test: 2014 - 2015

CHAPTER – 15 PROBABILITY

Std.: IX **MM: 25 Marks** **Time: 30 minutes** **Date:**

Name of School: **Name of Student:** **Roll No.:**

Q-1 Make appropriate sentences using the words given below. **(2½)**

i) Choice / Choices : _____

_____

_____

ii) Chance / Chances : _____

_____

_____

iii) Certainly : _____

_____

_____

iv) Probably : _____

_____

_____

v) Doubtful : _____

_____

_____

Q-2 Draw a Probability Line with appropriate labels (Fractions) and show the positions of given sentences on a Probability line according to their scale or level of uncertainty. **(3)**

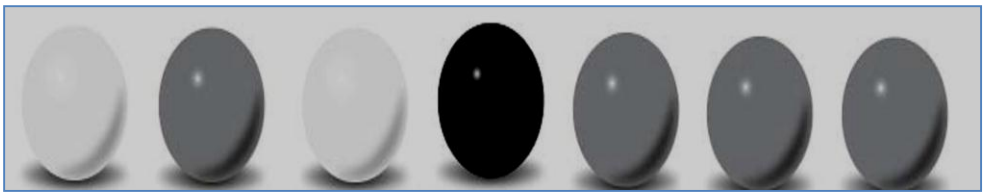
a) Tossing a Coin

b) Final board exams are going to start in the month of March

c) Selection of girls for sports team from a group of 3 girls and 7 boys

d) After an hour, there will be heavy rain in Vadodara

Q-3 The Marbles pictured below are grey, white & black in colour. They are placed in a bag and one is drawn at random. Based on this experiment, answer the questions A to E. (2½)



A. Which colour Marble is least likely to be drawn from the bag? _____

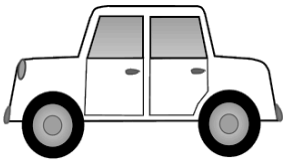
B. What is the Probability of drawing the black Marble from the bag? _____

C. What is the probability of drawing a grey Marble? _____

D. What is the Probability of drawing a marble that is not white? _____

E. If three more black marbles were added to the bag, then what would be the Probability of drawing a black marble? _____

Q-4 Mr. Shetty is looking for a vehicle to purchase from a fair of used vehicles. In a fair there are total 200 vehicles categorised as below: (5)



50 Cars

120 Motorbikes

30 Scooters

1) Calculate the Probability for each of the vehicles to be selected by Mr. Shetty.

2) What is the Probability that a selected vehicle is Car and Motorbike? _____

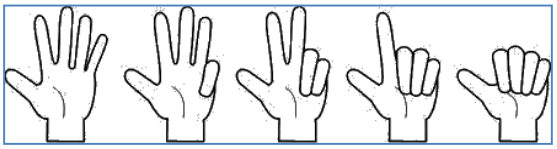
3) What is the Probability that a selected vehicle is Motorbike and Scooter? _____

Space For Rough Work

Q-5 Identify the type of an Event in Probability is Independent, Dependent or Mutually Exclusive Event in the given pictures. (3)

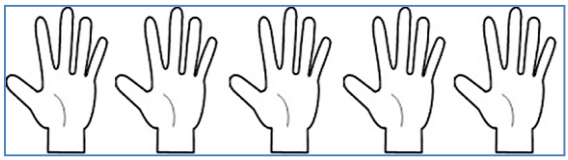
.

1) Selection of a finger (not bended) in five trials



_____

2) Selection of a finger in five trials



_____

3) An event where a man is looking for turn to left or right

_____

Q-6 Lucy has a box of 30 chocolates, 18 are milk chocolates and rest are dark chocolates. She takes a chocolate at random from a box and eats it. She then chooses a second. (3+2)

(a) Draw a tree diagram to show all the possible outcomes.

(b) Calculate the probability that Lucy chooses:

(i) 2 milk chocolates taken one by one.

(ii) A dark chocolate followed by a milk chocolate.

Q-7 Marks out of 100 achieved in Mathematics test by a class of 90 students are given in a table below. Then with the help of it, find the answers of following.

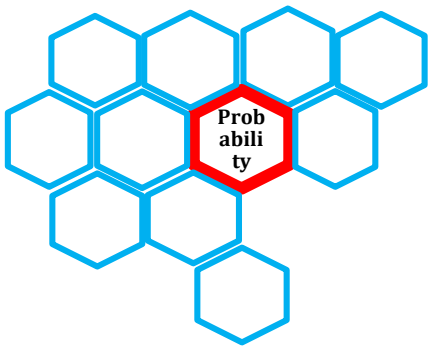
(i) Find Probability that a student obtained less than 20% in the Mathematics test

(ii) Find the Probability that a student obtained marks 60 or above. **(2½)**

Marks out of 100 (Class – Interval)	**00 – 20**	**20 - 30**	**30 - 40**	**40 - 50**	**50 - 60**	**60 - 70**	**70 – above**	**Total**
No. of Students (Frequencies)	**07**	**10**	**10**	**20**	**20**	**15**	**08**	**90**

Q-8 Arrange the keywords of Probability in the following framework. **(1½)**

A. Events
B. Outcomes
C. Independent Event
D. Experimental Probability
E. Rolling Dice
F. Dependent Event
G. Trials
H. Favourable /Unfavourable Outcomes
I. Mutually Exclusive Event
J. Without Replacement



Space For Rough Work

●●●●●● ALL THE BEST●●●●●●

Appendix – E(iii)

Final Draft

REACTION - REFLECTION SHEET

2014 – 2015

Name of Student: _____ **IX** Roll No

Name of School: _____

► **Put tick-marks at appropriate option/s (a, b, c, or d):**

Chapter – 15 Probability		
SOLO Levels	**Item No.**	**Item – Statements About My Learning Experiences and Achievements**
	I-1)	**Whether I was present in a Power Point Presentation (PPT) given on Probability ?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	I-2)	**I found the PPT on Probability as:**
	a)	Enriching with all the aspects for learning such as with examples, diagrams and exercises
	b)	Boring Presentation as it was not up to the mark of level of learning
	c)	Presentation was having the new content for learning and presented innovatively
●	d)	Appropriate presentation to the level of class IX
	I-3)	**Whether I have participated in an Activity-1 which was based on to arrange the sentences on Probability Line ?**
	a)	Yes
	b)	No
	I-4)	**How was an Activity-1?**
	a)	Very innovative way for practising and understating the English with Mathematics and vice versa with the help of a Probability line
	b)	Confused activity and difficult to understand the concept of Probability line with English and Mathematics together
	c)	Inappropriate or Irrelevant activity
	d)	Such an activity should be given in a group
	I-5)	**Whether I did an Activity – 2 on "Probability" ?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	I-6)	**I can say about an Activity-2 (in general) as:**
	a)	I found it of lower level activity and it should be of more higher or difficult level activity
▌	b)	Picture based examples in an activity was appropriate and relevant for the said concept
	c)	I found it as practical type of activity to understand the concept of Probability easily.
	d)	Only two examples in an activity are not enough to understand the Probability, but more such examples should be given for the better practice.
	I-7)	**The Activity – 1 and Activity - 2 for me was :**

	a)	Interesting & enjoyed the learning while doing it
	b)	I understood the basics of Probability easily by doing these activities.
	c)	Activities were not up to my level of understanding, it should be of more higher level
	d)	Activities were not up to my level of understanding, it should be of little lower level
	I-8)	**Whether I did an Activity – 3 about "Doing Experiment" for the Probability and an Activity – 4 on "Probability Tree"?**
	a)	Yes
	b)	No
	I-9)	**How was an Activity - 3 for me?**
	a)	Enjoyed the Activity in a small group and I learnt about all the terms of the Probability
	b)	I can learn more if such activity given at an individual level
	c)	I liked as traditional activity given in a different manner
	d)	I am unable to say about my learning
	I-10)	**An Activity - 4 for me was :**
	a)	I learnt about new topic "Probability Tree" which is not available in our textbook
	b)	I don't like to do such activity in a group
	c)	I don't found it is very useful for me to learn about the Probability
	d)	I haven't understood how to draw the Probability Tree for any event
	I-11)	**Whether I have participated in an Activity-5 for learning about the "Types of Events" ?**
	a)	Yes
	b)	No as I was absent in school / engaged with other school-activity
	I-12)	**How I found this activity for me?**
	a)	Two simple and same examples given in the form of Probability tree was quite easy for me to understand the difference between the Independent and Dependent Events.
	b)	Two same kind of examples made me confused and not understood by me clearly.
	c)	Good exercise experienced by me for calculating the Probabilities for each event and then to verify all the calculations for/with the calculation of total Probability
	d)	I felt difficulties in calculating the Probabilities for various events
	I-13)	**Whether I did an Activity – 6 on "Probability & Statistics"?**
	a)	Yes
	b)	No
	I-14)	**How was an Activity - 6 for me?**
	a)	Appreciate its interdisciplinary aspects which helped me to relate or associate the concept of Probability with Statistics as well with English grammar with the help of Probability Scale
	b)	I found it as higher level activity for me
	c)	I found it as irrelevant activity for me
	d)	No Comments
	I-15)	**My Learning experience about a chapter of Probability is :**
	a)	I understood the concepts of Probability and the full chapter thoroughly.

	b)	I found additional content (Probability tree, scale, types of events etc.) as useless for me and no need to learn it. It was beyond my understanding level.
	c)	All Activities and exercises were helped me to learn easily and to think for the real life applications of Probability as well the additional content were quite good.
	d)	Only few Activities were I found appropriate for me to learn and understand.
	I-16)	**Whether my Knowledge /Understanding on Probability have been improved because of the way of teaching - learning ?**
	a)	Yes but little
	b)	Yes and more
	c)	Unable to decide
	d)	No comment
What I liked Most?		
What I not liked?		
Your General Comments (About Instructor, Teaching-learning process, Remarks/ Improvements, Suggestions...):		

●●●●●●

◆◆◆◆◆◆HOPE ENJOYED THE LESSON◆◆◆◆◆

APPENDIX – F

RESEARCH INSTRUMENTS

- **First Draft Of Final Achievement Test (Post-test)**
- **Final Draft Of Final Achievement Test (Post-test)**
- **First Draft Of Reaction Scale**
- **Final Draft Of Reaction Scale**
- **List Of Experts**
- **Report Of One Of The Experts On Achievement Tests**

Appendix – F(i)

First Draft : POST – TEST

Final Achievement Test: 2014 – 2015

Mathematics
Standard – IX (CBSE)

Maximum Marks - 100 **Duration - 3 hours**

7th March, 2015

Name of the Candidate : _____

_____

Roll Number : _____

Name of the School : _____

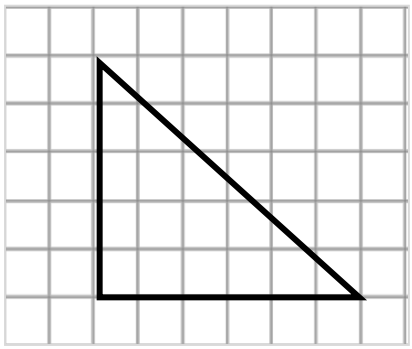
_____

Best of Luck

SECTION - I

Q – 1 Multiple choice questions, select correct one with √ : [A to E] (5)

[A] Area of a triangle given the figure below is (blocks are of 1x1 unit square) :



① 14.75 unit square

② 15.00 unit square

③ 15.25 unit square

④ 15.75 unit square

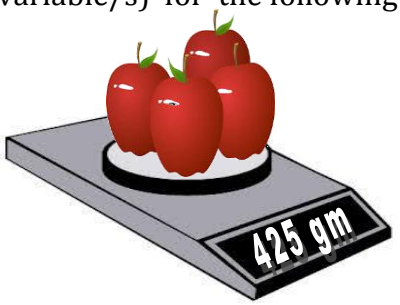
[B] Identify the Algebraic expression (using variable/s) for the following figure.

① x = 425

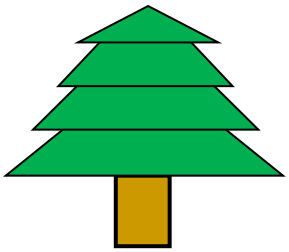
② y = 4

③ 4x = 425

④ 4yApples = 425



[C] How many Quadrilaterals (visible) are there in the given X-mass tree ?



① 4

② 5

③ 1

④ 3

[D] News papers, Magazines, Journals are considered as which kind of source/s in the context of the data collection process.

① Not a valid source

② Primary source

③ Secondary source

④ Difficult to say whether Primary or Secondary source

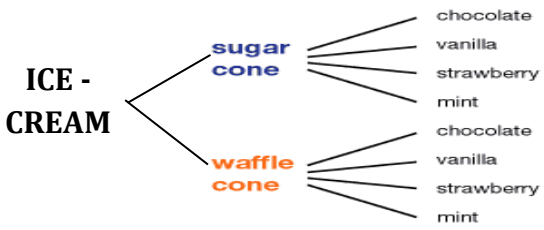
[E] From the following diagram, count the total choices at the end level :

① 2

② 4

③ 6

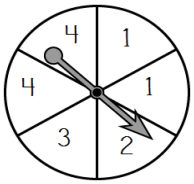
④ 8



SECTION - II

Q – 2 Do as directed: [F to J] **(10)**

[F]



i) What is the Probability of the spinner landing on a 3? _____

ii) What is the Probability of the spinner not landing on a 4? _____

[G] Calculate the Mean, Median and Mode for the following data is about the weight of the 15 students.

25, 42, 31, 27, 36, 33, 40, 31, 50, 43, 31, 56, 65, 33, 38

- Mean _____
- Mode _____
- Median _____
- Range _____

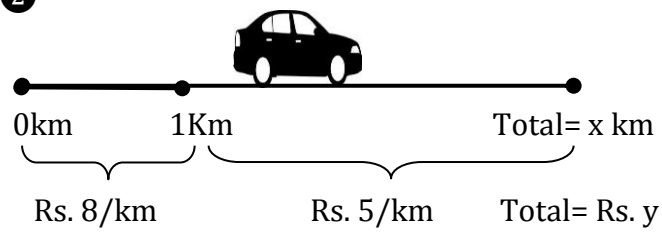
[H] Formulate a Linear equation in two variables from the given figure.

H.1

Linear Equation in two variables :

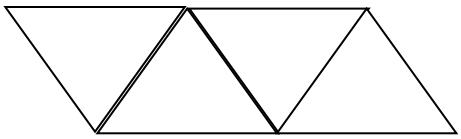
Standard form of the above Linear Equation :

H.2



Linear Equation in two variables:

OR



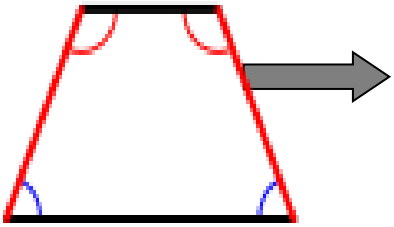
Linear Equation in two variables:

Rough Work

[I] Identify the quadrilateral from given properties and draw it neatly in given space. And in the second case, write down the properties of given quadrilateral. Mention the name of both the quadrilaterals.

Properties :

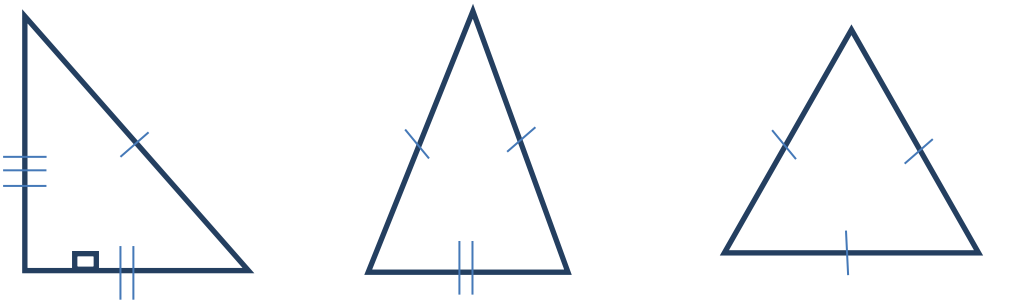
- All the sides are equal/congruent
- Both the pairs of opposite sides are parallel
- Both the pairs of opposite angles are congruent



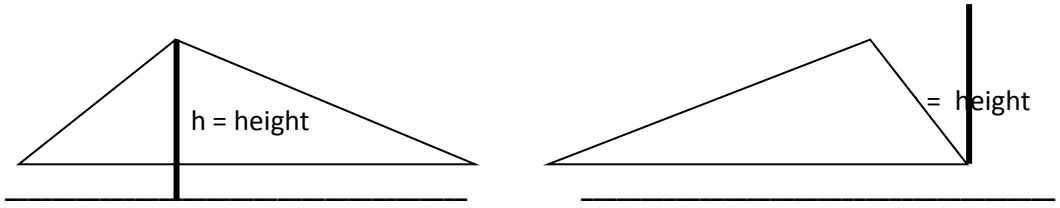
Write down the Properties:

[J] Identify as per the instructions:

J.❶ Identify the type of triangles based on the sides shown in the following figure :



J.❷ Identify the types of height shown in the following figure:



Rough Work

SECTION - III

Q – 3 Find the solutions :[K to O] **(15)**

[K] Following figure is a slice of a pizza. Draw / make the sides or outlines of a slice. Measure the length of all three sides of a slice and then find the area of a pizza-slice using Heron's Formula.

[L] Write four solutions in the given tables for each of the following equations:

L.❶

$\pi x + y = 9$		
No.	**x**	**y**
1		
2		
3		
4		

$x = 4y$		
No.	**x**	**y**
1		
2		
3		
4		

L.❷ Find that out of (3, 2) and (1, 4), which one is a solution of $2x + 3y = 12$?

Rough Work

[M] Identify the type of Quadrilateral in the following pictures and write down their name below the respective pictures :

Necklace

_____

Signboard

_____

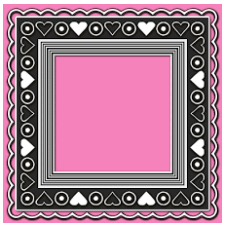
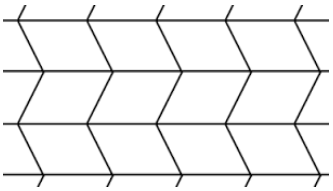


Photo frame

_____



Fencing

_____

Shopping Bag

_____

Wall

_____

[N] Following figure shows the position of the seats booked (with grey/dark fill) for a particular movie show in one of the multiplex/cinema hall. Based on these positions shown in the figure, fill up the given table with data regarding criteria, frequency & tally marks. Also write the type of 'Frequency distribution- whether grouped or ungrouped.

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Diamond = Rs. 230/-																				
A	■	■	■				■	■				■			■	■	■	■	■	■
B		■	■	■	■	■			■	■	■	■	■	■						
Platinum = Rs. 200/-																				
C			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
D	■	■				■			■				■	■						
Golden = Rs. 170/-																				
E	■	■		■	■	■				■	■	■	■			■	■	■	■	■
F				■	■	■	■	■	■	■		■	■	■	■			■	■	■
G		■	■	■	■	■	■													
H										■	■	■	■	■	■	■	■	■	■	
Silver = Rs. 110/-																				
I	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
J						■	■	■	■	■	■								■	■
K									■	■	■	■	■			■		■		

Sr. No.	Criteria	Frequency	Tally Marks

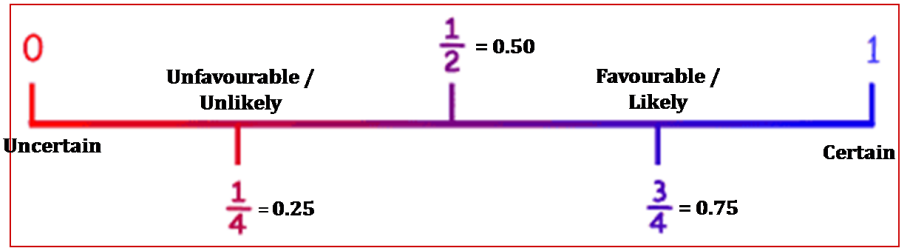
[0] Solve the followings :

0.❶ Show the position of the following sentences on the given Probability Line.

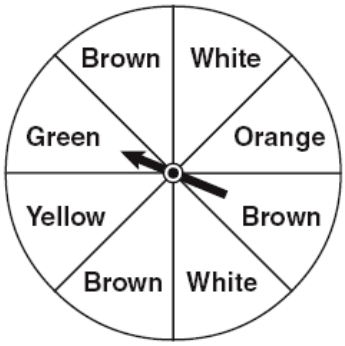
a) Selection between the north pole or south pole.

b) Five boys are selected for the dance from the group of six boys and nine girls.

c) In May, there will be summer vacation for us.



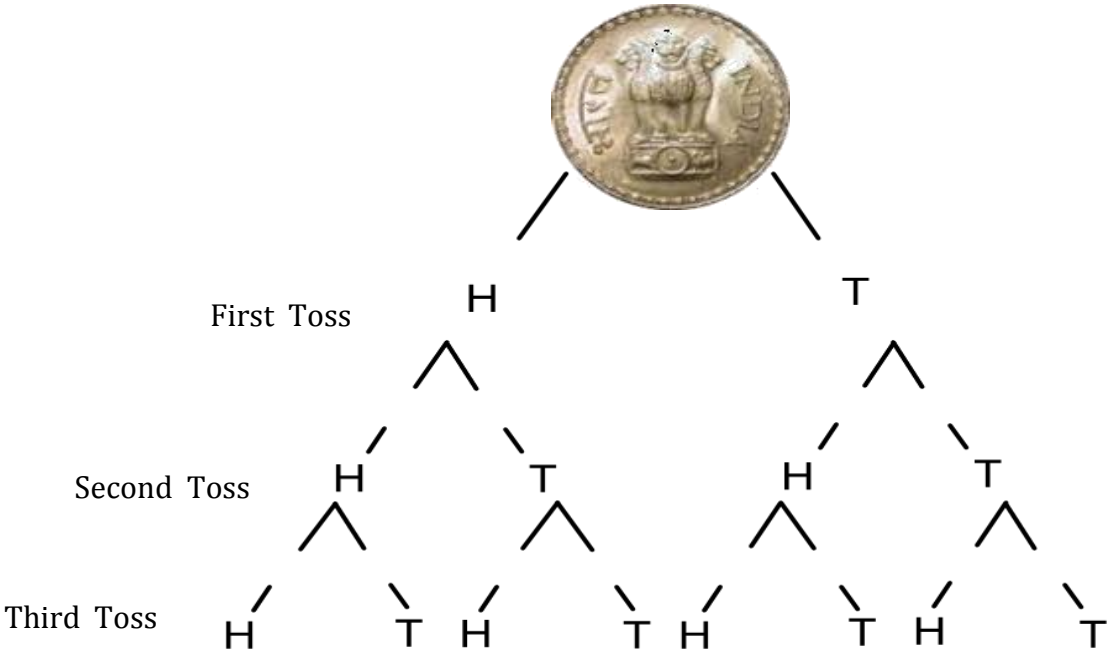
0.❷ Draw the Probability Tree (below the figure) for the selection of a colour from the given spinner wheel for the two times/trials.



SECTION - IV

Q – 4 Solve the given problems : [P to T] **(20)**

[P] Count the Probabilities for all the events of each level.



Total Probability =

_____

[Q] Compute for the following questions.

Q.❶ Following table is showing the grade points obtained by two students Rohit and Mukesh in the classes from V to IXth. Based on the measures of central tendency, interpret about their achievements.

Class	V	VI	VII	VIII	IX	**Total**	**Mean**	**Median**	**Mode**
Rohit	9	8.5	10	7.5	8				
Mukesh	7	10	9.5	8	9.5				

Interpretation : _____

_____

Rough Work

Q.❷ Given below are the seats won by different political parties in the polling outcome of a state assembly elections. Prepare graph for the given data.

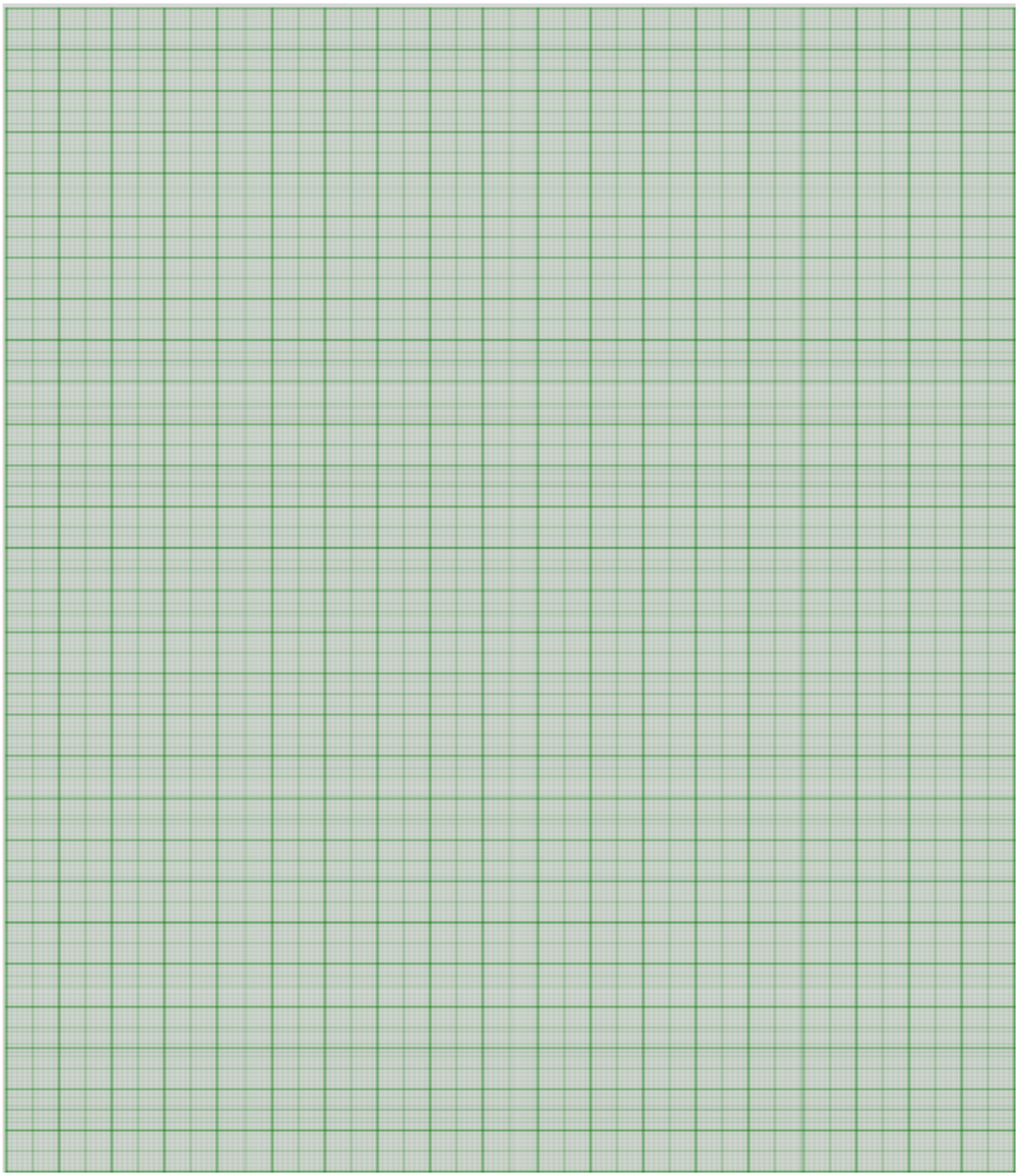
Political Party	A	B	C	D	E	F
Seats Won	75	42	55	29	10	37

i) Which type of data is given in this example?(tick mark)

☐ Discrete/Ungrouped ☐ Continues/Grouped ☐ Unable to say

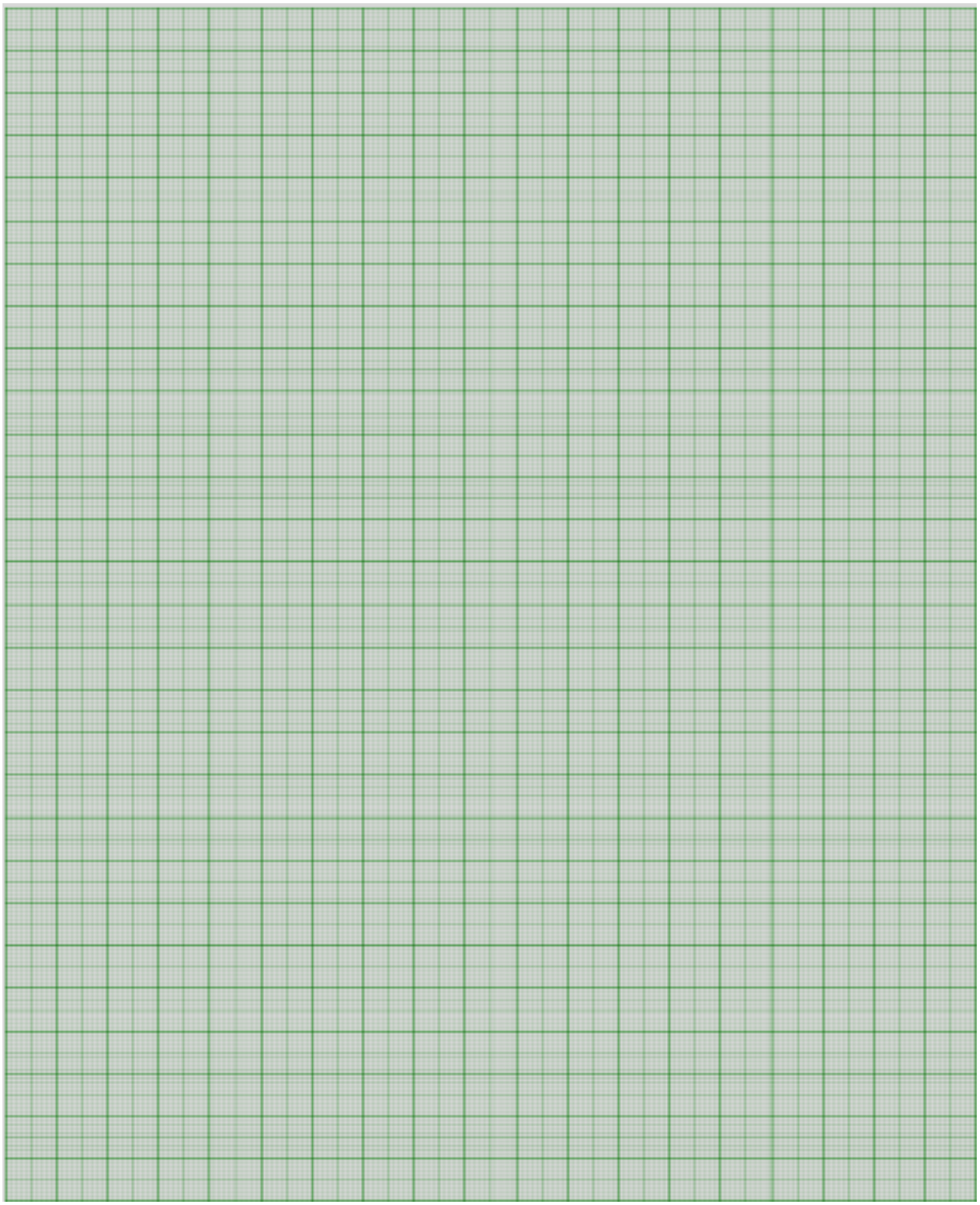
ii) Which kind of pictorial presentation will be made from such data (in general) ?

☐ Bar graph ☐ Histogram ☐ Frequency Polygon ☐ No idea



[R] Find out at least seven solutions for the given Linear equation in two variables and then make a graph from the obtained solutions.

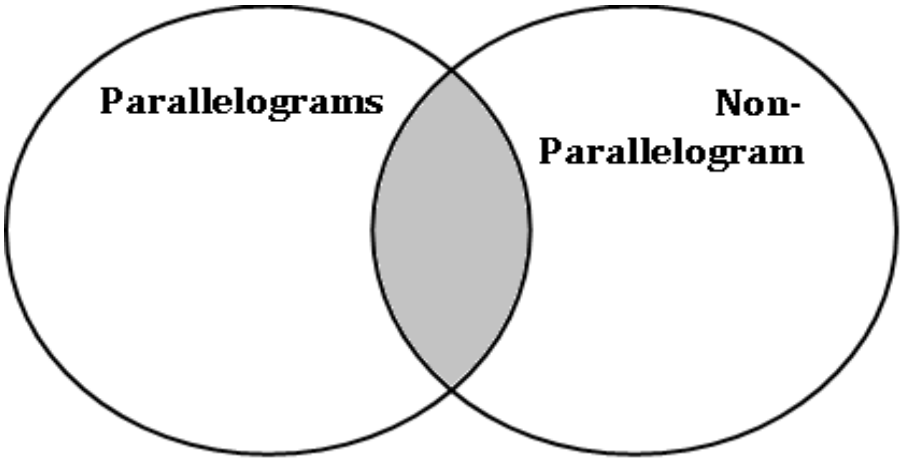
X + 2Y = 6										
X										
Y										



Rough Work

[S] Differentiate Quadrilaterals as Parallelograms or Non-Parallelograms. Various properties of the Quadrilaterals are given in the following table. Assign appropriate numbers in the appropriate circles given below the table. The numbers having common or similar properties, write into a grey portion (intersection of two circles).

1. Kite	**9.** Pair of opposite sides are parallel
2. Its having four sides	**10.** Sum of all the angles are 360°
3. Its all the angles are of 90°	**11.** Tiles
4. Both the diagonals do not divide into two congruent triangles	**12.** Trapezium
5. Rhombus	**13.** Its having four vertices
6. Its having four angles	**14.** Diamond
7. Blackboard	**15.** Only one pair of opposite sides is parallel
8. Both the pairs of opposite angles are congruent	**16.** Rectangle



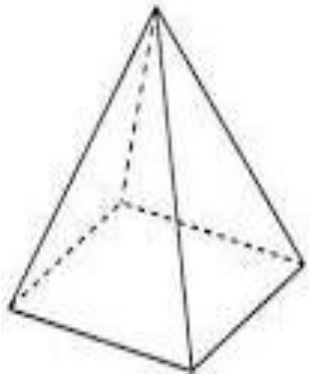
[T] Find the area of the parallelogram ABCD in which AB=9 cm, BC=28 cm and diagonal AC=35cm using Heron's formula (draw neat and clean diagram to show measurements).

Rough Work

SECTION - V

Q – 5 Do as per the instructions : [U to Y] **(25)**

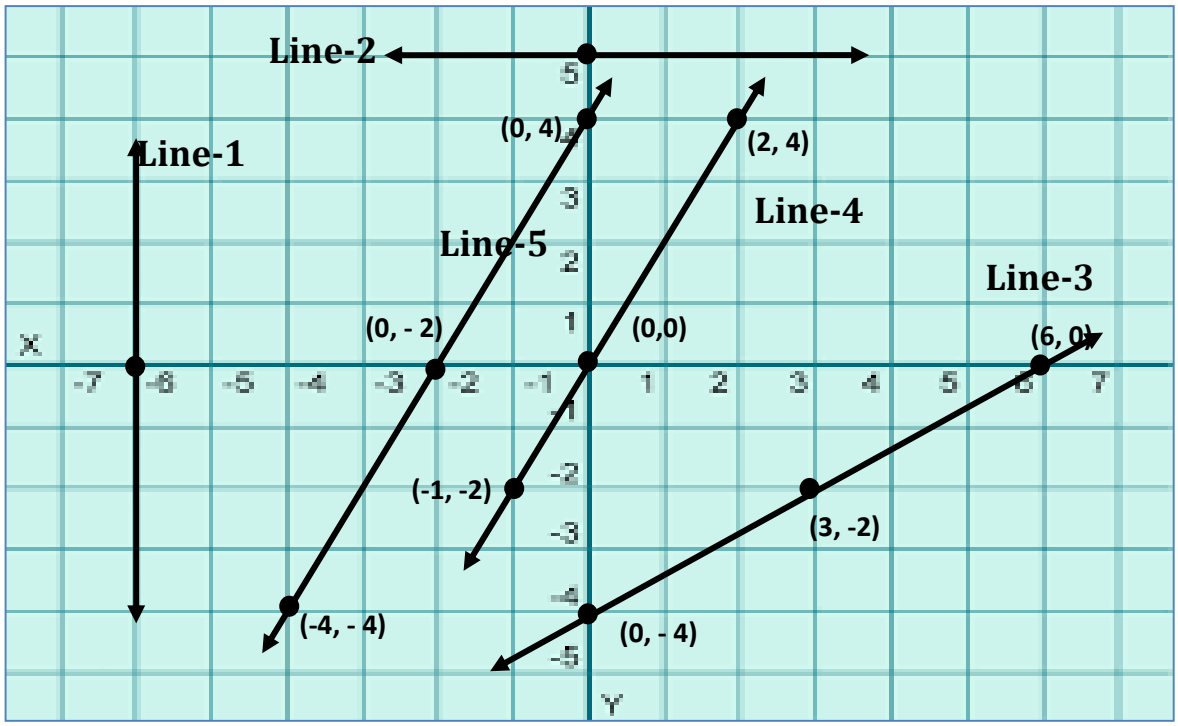
[U] Following figure is a Square pyramid or pyramid with square base. It consists triangles of same size where base is 10ft and other two equal sides as of 15ft. Using Heron's Formula, find the area of given Square Pyramid.



[V] Match the sections A and B, based on the following graphical presentation.

Section A		Section B	
i	Line-1	a	2x – 3y = 12
ii	Line-2	b	x = 5
iii	Line-3	c	y = 2x
iv	Line-4	d	x = -6
v	Line-5	e	y = 5
		f	y = 2x + 4

Rough Work



[W] Draw a figure for 'Tangram', using Quadrilaterals only.

[X] Following data represent the learning style of 50 students of IXth class. Calculate the percentage for each of style/criteria and write down the interpretations/ conclusions based on the calculated percentages.

Sr. No.	**Learning Style** V = Learning by visuals/video A=Learning by listening / audio K=Learning by doing/practically	**No. Of Students out of 50**	**Percentages %**
1	**V**	**35**	
2	**A**	**25**	
3	**K**	**45**	
4	**V & A**	**30**	
5	**V & K**	**40**	
6	**A & K**	**30**	

Interpretation / Conclusions : _____

_____

_____

_____

_____

_____

_____

[Y] An Insurance company selected 2000 drivers at random in a particular city to find a relationship between age and accidents. The Data obtained are given in the following table.

Age of drivers in years	**Accident in one year**				
	0	1	2	3	Over 3
18 - 29	440	160	110	61	35
30 – 50	505	125	60	22	18
Above 50	360	45	35	15	9

Find the Probability of the following events for a driver chosen at random from the city.

(i) Being 18-29 years of age and having exactly 3 accidents in one year.

Rough Work

(ii) Being 30-35 years of age and having one or more accidents in a year

(iii) Having no accidents in one year

SECTION - VI

Q – 6 Do the followings: [Z] **(25)**

[Y] Attempt both the questions given below, (Ask for the blank sheets).

(a) Show the concept arrangements for any two chapters (out of five chapters) using hexagonal shaped graphical organiser. (20)

(b) Draw a Rectangular-Pyramid. (5)

Rough Work

ALL IS WELL

Appendix – F(ii)

Final Draft : POST – TEST

Final Achievement Test: 2014 – 2015

MATHEMATICS

STANDARD – IX (CBSE)

Maximum Marks: 75 **Duration: 2½ hours**

7th March, 2015

Name of the Candidate : _____

_____

Roll Number : _____

Name of the School : _____

_____

Instructions:

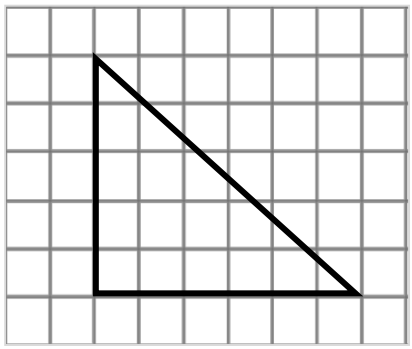
a) This question paper cum answer book is designed and will be evaluated for the purpose of research study only.
b) This question paper is developed based on the selected five chapters (Heron's formula, Linear equation in two variables, Quadrilaterals, Statistics and Probability) only.
c) There are total 5 sections and each section consists of five questions (mentioned with capital alphabets) of equal weightages.
d) Follow the guidelines for attempting the questions in all the sections.
e) All the questions are compulsory.
f) Write the paper with neat and clean handwritings.
g) Wherever needed then draw the neat diagrams with pen or pencil.
h) Space for the rough work is provided at the bottom of the respective pages.

Best of Luck

SECTION - I

Q – 1 Multiple choice questions, select correct one with √: [A to E] (5)

[A] Area of a triangle given in the following figure is (blocks are of 1x1 unit square):



① 14.75 unit square

② 15.00 unit square

③ 15.25 unit square

④ 15.75 unit square

[B] Identify the Algebraic expression (using variable/s) for the given figure.

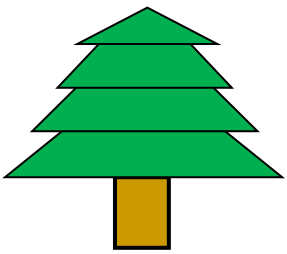
① x = 425

② y = 4

③ 4x = 425

④ 4yApples = 425

[C] How many Quadrilaterals (visible) are there in the given X-mass tree?



① 4

② 5

③ 1

④ 3

[D] Newspapers, Magazines, Journals are considered as which kind of source/s in the context of the data collection process.

① Not a valid source

② Primary source

③ Secondary source

④ Difficult to say whether Primary or Secondary source

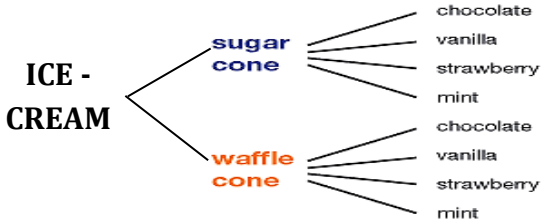
[E] From the following diagram, count the total choices at the end level :

① 2

② 4

③ 6

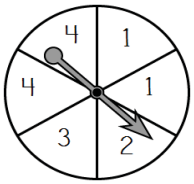
④ 8



SECTION - II

Q – 2 Do as directed: [F to J] **(10)**

[F]



i) What is the Probability of the spinner landing on 3? _____

ii) What is the Probability of the spinner not landing on 4? _____

[G] Calculate the Mean, Median, Mode and Range for the following data which is about the weight of 15 students.

25, 42, 31, 27, 36, 33, 40, 31, 50, 43, 31, 56, 65, 33, 38

- ♦ Mean _____ ♦ Mode _____
- ♦ Median _____ ♦ Range _____

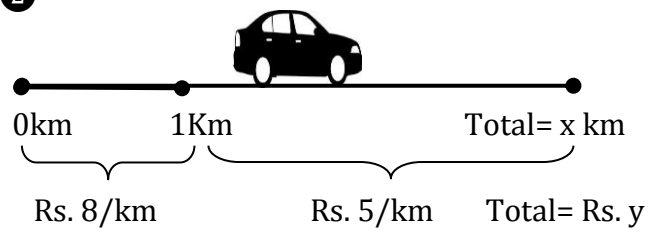
[H] Formulate a Linear equation in two variables from the given figure.

H.❶

Linear Equation in two variables :

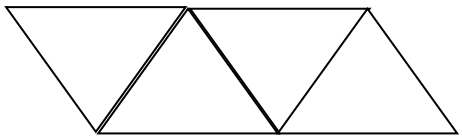
Standard form of the above Linear Equation :

H.❷



Linear Equation in two variables:

OR



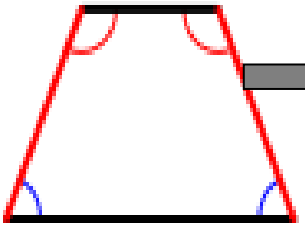
Linear Equation in two variables:

Space For Rough Work

[I] Identify the quadrilateral from given descriptions and draw it neatly in a given space. In the second case, write down the description/properties of given quadrilateral. Mention the name of both the quadrilaterals.

Properties:

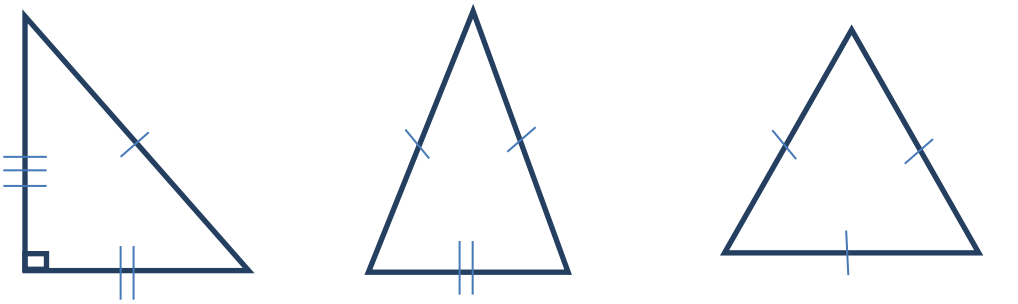
- All the sides are equal/congruent
- Both the pairs of opposite sides are parallel
- Both the pairs of opposite angles are congruent



Write down the Properties:

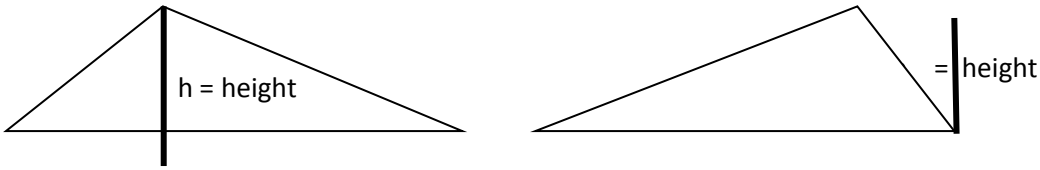
[J] Identify as per the instructions:

J.❶ Identify the type of triangles based on the sides as shown in the following figures :



_____ _____ _____

J.❷ Identify the type of height of the triangles shown in the following figures:



_____ _____

Space For Rough Work

SECTION - III

Q – 3 Find the solutions : [K to O] **(15)**

[K] Following figure is a slice of a pizza. Draw the sides or outlines of a slice. Measure the length of all three sides of a slice and then find the area of a pizza-slice using Heron's Formula.

[L] Write four solutions in the given tables for each of the following equations:

L.❶

$\pi x + y = 9$		
No.	**x**	**y**
1		
2		
3		
4		

$x = 4y$		
No.	**x**	**y**
1		
2		
3		
4		

L.❷ Find that out of (3, 2) and (1, 4), which one is a solution of $2x + 3y = 12$?

Space For Rough Work

[M] Identify the type of Quadrilaterals shown in the following pictures and write down their names below the respective pictures :

Necklace

_____

Signboard

_____

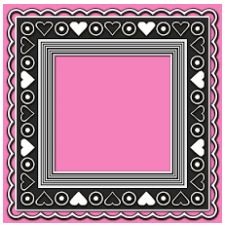
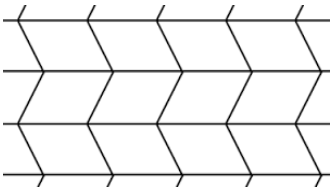


Photo frame

_____



Fencing

_____

Shopping Bag

_____

Wall/Bricks

_____

[N] Following figure shows the position of the seats booked (with grey/dark fill) for a particular movie show in one of the multiplex/cinema hall. Based on these positions shown in the figure, fill up the given table with data regarding category, frequency and tally marks. Also write the type of 'Frequency distribution as whether it is a grouped or ungrouped.

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Diamond = ₹. 230/-																				
A	■	■	■				■	■				■			■	■	■	■	■	■
B		■	■	■	■	■			■	■	■	■	■	■						
Platinum = ₹. 200/-																				
C			■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
D	■	■				■			■				■	■						
Golden = ₹. 170/-																				
E	■	■		■	■	■				■	■	■	■			■	■	■	■	■
F				■	■	■	■	■	■	■		■	■	■	■			■	■	■
G		■	■	■	■	■	■													
H										■	■	■	■	■	■	■	■	■	■	
Silver = ₹. 110/-																				
I	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■
J						■	■	■	■	■	■								■	■
K									■	■	■	■	■			■		■		

Sr. No.	Category	Frequency	Tally Marks

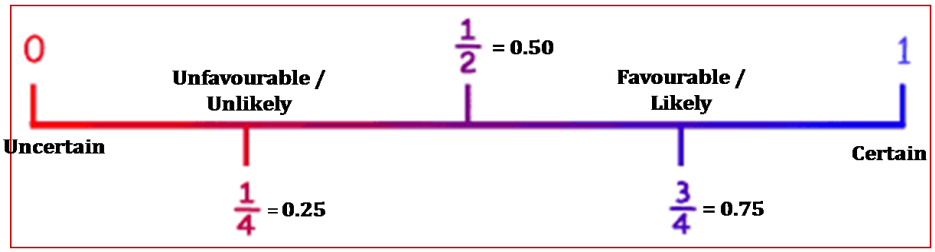
[O] Solve the followings:

O.1 Show the position of the following sentences on a given Probability Line.

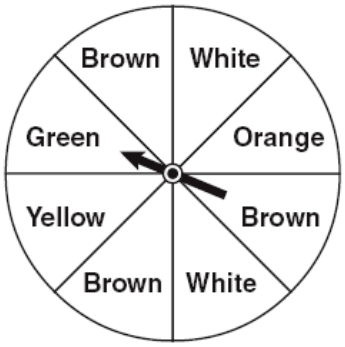
a) Selection between the North Pole or South Pole.

b) Five boys are selected for the dance from the group of six boys and nine girls.

c) In May, there will be summer vacation for us.



O.2 Draw a Probability Tree (below the figure) for the selection of a colour from the given spinner wheel for the two times or trials.



SECTION - IV

Q – 4 Solve the given problems: [P to T] **(20)**

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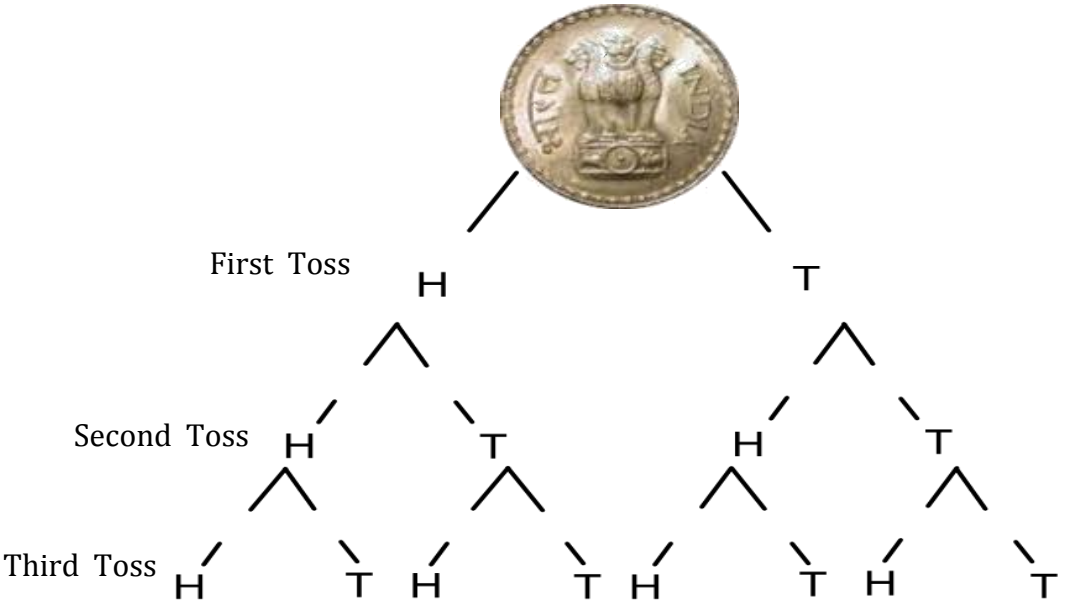

Total Probability = _____

[Q] Compute for the given questions.

Q.❶ Following table is about the grade points obtained by two students Rohit and Mukesh in the classes from V to IXth. Based on the measures of central tendency, interpret about their achievements.

Class	V	VI	VII	VIII	IX	**Total**	**Mean**	**Median**	**Mode**
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Interpretation: _____

_____

Space For Rough Work

Q.❷ Given data are about the seats won by different political parties in the polling outcome of a state assembly elections. Prepare a graph for the given data.

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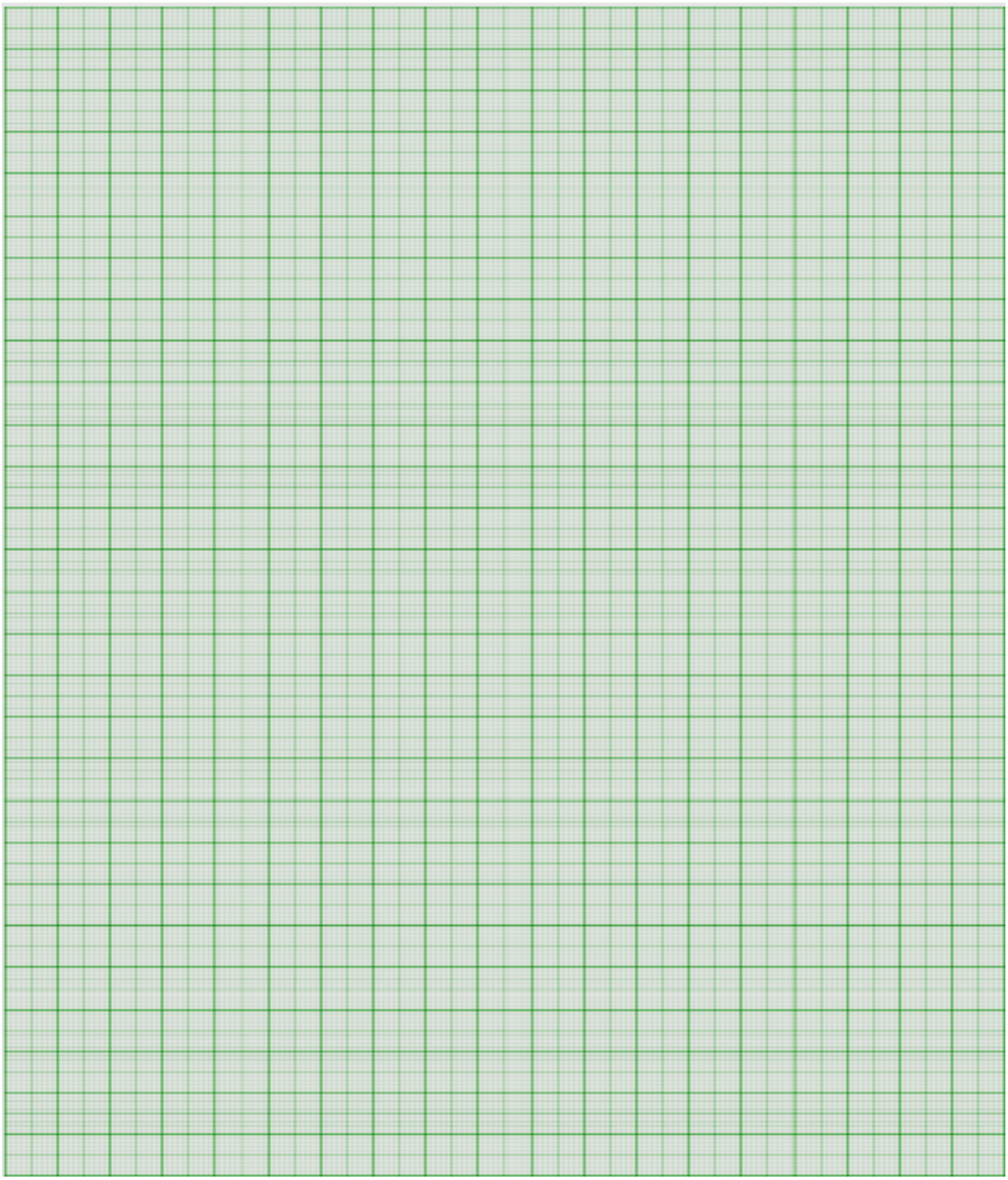
☐ Bar graph ☐ Histogram ☐ Frequency Polygon ☐ No idea



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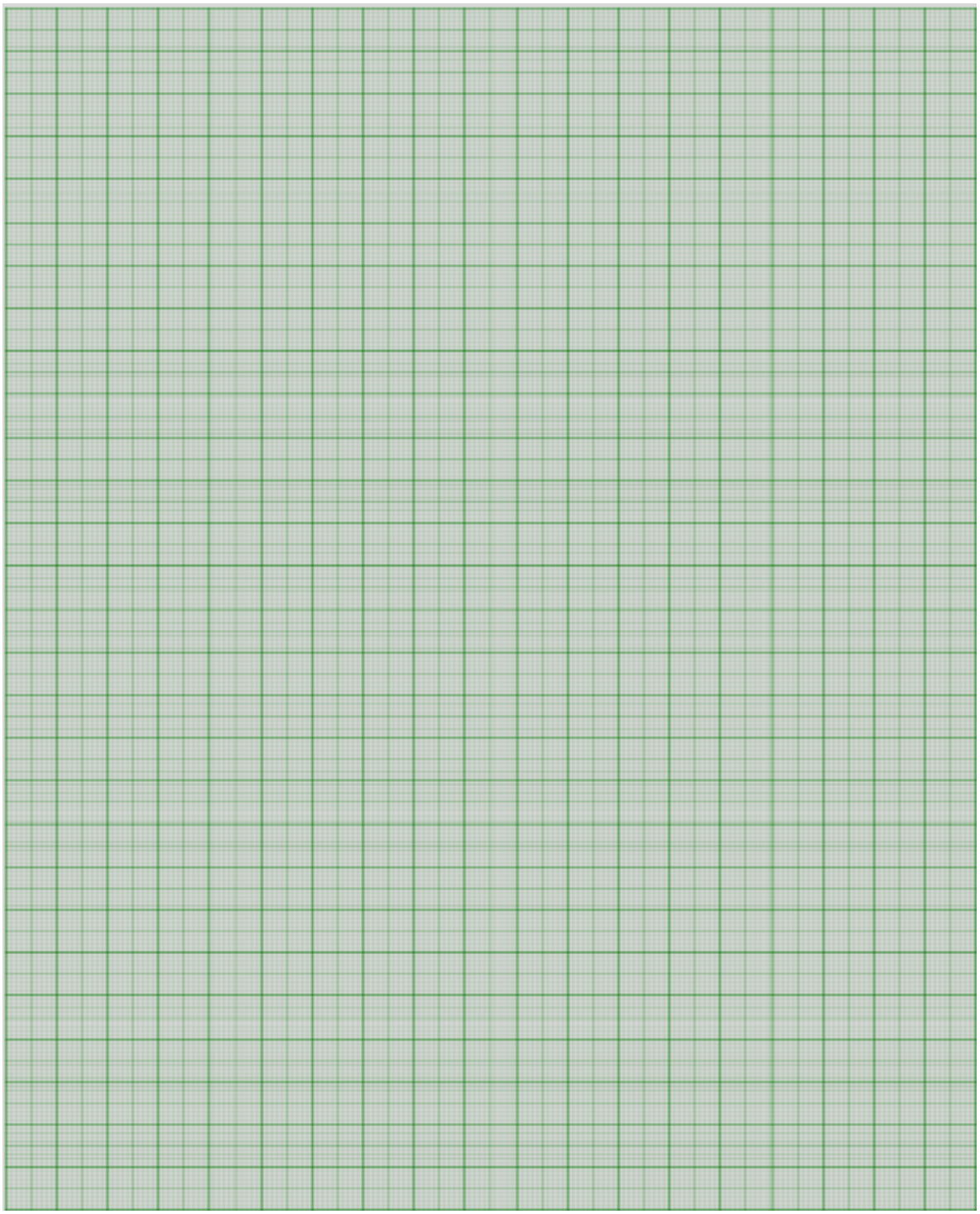
X + 2Y = 6										
X										
Y										



Space For Rough Work

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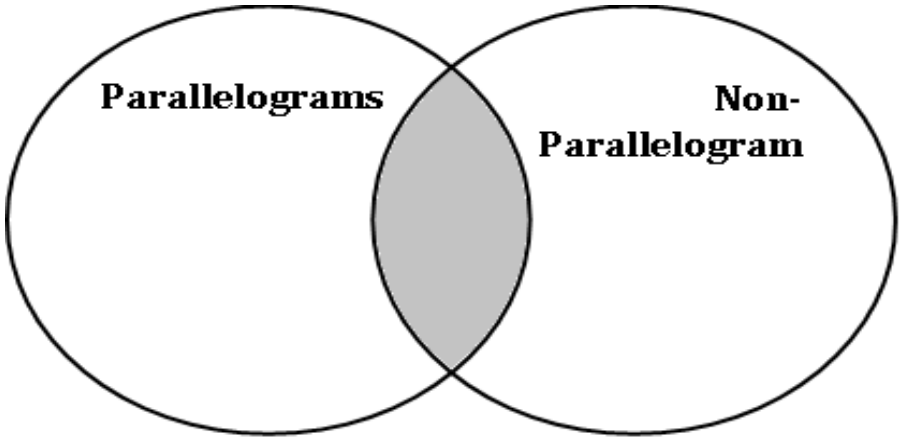

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Space For Rough Work

SECTION - V

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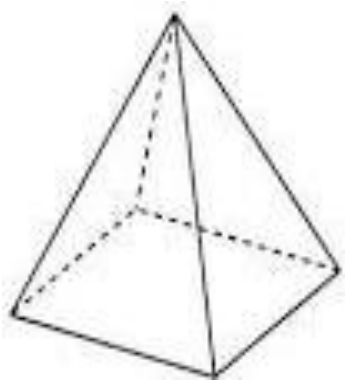

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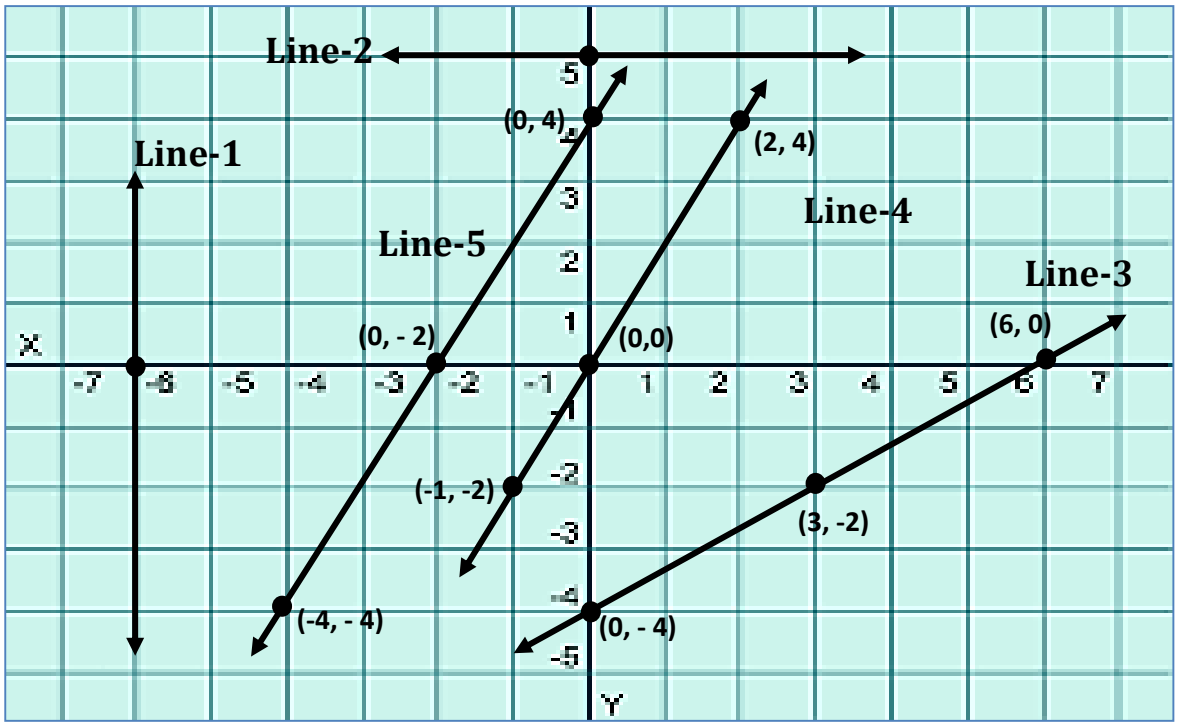
ii	Line-2	b	x = 5
iii	Line-3	c	y = 2x
iv	Line-4	d	x = -6
v	Line-5	e	y = 5
		f	y = 2x + 4

Space For Rough Work



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[X] Following data represent the learning style of 50 students of IXth class. Calculate the percentages for each of the style, then write down the interpretations based on the calculated percentages.

Sr. No.	Learning Style V = Learning by visuals/video A=Learning by listening / audio K=Learning by doing/practically	No. Of Students out of 50	Percentages %
1	V	35	
2	A	25	
3	K	45	
4	V & A	30	
5	V & K	40	
6	A & K	30	

Interpretation / Conclusions : _____

_____

_____

_____

_____

_____

_____

[Y] An Insurance company selected 2000 drivers at random in a particular city to find a relationship between age and accidents. The Data obtained are given in the following table.

Age of drivers in years	Accident in one year				
	0	1	2	3	Over 3
18 - 29	440	160	110	61	35
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Above 50	360	45	35	15	9

Find the Probability of the following events for a driver chosen at random from the city.

(i) Being 18-29 years of age and having exactly 3 accidents in one year.

Space For Rough Work

(ii) Being 30-35 years of age and having one or more accidents in a year

(iii) Having no accidents in one year

Space For Rough Work

🏆🏆🏆🏆🏆 **ALL IS WELL** 🏆🏆🏆🏆🏆

Appendix - F(iii)

First Draft

Reaction Scale

Name of Student :_____

Name of School : _____

IX Roll No

Section – I : About You In Mathematics

Put √ in an appropriate box on the right side.

1) I like Mathematics,
   a) Very much ☐
   b) It's my most favorite subject from all the subjects ☐
   c) Don't like at all ☐
   d) Unable to say, sometimes I like and sometimes I don't like ☐
   e) No comments ☐

2) I like Mathematics period,
   a) Always I like ☐
   b) Never I like ☐
   c) Depend on the areas (Arithmetic, Algebra, Geometry…) or Topic/s of Mathematics ☐
   d) Depend on my mood for learning Mathematics ☐
   e) Depend on the teaching of a teacher ☐

3) My interest in Mathematics is because of,
   a) The nature of the subject-Mathematics ☐
   b) The teaching of my school Mathematics teacher ☐
   c) The teaching of my tuition-class tutor ☐
   d) As it is a compulsory subject of the curriculum and necessary to study ☐
   e) No comments ☐

4) The most motivational factor that enhance or retains my interest in Mathematics is,
   a) My inner drive to learn the Mathematics ☐
   b) My school is providing good facilities through Mathematics laboratory, Mathematics club as well exposures through many extra events/activities/ competitions based on Mathematics ☐
   c) My peers/friends are good in Mathematics and always getting good help from them ☐
   d) Competitions within a class for better performance in Mathematics ☐
   e) Support from my parents as well as the suitable culture and environment at home ☐

5) My achievements in Mathematics on an average is about (throughout all examinations)
   a) High – 70% & above ☐
   b) Above Average – 60% to 70% ☐
   c) Average – 50% to 60% ☐
   d) Below Average – 40% to 50% ☐
   e) Below 40% ☐

6) I am doing special efforts to strengthen myself in Mathematics by,
   a) Regular practices and revisions of only textbook examples and exercises ☐
   b) Apart from textbook, regularly referring other Mathematics practice books to solve/practice for variety of examples ☐
   c) Regularly playing Mathematical games like solving puzzles, crosswords, other logical & reasoning based games, video games or games on computer/internet ☐
   d) Preparing and participating in competitive exams based on Mathematics like Mathematics Olympiads, Talent search exams, quizzes, Mathematics fairs etc ☐
   e) Regularly chatting/discussing/talking about Mathematics with my peers, friends & elders ☐

7) My learning style for Mathematics is,(select one option which is most relevant to your learning)
   a) Proper understanding of the concepts and logic behind it ☐
   b) Proper understanding of procedures or step-wise derivations for solution of any example or theorem ☐
   c) By rote memorization only ☐
   d) Drill / practices and revisions more than two-three times ☐
   e) Unable to say ☐

8) I develop my understanding in Mathematics through my Mathematics textbook/s in a manner,
   a) First I would like to read the whole chapter including content-theory as well the solved examples of any chapter from Mathematics textbook ☐
   b) I never like to read content-theory given in the chapters of a textbook ☐
   c) I would like to read only the solved examples and illustrations and to apply the same procedures to solve the exercises of respective chapters of a textbook ☐
   d) I always feel that content-theory given in any chapter of a Mathematics textbook is not enough to understand a respective chapter properly, so I take support of other reference material to understand ☐
   e) I read the chapters but I always need to ask teachers, peers or others to explain it again ☐

9) Generally I take support from the following reference materials apart from my Mathematics textbook
   a) Practice books, Practice workbooks, Guides etc ☐
   b) Materials downloaded from internet or the websites like ‘Meritnation’ ☐
   c) Readymade CDs and Software-Applications ☐
   d) Various assignments collected from my tuition class or other tuition classes ☐
   e) Mathematics textbooks of lower standards ☐

10) I like and learn the most if home-works or self-exercises should be given in the form of,
   a) Assignments to practice same kind of examples ☐
   b) Internet and information based projects ☐
   c) Discovery or survey method based projects ☐
   d) Worksheets ☐
   e) Various question papers to solve ☐

11) I believe that my achievement in Mathematics could be increased more by,

a) Through tuition class only as it takes personal care for proper practices & understanding in Mathematics ☐

b) If proper understanding on the concepts of Mathematics should be provided in school ☐

c) If more time and practices provided in school by increasing number of periods For Mathematics subject ☐

d) If it is taught by different or non-conventional (non-traditional) methods like through games, practical activities, field-visits, on computers or other learning by doing manner ☐

e) If number of same kind and relevant examples for the practices given as home-work or self exercises ☐

****

Section – II: About The Achievement Tests

Put √ in an appropriate column-box. Following are the meaning of possible responses given with respective Emojis.

 = **Not True / Not at all / No / Never / Strongly Disagree / Very Upset**

 = **Rarely True / Seldom / Few only / Disagree / Upset**

 = **Sometimes True / Some only / Not Sure / No Comments / Neutral / Normal**

 = **Mostly True / Most of the True / Majorly True / Usually True / Agree / Happy**

 = **Always True / Absolutely True / Every time / Strongly Agree / Very Happy**

Item No.	Item - Statements	Reactions				
						
1)	All the chapter-wise Achievement Tests were conducted on time.					
2)	I liked the achievement tests that were conducted after completion of each chapter to know about our learning.					
3)	Time duration given with respect to the total marks of the respective Achievement tests were appropriate.					
4)	Every time proper guidelines and instructions were provided before conducting the Achievement tests.					
5)	I liked all the test-papers were designed as Question cum Answer paper/book.					
6)	I found the style/format of the questions/test-papers were totally different from our regular/ conventional question/ test-papers.					
7)	I have realised that questions were arranged from					

	lower to higher level of difficulties as it seems to follow some hierarchical manner.					
8)	I have observed as maximum questions were framed in a very different manner and can be distinguished from questions given in a textbook or asked in our regular/conventional question-paper.					
9)	I found, most of the questions were based on the respective chapters but most were out of all the exercises of respective chapter of our Mathematics textbook.					
10)	Majority of the questions were based on the real life applications and relevant to the concepts of the respective chapters.					
11)	Most of the questions were based on logic, reasoning, higher order thinking and thought provoking.					
12)	All the questions were easy to understand.					
13)	All the questions were difficult to understand.					
14)	I found many questions were very interesting and I liked to write the answers for the same.					
15)	I felt more practical aspects rather than theoretical aspects in the questions of all the test-papers.					
16)	Most of the questions were based on the applications rather than knowledge or theory based.					
17)	Questions were easy to understand but I was facing difficulties in the ways of writing the answers.					
18)	I liked the questions based on the Graphical Organiser (hexagonal shapes) asked for the concept arrangements of the respective chapters.					
19)	I felt short of time in terms to complete the test-papers.					
20)	Overall, I have enjoyed myself while attempting the questions of all the chapter-wise test-papers.					
21)	I have also learnt many new things from these test-papers.					
22)	I liked the pattern of these test/question papers and I feel that our conventional/regular question papers also should be framed in this new manner.					
23)	The Printing quality, Visibility and Readability of the question papers.					
24)	Application type of questions and the way questions were framed.					
25)	Language used in questions					
26)	Pictures were used to understand the questions					
27)	Space provided for writing the answers					
28)	Rough space provided at the bottom of each page of question papers					
29)	Overall content in the test-papers					
30)	Overall pattern of the test/question papers					

****

Section – III :
Your Learning Experience Throughout New Intervention Program
(SOLO Based Instructional Strategy)

Put √ in an appropriate box. Following are the meaning of possible responses given with respective Emojis.

 = **Not True / Not at all / No / Never / Strongly Disagree / Very Upset**

 = **Rarely True / Seldom / Few only / Disagree / Upset**

 = **Sometimes True / Some only / Not Sure / No Comments / Neutral / Normal**

 = **Mostly True / Most of the True / Majorly / Usually True / Agree / Happy**

 = **Always True / Absolutely True / Every time / Strongly Agree / Very Happy**

No.	Statements	Reactions				
						
1)	I have experienced a non-conventional way of teaching-learning process in Mathematics that never had been experienced by me in the present class-IX.					
2)	I felt it was student-centred-approach rather than teacher-centred-approach throughout the process of teaching-learning					
3)	I can say it was an innovative way of teaching and learning.					
4)	Teaching – learning process was majorly based on the Conceptual Understanding of Mathematical concepts rather than Skill & Drill kind of practices.					
5)	The teaching and learning of the five selected chapters of Mathematics were conducted through various activities and worksheets only.					
6)	Explanations provided by the instructor during the whole intervention program were appropriate.					
7)	I found the instructor played the role of a facilitator during the teaching and learning processes rather than a lecturer.					
8)	Instructor has provided only instructions and guidelines time-to-time with respect to the activities and worksheets.					
9)	All the concepts of the respective chapters were covered by the instructor during the intervention program.					
10)	Appropriate examples, illustrations and demonstrations relevant to the respective concepts were provided.					
11)	All the activities along with the worksheets were very interesting and were assigned to do by ourselves as well many of were to do in pairs or					

	groups.					
12)	I liked all the activities given along with the worksheets.					
13)	I liked some of the activities only.					
14)	I liked working with the worksheets.					
15)	Additional content apart from the Mathematics textbook were given in the form of 'learning through activities'.					
16)	All the real life based simple examples & activities were helped me to learn and understand the respective concepts of Mathematics.					
17)	Most of the activities were of practical kind.					
18)	My experience of working and learning with group/s.					
19)	My experience of working and learning in pair.					
20)	My experience of working and learning individually.					
21)	Summarization of a chapter based on the Concept arrangement method through the hexagonal-shape based Graphical organiser.					
22)	My experience for understanding the relevance of the concepts by arranging it through a Graphical Organiser.					
23)	Overall teaching-learning process of Mathematics					
24)	Overall performance of an instructor					
25)	Overall my understanding and experience of the learning though this intervention program					

Your General Comments :

✸♦✸♦✸♦✸♦✸♦✸♦✸♦

Appendix - F(iv)

Final Draft

Reaction Scale

This Reaction Scale is designed for the research study only and feel free to fill about your Learning and/or Assessment Experiences obtained throughout the New Intervention Program based on the SOLO Taxonomy conducted during the academic year 2014 – 2015 for the five chapters selected from Class-IX Mathematics Textbook (CBSE) (Heron's Formula, Linear Equation in Two Variables, Quadrilaterals, Statistics & Probability).

Please mark your responses as per directed for the given items. The Data collected from this reaction sheet will be used purely for the purpose of research study only and all these (responses) data will remain confidential.

Name of Student :_____

Name of School : _____

Section – I:
About You In Mathematics

Put √ in an appropriate box on the right side.

1) I like Mathematics,
   - f) Very much ☐
   - g) It's my most favorite subject from all the subjects ☐
   - h) Don't like at all ☐
   - i) Unable to say, sometimes I like and sometimes I don't like ☐
   - j) No comments ☐

2) I like Mathematics period,
   - f) Always I like ☐
   - g) Never I like ☐
   - h) Depend on the areas (Arithmetic, Algebra, Geometry…) or Topic/s of Mathematics ☐
   - i) Depend on my mood for learning Mathematics ☐
   - j) Depend on the teaching of a teacher ☐

3) My interest in Mathematics is because of,
   - f) The nature of the subject-Mathematics ☐
   - g) The teaching of my school Mathematics teacher ☐
   - h) The teaching of my tuition-class tutor ☐
   - i) As it is a compulsory subject of the curriculum and necessary to study ☐
   - j) No comments ☐

4) The most motivational factor that enhance or retains my interest in Mathematics is,
   - f) My inner drive to learn the Mathematics ☐
   - g) My school is providing good facilities through Mathematics laboratory, Mathematics club as well exposures through more curricular events or activities or competitions based on Mathematics ☐
   - h) My peers/friends are good in Mathematics and always getting help from them ☐
   - i) Competitions within a class for better performance in Mathematics ☐
   - j) Support from my parents as well as the suitable culture and environment at home ☐

5) My achievements in Mathematics on an average is about (throughout all examinations)

f) High – 70% & above ☐
g) Above Average – 60% to 70% ☐
h) Average – 50% to 60% ☐
i) Below Average – 40% to 50% ☐
j) Below 40% ☐

6) I am doing special efforts to strengthen myself in Mathematics by,
f) Regular practices and revisions of only textbook examples and exercises ☐
g) Apart from textbook, regularly referring other Mathematics practice books to solve or practice for variety of examples ☐
h) Regularly playing Mathematical games like solving puzzles, crosswords, other logical & reasoning based games, video games or games on computer/internet ☐
i) Preparing and participating in competitive exams based on Mathematics like Mathematics Olympiads, Talent search exams, quizzes, and Mathematics fairs etc. ☐
j) Regularly chatting/discussing/talking about Mathematics with my peers, friends & elders ☐

7) My learning style for Mathematics is,(select one option which is most relevant to your learning)
f) Proper understanding of the concepts and logic behind it ☐
g) Proper understanding of procedures or step-wise derivations for solution of any example or theorem ☐
h) By rote memorization only ☐
i) Drill / practices and revisions more than two-three times ☐
j) Unable to say ☐

8) I develop my understanding in Mathematics through my Mathematics textbook/s in a manner,
f) First I would like to read the whole chapter including content-theory as well the solved examples of any chapter from Mathematics textbook ☐
g) I never like to read content-theory given in the chapters of a textbook ☐
h) I would like to read only the solved examples and illustrations and to apply the same procedures to solve the exercises of respective chapters of a textbook ☐
i) I always feel that content-theory given in any chapter of a Mathematics textbook is not enough to understand a respective chapter properly, so I take support of other reference material to understand ☐
j) I read the chapters but I always need to ask teachers, peers or others to explain it again ☐

9) Generally I take support from the following reference materials apart from my Mathematics textbook
f) Practice books, Practice workbooks, Guides etc ☐
g) Materials downloaded from internet or the websites like 'Meritnation' ☐
h) Readymade CDs and Software-Applications ☐
i) Various assignments collected from my tuition class or other tuition classes ☐
j) Mathematics textbooks of lower standards ☐

10) I like and learn the most if home-works or self-exercises should be given in the form of,
f) Assignments to practice same kind of examples ☐
g) Internet and information based projects ☐
h) Discovery or survey method based projects ☐
i) Worksheets ☐
j) Various question papers to solve ☐

11) I believe that my achievement in Mathematics could be increased more by:

f) Through tuition class only as it takes personal care for proper practices & understanding in Mathematics ☐

g) If proper understanding on the concepts of Mathematics should be provided in school ☐

h) If more time and practices provided in school by increasing number of periods for Mathematics subject ☐

i) If it is taught by different or non-conventional (non-traditional) methods like games practical activities, field-visits, on computers or other learning by doing manner ☐

j) If number of same kind and relevant examples for the practices given as home-work or self exercises ☐

****

Section – II:
About The Achievement Tests

Following are the statements related with the chapter-wise tests as well as the final Achievement test were conducted for five selected chapters (Heron's formula, Linear equation in two variables, Quadrilaterals, Statistics & Probability) of CBSE class IX Mathematics. With reference to the same, you have to select one of the option as your honest response as about your gained experience/s.

Put √ in an appropriate column-box. Following are the meaning of possible responses given with respective Emojis.

 = Not True / Not at all / No / Never / Strongly Disagree / Very Upset
 = Rarely True / Seldom / Few only / Disagree / Upset
 = Sometimes True / Some only / Not Sure / No Comments / Neutral / Normal
 = Mostly True / Most of the True / Majorly True / Usually True / Agree / Happy
 = Always True / Absolutely True / Every time / Strongly Agree / Very Happy

No.	Statements	Reactions				
						
1)	All the chapter-wise Achievement Tests were conducted on time.					
2)	I liked the achievement tests that were conducted after completion of each chapter to know about our learning.					
3)	Time duration given with respect to the total marks of the respective Achievement tests were appropriate.					
4)	Every time proper guidelines and instructions were provided before conducting the Achievement tests.					
5)	I liked all the test-papers were designed as Question cum Answer paper/book.					
6)	I found the style/format of the questions/ test-papers were totally different from our					

	regular/conventional question/ test-papers.					
7)	I have realised that questions were arranged from lower to higher level of difficulties as it seems to follow some hierarchical manner.					
8)	I have observed as maximum questions were framed in a very different manner and can be distinguished from questions given in a textbook or asked in our regular/conventional question-paper.					
9)	I found, most of the questions were based on the respective chapters but most were out of all the exercises of respective chapter of our Mathematics textbook.					
10)	Majority of the questions were based on the real life applications and relevant to the concepts of the respective chapters.					
11)	Most of the questions were based on logic, reasoning, higher order thinking and thought provoking.					
12)	All the questions were easy to understand.					
13)	All the questions were difficult to understand.					
14)	I found many questions were very interesting and I liked to write the answers for the same.					
15)	I felt more practical aspects rather than theoretical aspects in the questions of all the test-papers.					
16)	Most of the questions were based on the applications rather than knowledge or theory based.					
17)	Questions were easy to understand but I was facing difficulties in the ways of writing the answers.					
18)	I liked the questions based on the Graphical Organiser (hexagonal shapes) asked for the concept arrangements of the respective chapters.					
19)	I felt short of time in terms to complete the test-papers.					
20)	Overall, I have enjoyed myself while attempting the questions of all chapter-wise test-papers.					
21)	I have also learnt many new things from these test-papers.					
22)	I liked the pattern of these test/question papers and I feel that our conventional/ regular question papers also should be framed in this new manner.					
23)	The Printing quality, Visibility and Readability of the question papers.					

24)	Application type of questions and the way questions were framed.					
25)	Language used in questions					
26)	Pictures were used to understand the questions					
27)	Space provided for writing the answers					
28)	Rough space provided at the bottom of each page of question papers					
29)	Overall content in the test-papers					
30)	Overall pattern of the test/question papers					

****

Section – III:
Your Learning Experience Throughout New Intervention Program (SOLO Based Instructional Strategy)

Following are the statements related with the chapter-wise teaching-learning process conducted for five selected chapters (Heron's formula, Linear equation in two variables, Quadrilaterals, Statistics & Probability) of CBSE class IX Mathematics. With reference to the same, you have to select one of the options as your honest response for your gained experience/s.

Put √ in an appropriate column-box. Following are the meaning of possible responses given with respective Emojis.

 = Not True / Not at all / No / Never / Strongly Disagree / Very Upset
 = Rarely True / Seldom / Few only / Disagree / Upset
 = Sometimes True / Some only / Not Sure / No Comments / Neutral / Normal
 = Mostly True / Most of the True / Majorly True / Usually True / Agree / Happy
 = Always True / Absolutely True / Every time / Strongly Agree / Very Happy

No.	Statements	Reactions				
						
1)	I have experienced a non-conventional way of teaching-learning process in Mathematics that never had been experienced by me in the present class-IX.					
2)	I felt it was student-centred-approach rather than teacher-centred-approach throughout the process of teaching-learning					
3)	I can say it was an innovative way of teaching and learning.					

4)	Teaching – learning process was majorly based on the Conceptual Understanding of Mathematical concepts rather than Skill & Drill kind of practices.					
5)	The teaching and learning of the five selected chapters of Mathematics were conducted through various activities and worksheets only.					
6)	Explanations provided by the instructor during the whole intervention program were appropriate.					
7)	I found the instructor played the role of a facilitator during the teaching and learning processes rather than a lecturer.					
8)	Instructor has provided only instructions and guidelines time-to-time with respect to the activities and worksheets.					
9)	All the concepts of the respective chapters were covered by the instructor during the intervention program.					
10)	Appropriate examples, illustrations and demonstrations relevant to the respective concepts were provided.					
11)	All the activities along with the worksheets were very interesting and were assigned to do by ourselves as well many of were to do in pairs or groups.					
12)	I liked all the activities given along with the worksheets.					
13)	I liked some of the activities only.					
14)	I liked working with the worksheets.					
15)	Additional content apart from the Mathematics textbook were given in the form of 'learning through activities'.					
16)	All the real life based simple examples & activities were helped me to learn and understand the respective concepts of Mathematics.					
17)	Most of the activities were of practical kind.					
18)	My experience of working and learning with group/s.					
19)	My experience of working and learning in pair.					
20)	My experience of working and learning individually.					
21)	Summarization of a chapter based on the Concept arrangement method through the hexagonal-shape based Graphical organiser.					

22)	My experience for understanding the relevance of the concepts by arranging it through a Graphical Organiser.					
23)	Overall teaching-learning process of Mathematics					
24)	Overall performance of an instructor					
25)	Overall my understanding and experience of the learning though this intervention program					

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✸♦✸♦✸♦✸♦✸♦✸♦✸♦

Appendix – F(v)

LIST OF EXPERTS (TOOLS VALIDATION)

SR. NO.	NAME OF THE EXPERTS	DETAILS
1.	**Dr. Pradeep Patel**	**Trustee,** (B.Com., M.Com., B.Ed., DLP, Ph.D. (Education)) Sarwa Mangal School, Karelibaug, Vadodara
2.	**Mr. Nitesh N. Patel**	**Lecturer** (M.Sc. (Mathematics), M.Ed) Sigma Institute of Tech.& Engg. (Polytechnic), Vadodara
3.	**Ms. Shalini Varandani**	**Research Student,** CASE – Department of Education, Faculty of Education and Psychology, The Maharaja Sayajirao University of Baroda, Vadodara.
4.	**Shri Arun Singh**	**Mathematics Teacher (Secondary)** Kendriya Vidyalaya – 4, ONGC Campus, Makarpura Road, Vadodara.
5.	**Mr. Deepak Patil**	**Mathematics Teacher (Secondary)** Urmi School, Sama-Savali Road, Sama, Vadodara
6.	**Mrs. Leena Khedkar**	**Mathematics Teacher (Secondary)** Prince Ashok Raje Gaekwad School, Lalbaug, Vadodara
7.	**Group Discussions with Research Scholars and Fellows**	**1. Kadem Srinivas (URF)** **2. Bharti Ganiger (SRF)** **3. M. Ramesh (SRF)** **4. Arti Bhatti** **5. Brijesh Darji** **6. Meghavi Bhatia (URF)** **7. Asit Purohit** **8. Sonia Rohilla** **9. Pinkal Chudhary (JRF)** **10. A. V. Jaylakshmi (JRF)** **11. Sandeep Chaudhary (JRF)** **12. Sardar Paparaidu (JRF)** **13. Ravi V. (JRF)**

SRF – Senior Research Fellow ; JRF – Junior Research Fellow; URF – University Research Fellow

Appendix – F(vi)

REPORT OF ONE OF THE EXPERT ON ACHIEVEMENT TESTS

POST TEST
ACHIEVEMENT TEST – 2014-15
MATHEMATICS

CHAPTER -12 : HERON'S FORMULA

QUE	CRITICAL CCOMMENT	SUGGESTION IF REQUIRE
1	Learn to differentiate between Formula method and counting method to find area of triangle for Heron's formula	--------
2	Learn to classify types of triangle by sides and learn to use its formula to find height and area	Not require to mention that by using Pythagorean theorem as well as its height and base for finding area (It's like clue)
3	Learn to draw altitude, when there is different types of triangle as well as differentiate between base and altitude and importance of vertex of triangle	------
4	Creative pictures initiate to observe find shapes of triangle around them and connect them with their daily life. (Creative Question)	-------
5	Learn to differentiate triangles as quadrilaterals and its mechanism	-----
6	Learn to know and use Heron's formula for finding area for equilateral triangle as well.	-----
7	Understand the concepts and it's relation and function with each other	If you provide 10 hexagonal blank shapes, then students will fill all 10 blocks. They know to fill the blanks by using key words. So give only related concepts number block.

CHAPTER -4 : Linear Equation in two variables

QUE	CRITICAL CCOMMENT	SUGGESTION IF REQUIRE
1	Innovative question, learn to differentiate here variable and number and find variable's value and create equation as well	Figure is not proper depict variable and Number (Not proper visible)
2	• Learn to solve linear equation, to identify the linear equation in one variable or two variables. • When solve the equation to find value, then learn to change the sign of variable and numbers when we change its side	------
3	Identify two different instances and attribute it with proper variables to write that event in equation form. (Daily occasion covert into Mathematics form)	-----
4	Learn to know the standard form of linear equation, conversion of linear equation into standard form, identify the place of co-efficient	-------
5	Learn to express equation as per the given combination, as well as differentiate between variables and coefficients too.	-----
6	By using variables value, solve the linear equation and learn to plot graph in two dimension with X and Y axis	----
7	Learn to check the order pair of variables are the solution or not as well as know that how to write solution in order form	----
8	Concept clarity of linear equation tested	----
9	Convert Graphical representation into linear equation form (Advanced question)	Most of the time, draw the graph from the linear equ.is asked.
10	Concept clarity of linear equation and its relation tested	-----

CHAPTER -8: QUADRILATERALS

QUE	CRITICAL CCOMMENT	SUGGESTION IF REQUIRE
1	Learn to draw different types of quadrilateral and its structures. Functioning of quadrilaterals evaluate through this question	------

2 – A, B	• From the picture, students identify different shapes of quadrilateral and four angle figure as quadrilateral. Learn to observe four shape image around them • Daily use devices and object classify as quadrilaterals and Attach life with Maths	-----
3, 4-A	Evaluate the knowledge of Properties of Quadrilaterals tested and classify into form of venn diagram as well as tabulation form. Innovative question	------
4-B	Conversion Mathematical properties of Quadrilateral in to diagrammatic form with name and sign. By using result and properties of quadrilateral prove the theorem.	------
5	Learn to differentiate Area and Perimeter of Quadrilaterals, and from the formulae of its, area and perimeter find out.	------
6	Concept clarity of quadrilaterals and its relation tested	------

CHAPTER - 14: Statistics

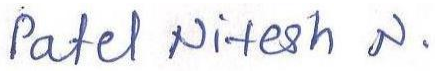
QUE	CRITICAL COMMENT	SUGGESTION IF REQUIRE
1	By using Match , Definition in one term is proper to measure basic terminology of statistics	----
2	From the picture, identify the primary and secondary sources as Data, meaningful question to ask to check their basic knowledge.	----
3 -A	Differentiate and write the class and frequency from the daily base experience. Innovative examples	----
3-B	Learn to know, how to draw Bar graph by using class and frequency and what to mention on X axis and What to mention on Y axis.	----
4 - A	Frequency and class from the daily life oriented problems converted into statistics.	
4 - B	Conversion statistical data into histogram representation. Creative question to evaluate their statistical data conversion into graphical representation	
5	Differentiate group and un-group data to find Mean, Median and Mode. Apply in real life to find central tendency of measurement.	
6	Concept clarity of Statistical terminology and its relation tested	

CHAPTER -15 :PROBABILITY

QUE	CRITICAL CCOMMENT	SUGGESTION IF REQUIRE
1	Similar terminology word used to evaluate the meaning of probability. Proper question to ask.	------
2	Learn to draw probability line from the life oriented events in fraction form.	-----
3,4,5,6	Probability find from the certain and uncertain events, differentiate certain and uncertain events, attach this instances with own life events and enjoy Mathematics in daily life.	------
7	Concept clarity of probability terminology and its relation with each other.	

Checked and Verified By

Nitesh N. Patel

Sign : 

M.Sc. (Mathematics), M.Ed

Lecturer

Sigma Institute of Tech.& Engg. (Polytechnic)

Vadodara

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APPENDIX – G

MISCELLANEOUS

APPENDIX – G(i)

LIST OF CBSE SECONDARY SCHOOLS OF VADODARA – 2013

SR. NO.	NAME OF THE SCHOOLS	ADDRESS
1.	**Prince Ashokraje Gaekwad School**	Dhairya Prasad Palace, Lalbaug Main Road, Manjalpur, Vadodara - 390011, Gujarat, India
2.	**Ambe School**	Opp. Sun City, Near. Darbar Chowkadi, Manjalpur, Vadodara - 390011, Gujarat, India.
3.	**Kendriya Vidyalaya No.1**	Harni Road, Near Sangam Char Rasta, Vadodara - 390022, Gujarat, India.
4.	**Kendriya Vidyalaya No.2**	Vadodara, Gujarat, India.
5.	**Kendriya Vidyalaya No.3**	Air Force Station, Makarpura, Vadodara - 390014, Gujarat, India
6.	**Kendriya Vidyalaya No.4**	ONGC Campus, Makarpura Road, Vadodara - 390009, Gujarat, India.
7.	**Bharatiya Vidya Bhavans Vallabhram Mehta Public School**	Teen Rasta Makarpura Road, Vadodara - 390009, Gujarat, India
8.	**Baroda Public School**	Maret Green Valley, Ankhi-Ramnath Road, Por, Tal-Vadodara, Vadodara – 391243, India.
9.	**Delhi Public School**	Transpek- Vadsar Road, Kalali, Vadodara - 390012, Gujarat, India.
10.	**Delhi Public School (DPS)**	Near Airport, Harni- Virod Road, Vadodara - 390022, Gujarat, India.
11.	**Gujarat Public School**	Nr. Kalali-Atadra Railway Crossing, Off. Old Padra Road, Vadodara - 390012, Gujarat, India.
12.	**Vibgyor International High School**	Opp. Banco Products, Padra Rd., Behind Bhayali Rly Stn., Village: Bill, Vadodara, Gujarat.
13.	**Jawahar Navodaya Vidyalaya**	At. & Po. Sadhi, Sadad Road, Tehsil Padra, Dist.- Vadodara - 391445, Gujarat, India.
14.	**Mira – The Happy School**	Nr. Kalali-Atadra Railway Crossing, Off. Old Padra Road, Vadodara - 390012, Gujarat, India
15.	**St. Kabir CBSE School**	St. Kabir Circle, Vasana Road, Vadodara, Gujarat, India.

16.	**Bright Day School**	Near, Satyadev Chemicals, Vasna-Bhaili Road, Vadodara - 391110, Gujarat, India.
17.	**Bright Day School**	Airport Road, Harni, Vadodara - 391110, Gujarat, India.
18.	**Navrachana International School**	Vasna- Bhayali, Vadodara - 391410, Gujarat, India.
19.	**Anand Vidya Vihar**	Harinagar Society, Nr. Inox, Gotri Road, Vadodara - 390023, Gujarat, India.
20.	**Green Valley High School**	Via Gotri Sevasi, Off Effluent Channel Road, Near Bhimpura, Ampad, Vadodara - 391101, Gujarat, India
21.	**Podar World School**	Bhimpura-Koyali Channel Road Opp. Bapu Nagar, Bus Stand Near Chandan Multiplex Sherki, Vadodara, Gujarat, India.
22.	**Baselios Public School**	13/35, Jawahar Nagar, Refinery Township, Vadodara - 391320, Gujarat, India.
23.	**Utkarsh Vidyalaya**	Near Lion's Hall Gotri Road, Vadodara - 401303, Gujarat, India.
24.	**New Era Senior Secondary School**	Near Arpan Complex, Nizampura, Vadodara - 390002, Gujarat, India.
25.	**Navrachana School**	Sama Road, Vadodara - 390008, Gujarat, India.
26.	**Shannen School**	Shannen Near. L & T circle, Opp. Vuda office, VIP Road, Vadodara, Gujarat, India.
27.	**Urmi School**	Sama-Savli Road, Near Flyover, Sama. Vadodara - 390024, Gujarat, India.
28.	**Cygnus World School**	Motnath Mahadev Road, Virod Road, Harni, Vadodara - 390022, Gujarat, India.
29.	**Jawahar Navodaya Vidyalaya**	Kumar Shala No.1, Wadi, Bambkhana, Vadodara - 390017, Gujarat, India
30.	**American School of Baroda**	Opp. Sayajipura Village Ajwa-Nimeta Road, Beyond NH #8 bypass, Vadodara, Gujarat, India.

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APPENDIX – C(ii)

MATCHING OF SAMPLE GROUPS FOR EQIVALENCE

Control Group

Sr. No.	Code of Students	% in VIII Maths
1	CA-906	46.00
2	CA-920	50.80
3	CA-922	51.30
4	CA-907	52.00
5	CB-929	53.00
6	CA-927	57.00
7	CA-911	60.00
8	CB-927	66.80
9	CA-904	67.00
10	CA-908	72.50
11	CB-904	72.70
12	CA-905	73.40
13	CA-902	74.60
14	CB-902	74.70
15	CA-901	76.90
16	CA-921	80.00
17	CA-909	80.60
18	CB-907	81.00
19	CB-921	81.00
20	CA-914	82.20
21	CA-931	83.00
22	CA-918	90.60
23	CB-933	91.70
24	CB-928	93.00
25	CA-915	94.00
26	CB-916	95.80
27	CB-932	96.10
28	CB-915	97.00
29	CB-934	97.00
30	CA-934	98.60

Experimental Group

Sr. No.	Code of Students	% in VIII Maths
1	E-929	46.00
2	E-915	51.00
3	E-918	51.00
4	E-904	53.00
5	E-917	53.00
6	E-939	57.00
7	E-914	60.00
8	E-940	61.00
9	E-913	62.00
10	E-905	71.00
11	E-901	75.00
12	E-907	76.00
13	E-910	77.00
14	E-912	77.00
15	E-922	77.00
16	E-923	80.00
17	E-911	81.00
18	E-934	82.00
19	E-928	83.00
20	E-926	86.00
21	E-932	86.00
22	E-931	92.00
23	E-902	93.00
24	E-925	93.00
25	E-920	94.00
26	E-919	95.00
27	E-921	97.00
28	E-927	97.00
29	E-935	98.00
30	E-936	98.00

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APPENDIX – C(iii)

LEARNING OUTCOMES: APPROPRIATE VERBS FOR DIFFERENT LEVELS OF S.O.L.O. TAXONOMY

Sr. No.	Unistructure	Multistructure	Relational	Extended Abstract
1)	Transmit	Rework	Inquire	Imagine
2)	Tell	Clarify	Apply	Elaborate
3)	State	Explain	Outline	Create
4)	Recognise	Define	Distinguish	Initiate
5)	Recall	Extend	Map	Judge
6)	Quote	Interpret	Analyse	Synthesis
7)	Note	Revise	Classify	Hypothesis
8)	Name	List	Contrast	Validate
9)	Identify	Symbolise	Categorise	Organise
10)		Solve	Observe	Visualise
11)		Describe	Summarise	Value/Judge
12)		Examine	Predict	Appreciate / Deep understanding
13)			Combine	Develop
14)			Demonstrate	Debate
15)			Appraise	Reflect
16)			Perform	Theorise
17)			Evaluate	Assess
18)				Generate/develop

(Source: TLC Workshop Document, Lingnan University, Retrieved from http://study.ln.edu.hk>sites>default>files>solotaxonomyverbs.pdf)

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APPENDIX – G(iv)

Critical Values for the Mann-Whitney U-Test

Level of significance: 5% (P = 0.05)

Size of the smallest sample (n_1) \ Size of the largest sample (n_2)	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
3	0	1	1	2	2	3	3	4	4	5	5	6	6	7	7	8	8	9	9	10	10	11	11	12	13	13
4	1	2	3	4	4	5	6	7	8	9	10	11	11	12	13	14	15	16	17	17	18	19	20	21	22	23
5	2	3	5	6	7	8	9	11	12	13	14	15	17	18	19	20	22	23	24	25	27	28	29	30	32	33
6		5	6	8	10	11	13	14	16	17	19	21	22	24	25	27	29	30	32	33	35	37	38	40	42	43
7			8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54
8				13	15	17	19	22	24	26	29	31	34	36	38	41	43	45	48	50	53	55	57	60	62	65
9					17	20	23	26	28	31	34	37	39	42	45	48	50	53	56	59	62	64	67	70	73	76
10						23	26	29	33	36	39	42	45	48	52	55	58	61	64	67	71	74	77	80	83	87
11							30	33	37	40	44	47	51	55	58	62	65	69	73	76	80	83	87	90	94	98
12								37	41	45	49	53	57	61	65	69	73	77	81	85	89	93	97	101	105	109
13									45	50	54	59	63	67	72	76	80	85	89	94	98	102	107	111	116	120
14										55	59	64	67	74	78	83	88	93	98	102	107	112	118	122	127	131
15											64	70	75	80	85	90	96	101	106	111	117	122	125	132	138	143
16												75	81	86	92	98	103	109	115	120	126	132	138	143	149	154
17													87	93	99	105	111	117	123	129	135	141	147	154	160	166
18														99	106	112	119	125	132	138	145	151	158	164	171	177
19															113	119	126	133	140	147	154	161	168	175	182	189
20																127	134	141	149	156	163	171	178	186	193	200
21																	142	150	157	165	173	181	188	196	204	212
22																		158	166	174	182	191	199	207	215	223
23																			175	183	192	200	209	218	226	235
24																				192	201	210	219	228	238	247
25																					211	220	230	239	249	258
26																						230	240	250	260	270
27																							250	261	271	282
28																								272	282	293
29																									294	305
30																										317

(Source : http://psych.unl.edu>handcomp>hcmann, Retrieved on April, 2016)

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APPENDIX – H

[I] PHOTO GALLERY – 1

[II] PHOTO GALLERY - 2

Most People Learn .....

10%	of what they Read
20%	of what they Hear
30%	of what they See
50%	of what they See and Hear
70%	of what they Talk over with others
80%	of what they Use and Do in Real-life
95%	of what they Teach someone else

(Source: Attributed to William Glasser; quoted by Association for Supervision & Curriculum Development Guide 1988, quoted in Biggs & Tang (2011)

Appendix – H(i)

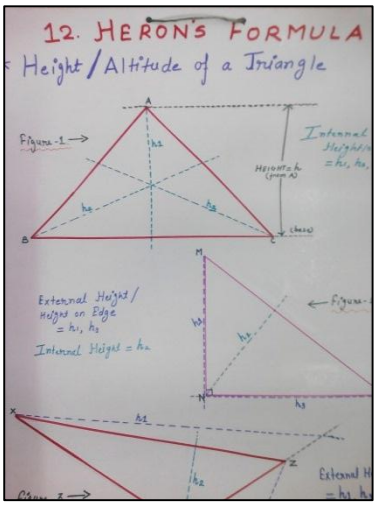
PHOTO GALLERY – 1

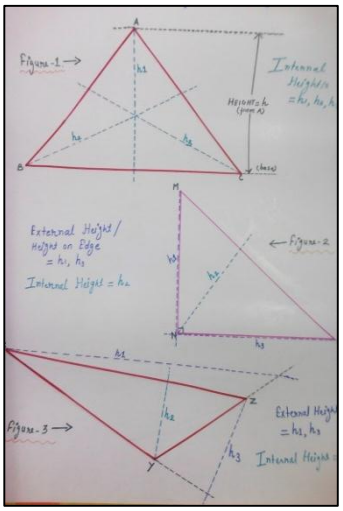
CHAPTER-WISE

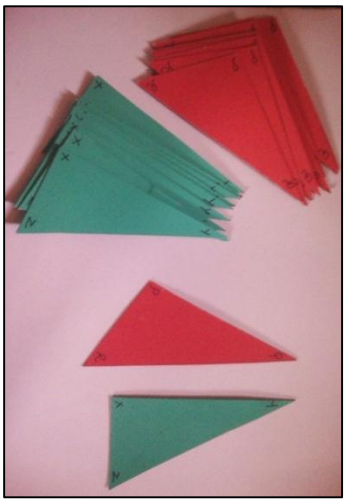
TEACHING LEARNING MATERIAL (TLM)

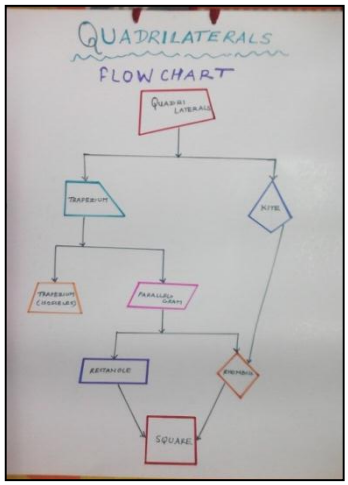
Following are the images of the charts, posters, models and other materials or other Manipulative used during the teaching-learning process conducted for the five selected chapters of Mathematics Class-IX. Chapter-wise it is arranged below.

CHAPTER - 12
HERON'S FORMULA









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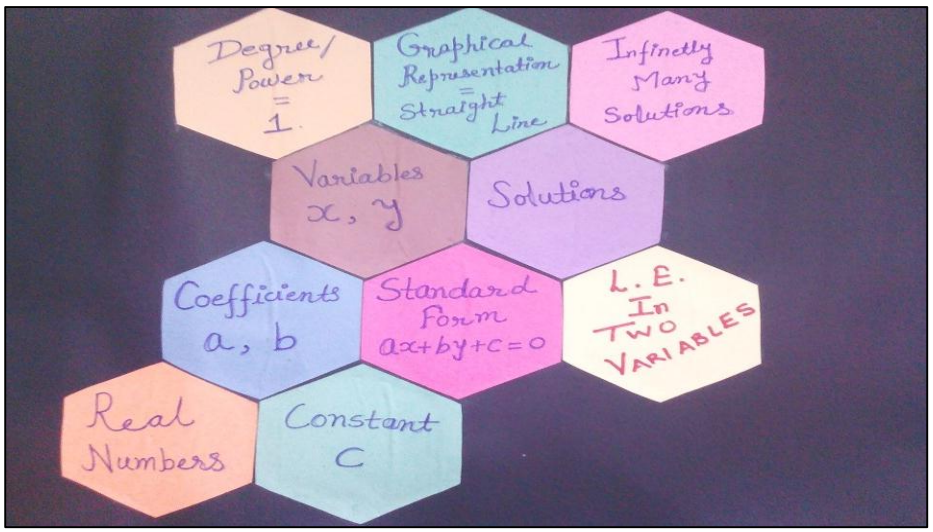
CHAPTER - 4
LINEAR EQUATION IN TWO VARIABLES



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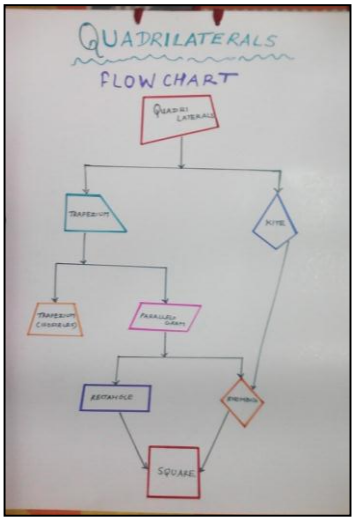
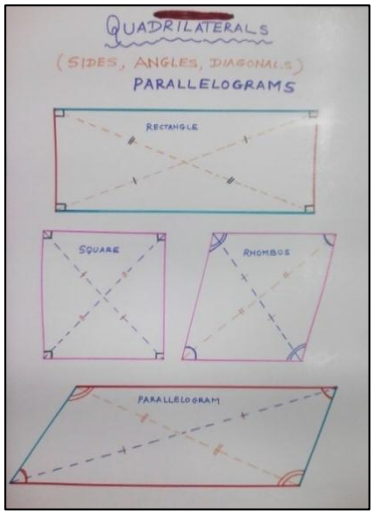
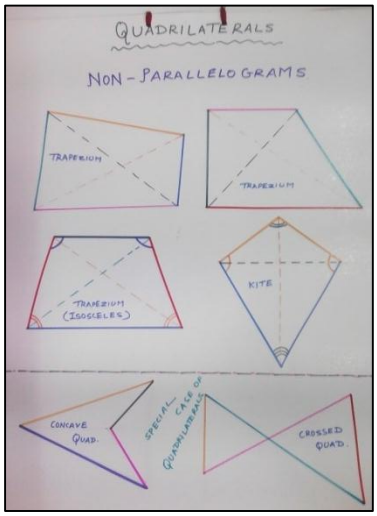
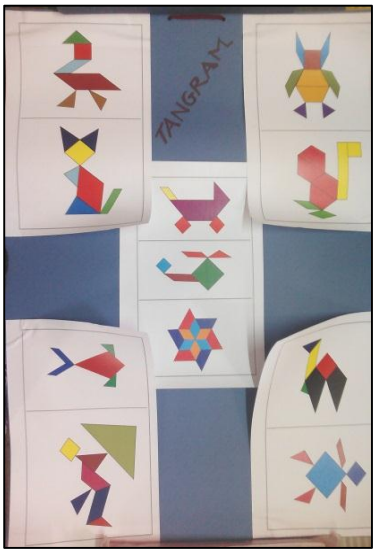
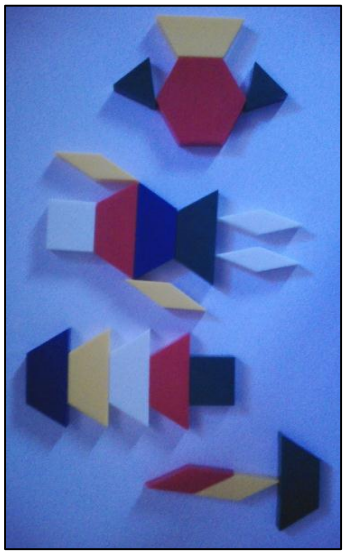
CHAPTER - 8
QUADRILATERALS

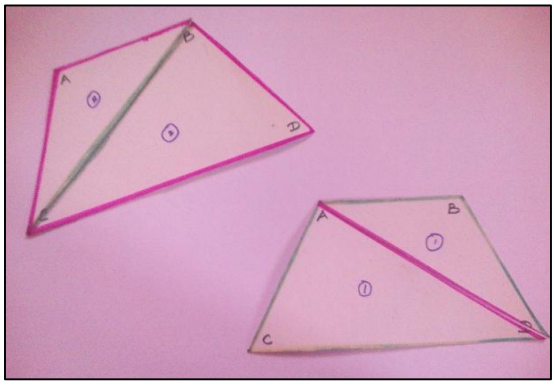


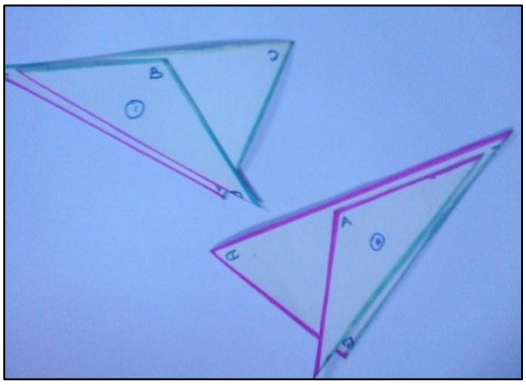


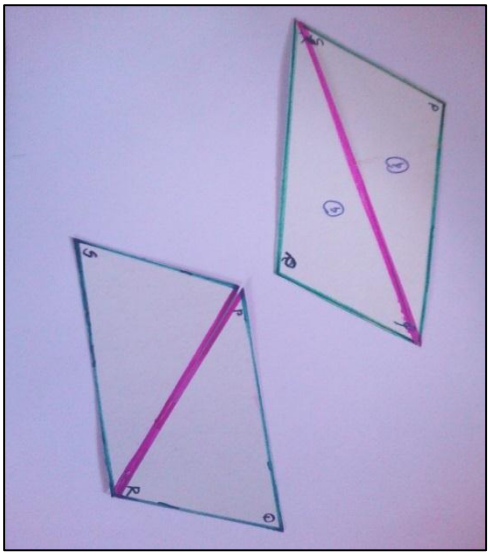


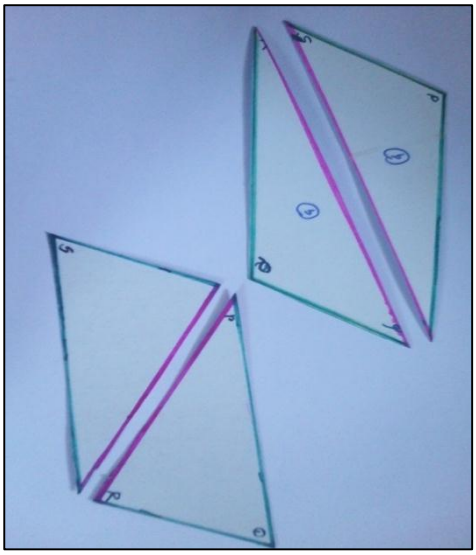






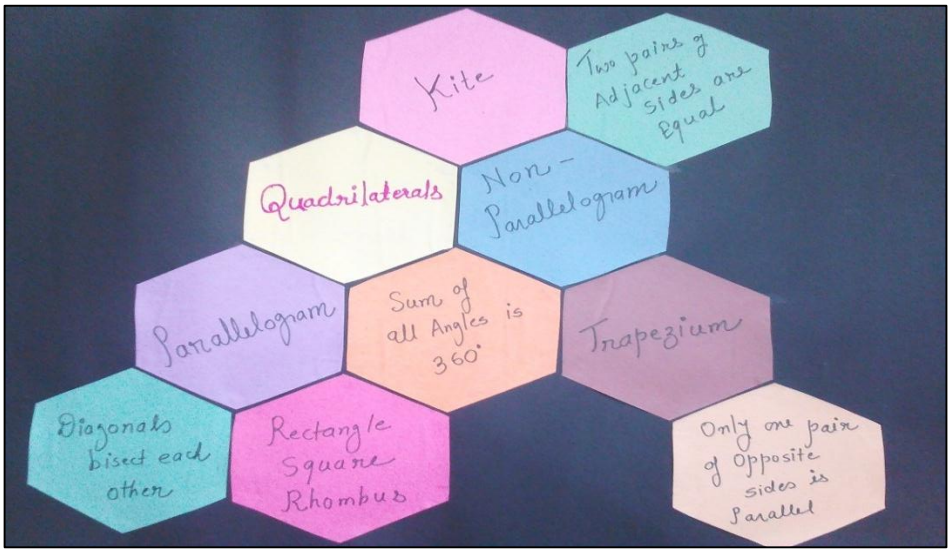




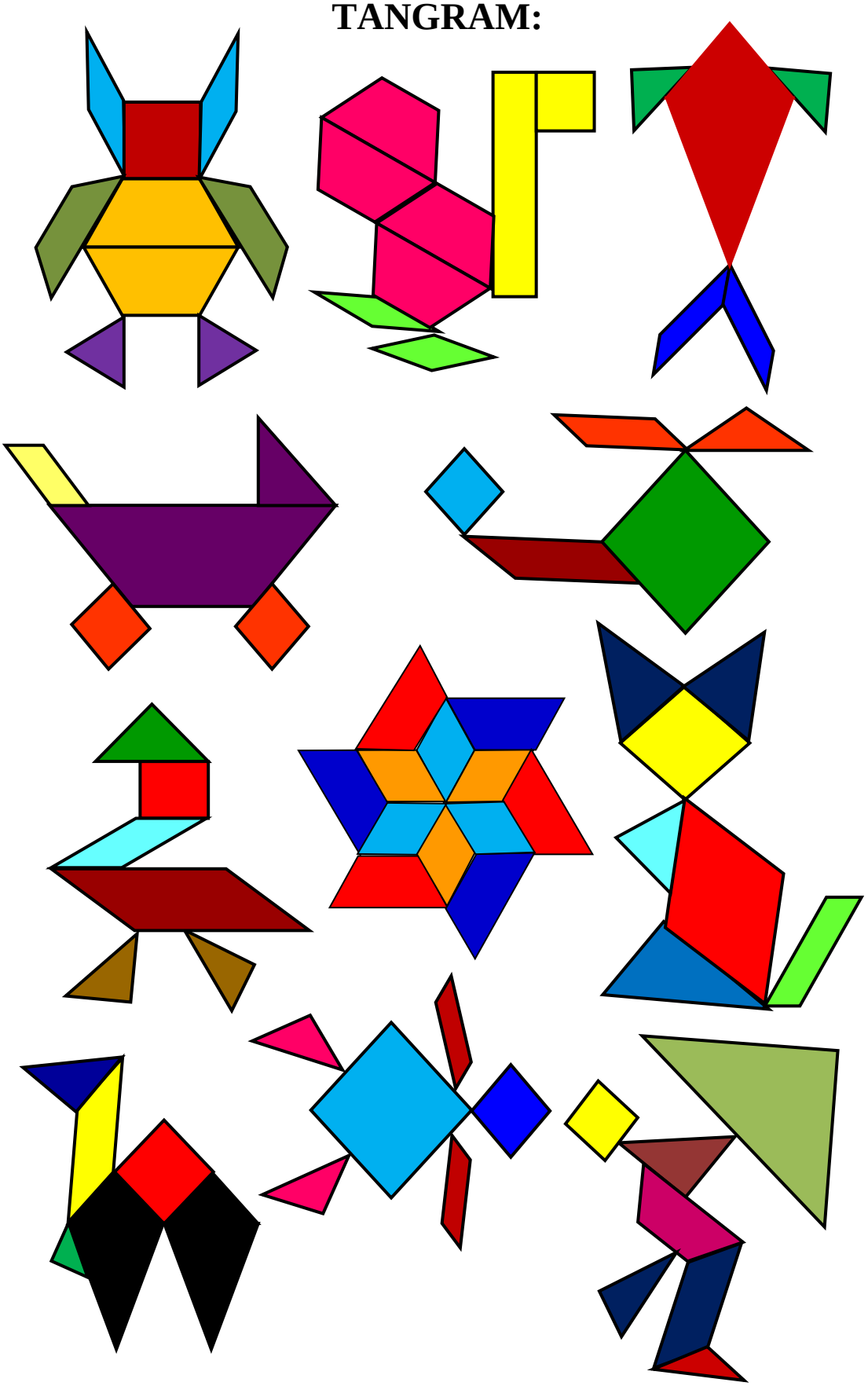



A K H E S W O
P F Z B L U
V C G J M Y Q
D X R N I T


A I C B J H D E K L G F M N O R V X Z P Q U W Y S T


Kite
Two pairs of Adjacent sides are Equal
Quadrilaterals
Non-Parallelogram
Parallelogram
Sum of all Angles is 360°
Trapezium
Diagonals bisect each other
Rectangle Square Rhombus
Only one pair of Opposite sides is Parallel

TANGRAM:



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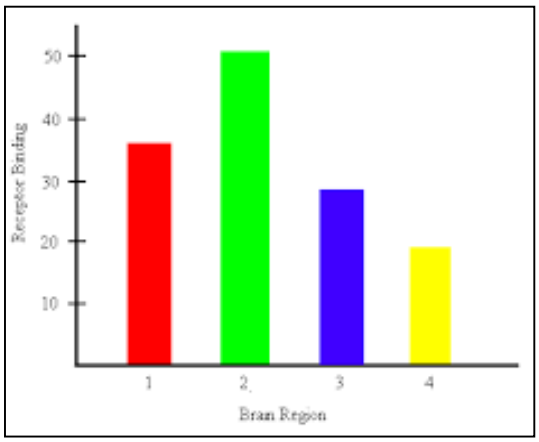
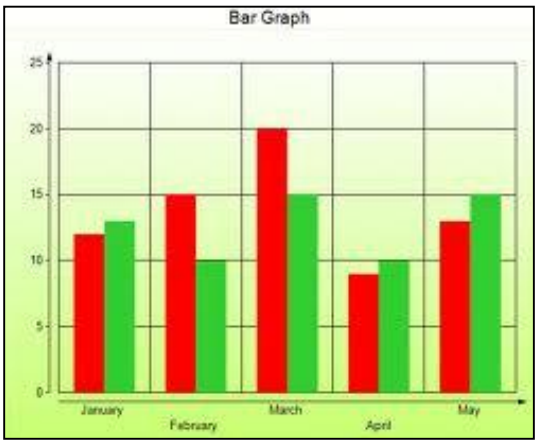
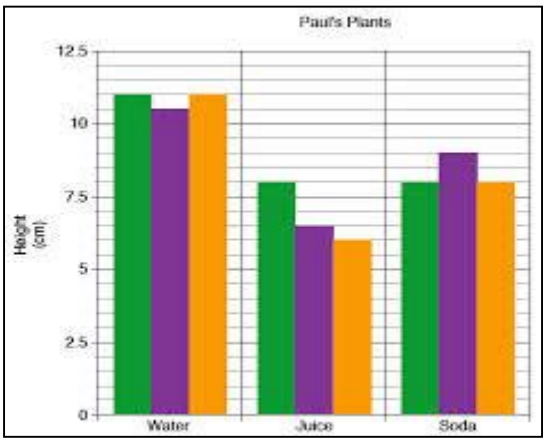
CHAPTER - 14
STATISTICS

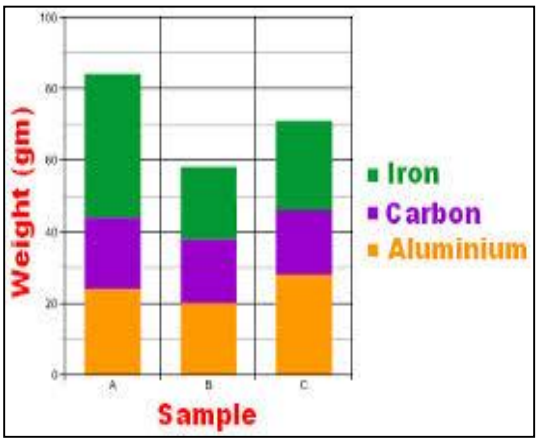
CHART PRESENTATION ON STATISTICAL GRAPHS

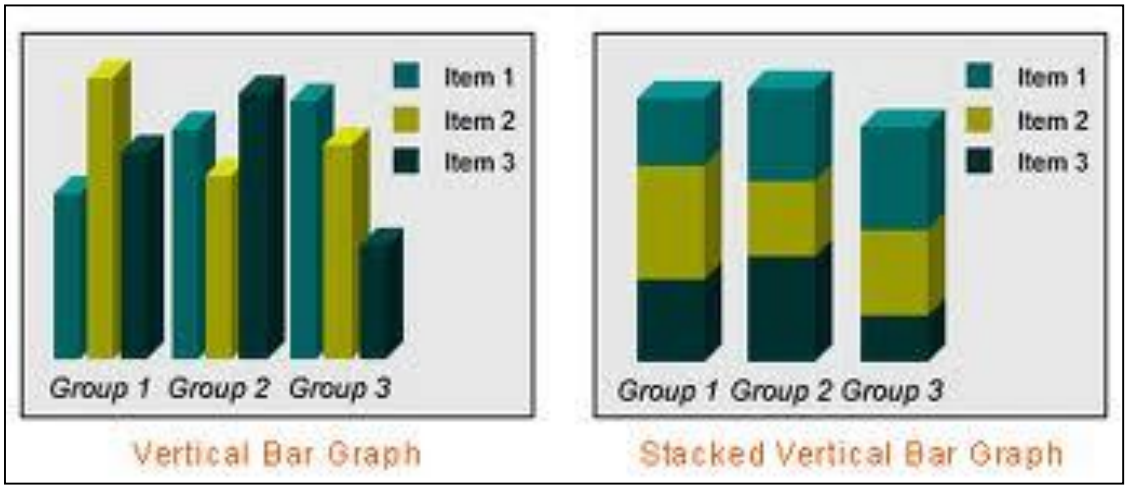
BAR GRAPHS

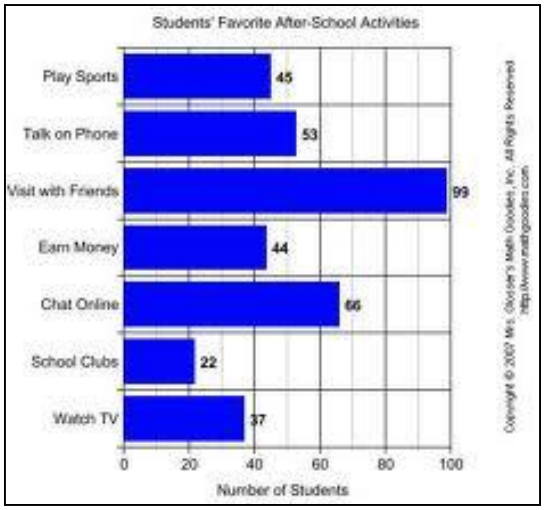


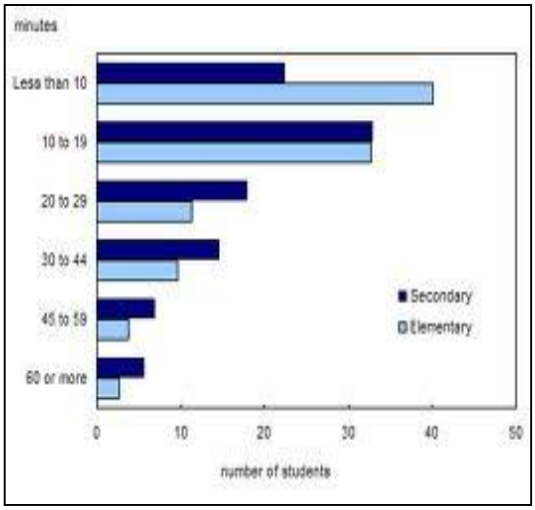


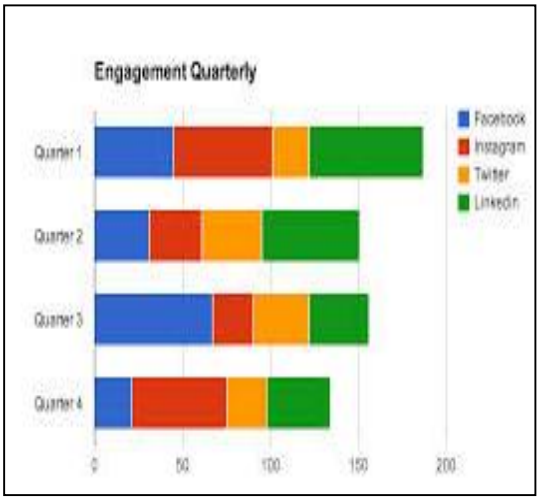


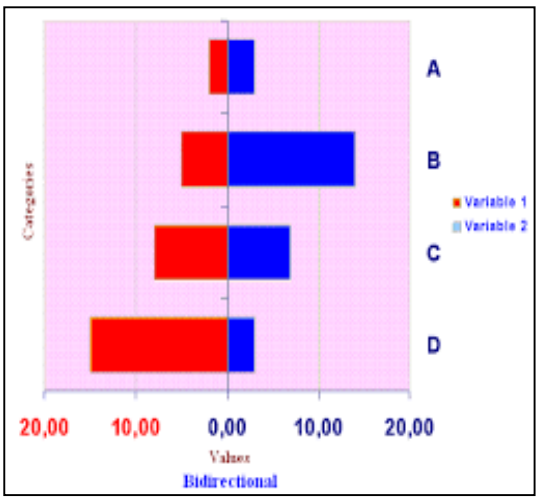




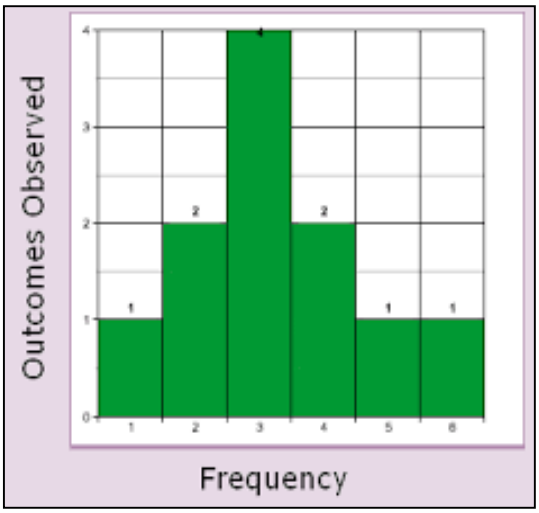

Students' Favorite After-School Activities
Play Sports
Talk on Phone
Visit with Friends
Earn Money
Chat Online
School Clubs
Watch TV
45
53
99
44
66
22
37
0
20
40
60
80
100
Number of Students

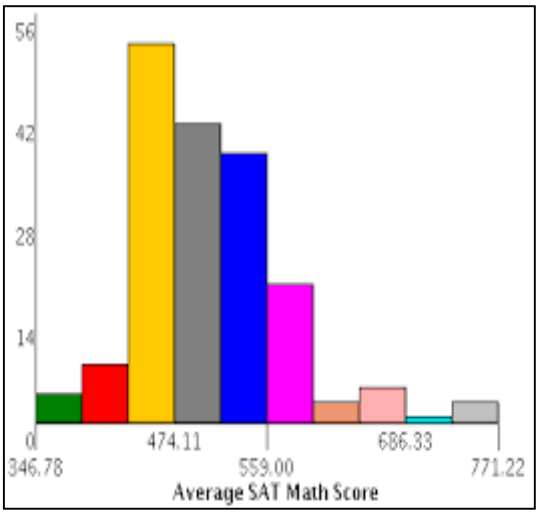

minutes
Less than 10
10 to 19
20 to 29
30 to 44
45 to 59
60 or more
Secondary
Elementary
0
10
20
30
40
50
number of students

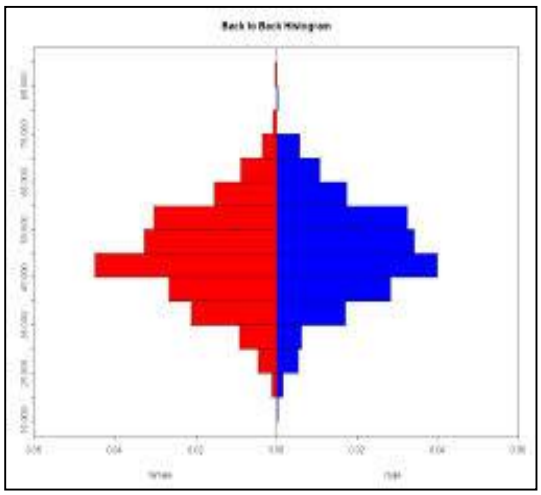

Engagement Quarterly
Quarter 1
Quarter 2
Quarter 3
Quarter 4
Facebook
Instagram
Twitter
LinkedIn
0
50
100
150
200

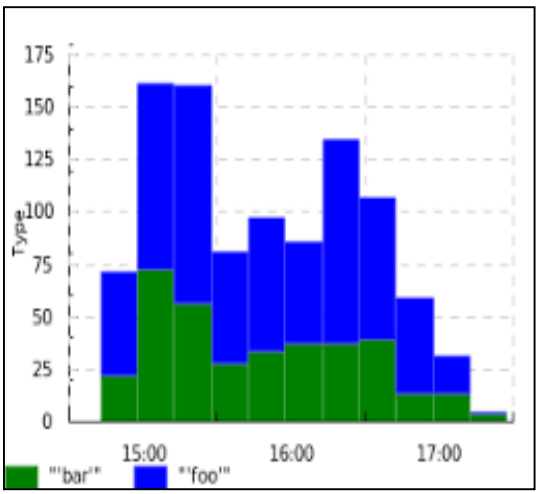

A
B
C
D
Categories
Variable 1
Variable 2
20,00
10,00
0,00
10,00
20,00
Values
Bidirectional

HISTOGRAMS

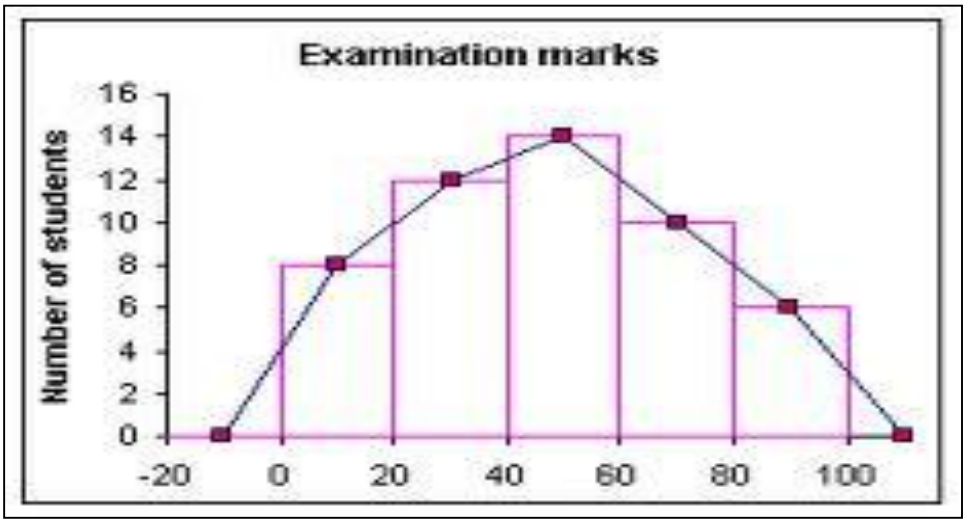

Outcomes Observed
Frequency

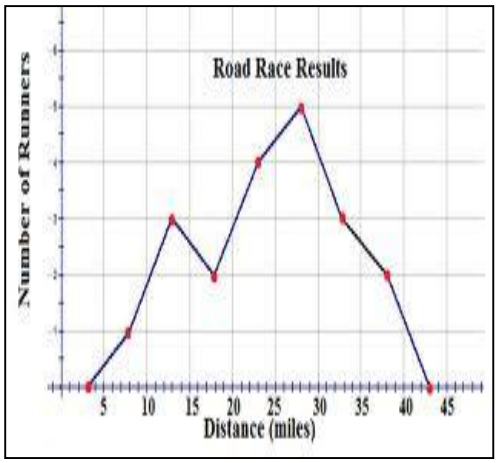

56
42
28
14
0
474.11
686.33
346.78
559.00
771.22
Average SAT Math Score

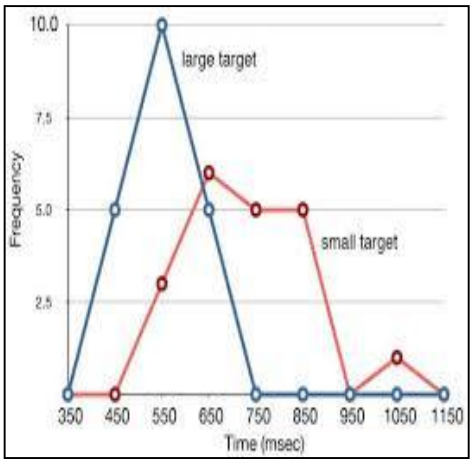


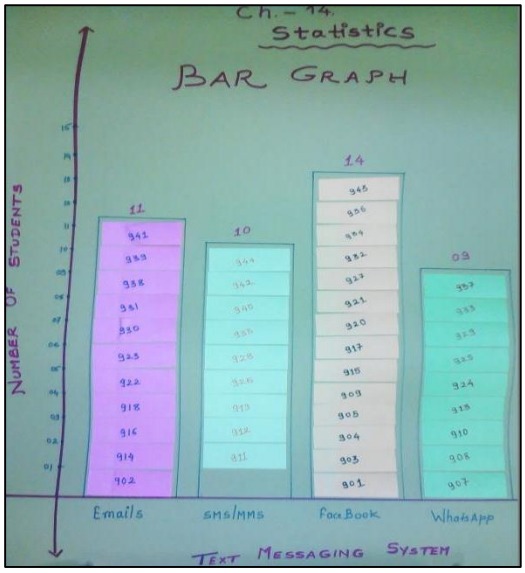


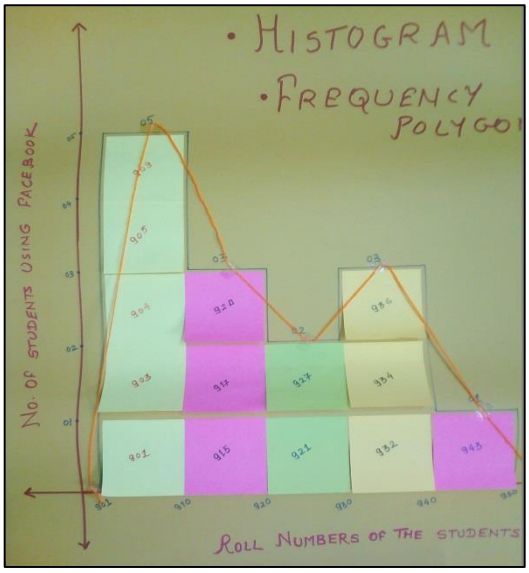
FREQUENCY POLYGON

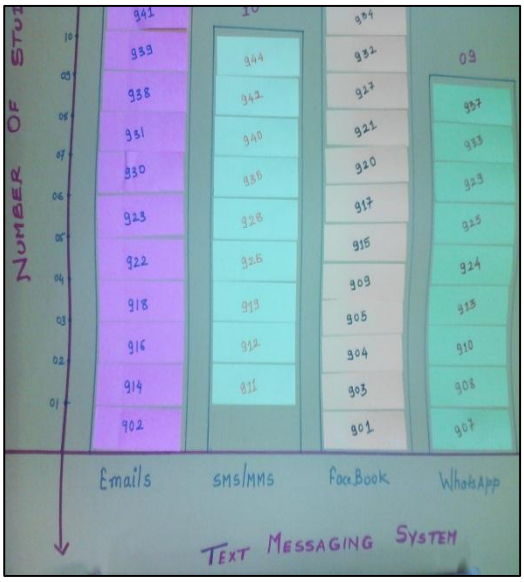


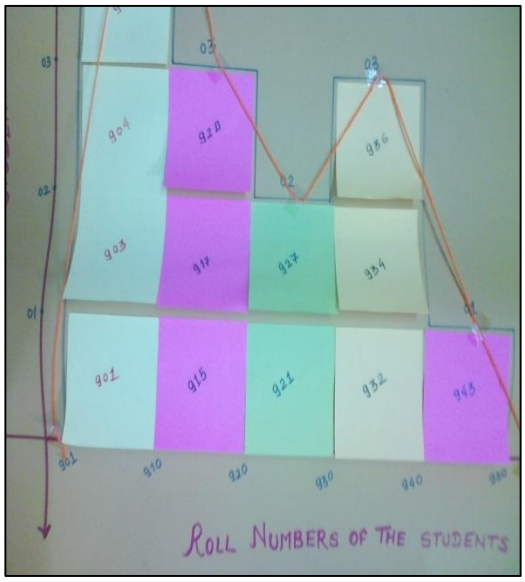





Ch. - 14
Statistics
BAR GRAPH
NUMBER OF STUDENTS
11
10
14
09
Emails
SMS/MMS
FaceBook
WhatsApp
TEXT MESSAGING SYSTEM


• HISTOGRAM
• FREQUENCY POLYGON
NO OF STUDENTS USING FACEBOOK
ROLL NUMBERS OF THE STUDENTS

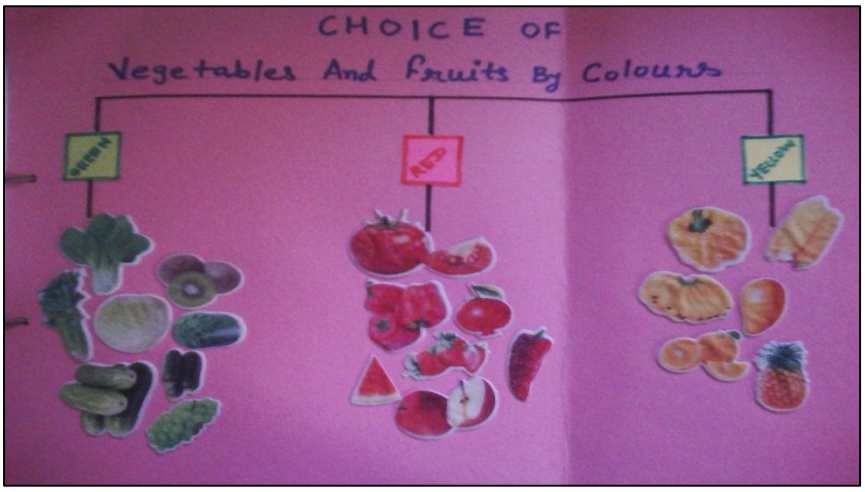

NUMBER OF STU
Emails
SMS/MMS
FaceBook
WhatsApp
TEXT MESSAGING SYSTEM

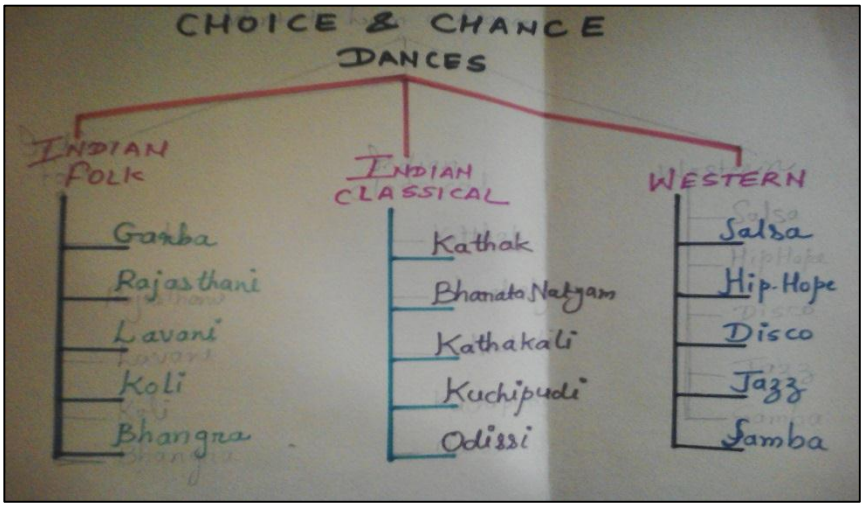

ROLL NUMBERS OF THE STUDENTS

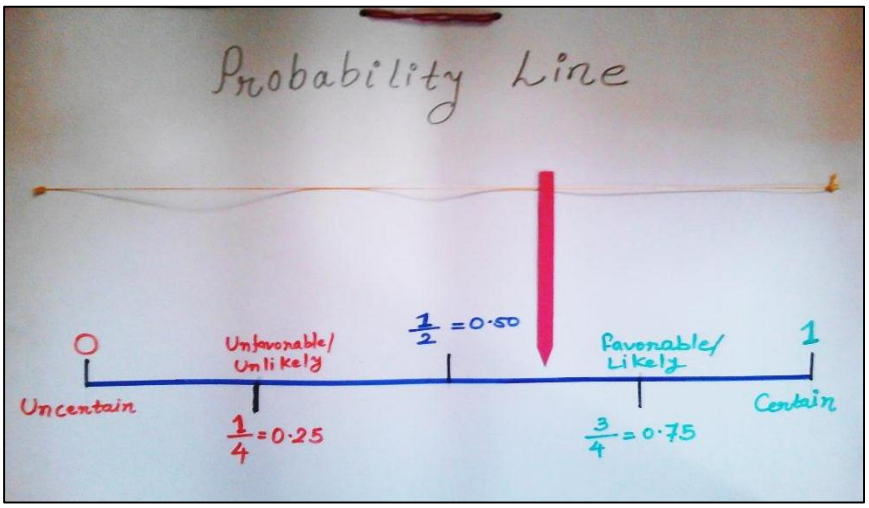

(Bar) Graphs (Histograms, F.P.)
Presentation of Data
Analysis of Data
Interpretation of Data
Organization of Data
Statistics
Measures of Central Tendency (M, M, M)
Tally Marks
Collection of Data
Ungrouped / Grouped form of Data
Primary / Secondary Source of Information

****

CHAPTER - 15
PROBABILITY








K
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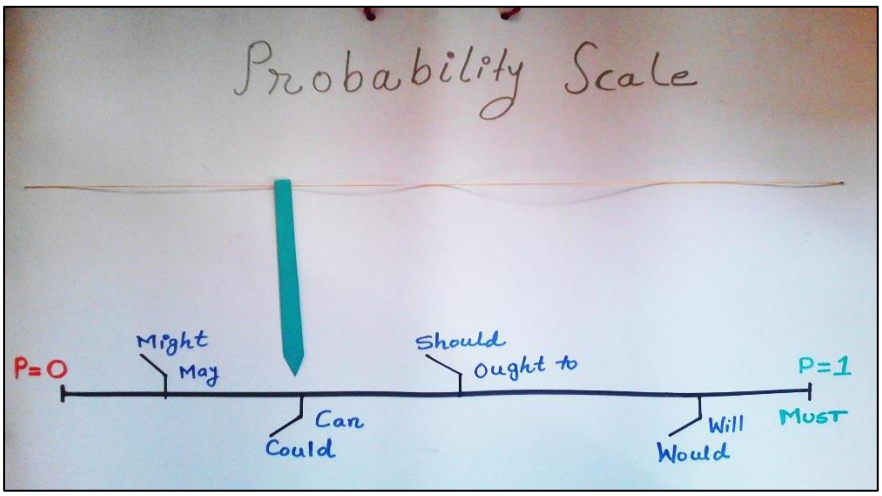

Probability Scale
P=0
Might
May
Can
Could
Should
Ought to
Will
Would
P=1
MUST

****

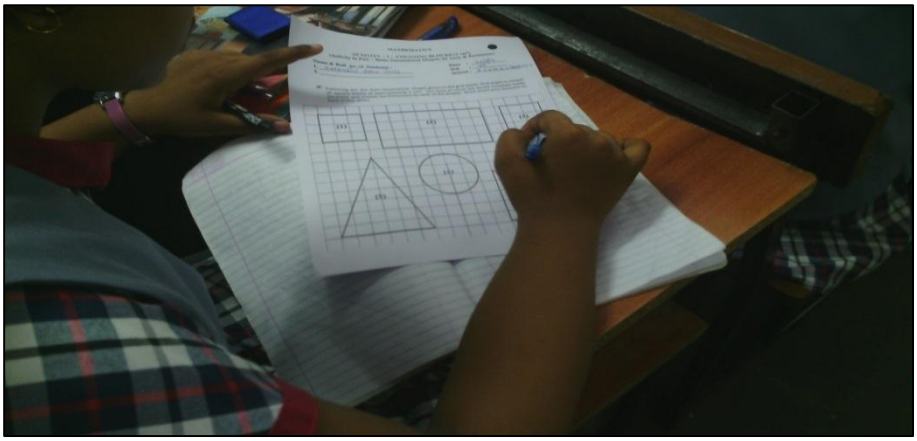
●●●●●●●●●●●●●●●●●●

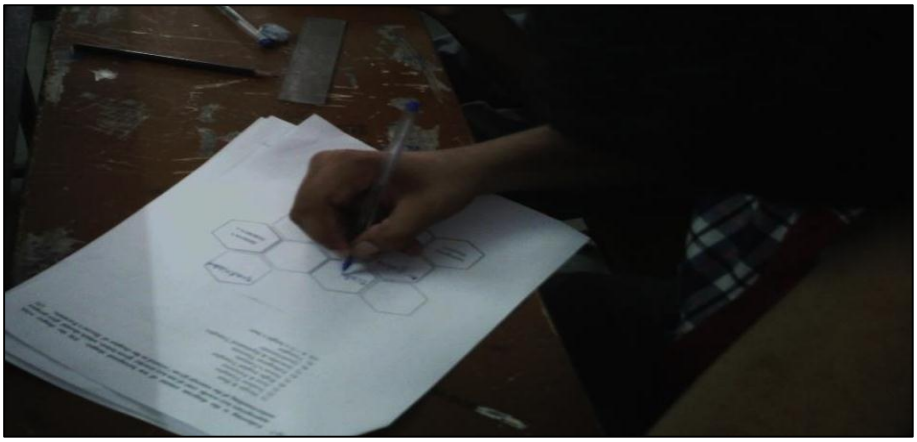
Appendix – H(ii)

PHOTO GALLERY – 2

EXPERIMENTAL GROUP

CHAPTER – 12
HERON'S FORMULA

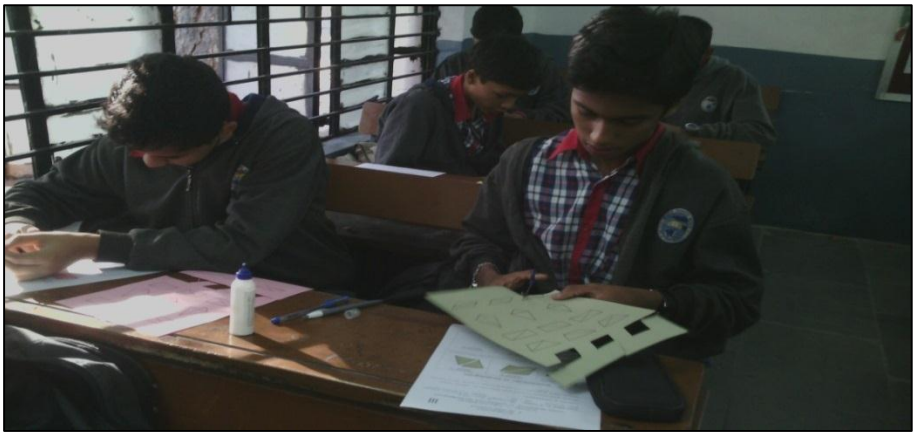


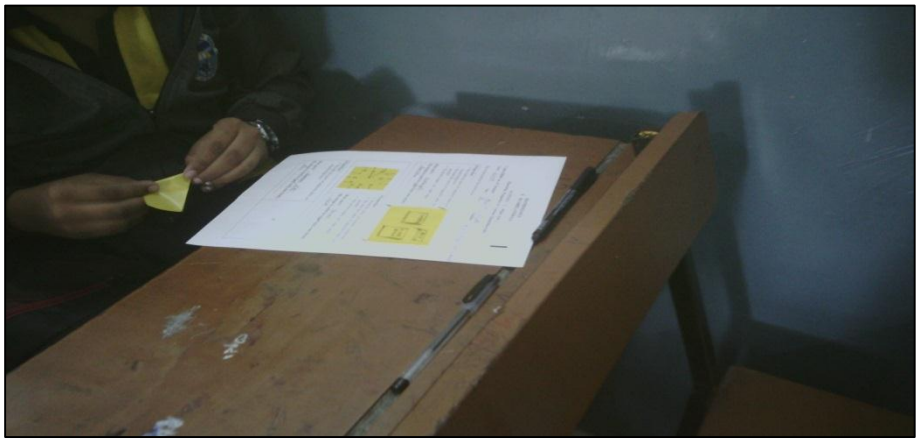



HERON'S
Formula
SCALENE
TRIANGLES
QUADRILATERALS
AREA
Basic idea
TRIANGLE
RIGHT
ANGLED
TRIANGLE
ALTITUDE/
HEIGHT
(h)
Base (b)
ISOSCELES
&
EQUILATERAL
TRIANGLES
Pythagoras
Theorem

CHAPTER – 4
LINEAR EQUATION IN TWO VARIABLES

CHAPTER – 8
QUADRILATERALS





CHAPTER – 14
STATISTICS

CHAPTER – 15
PROBABILITY

****

CONTROL GROUP

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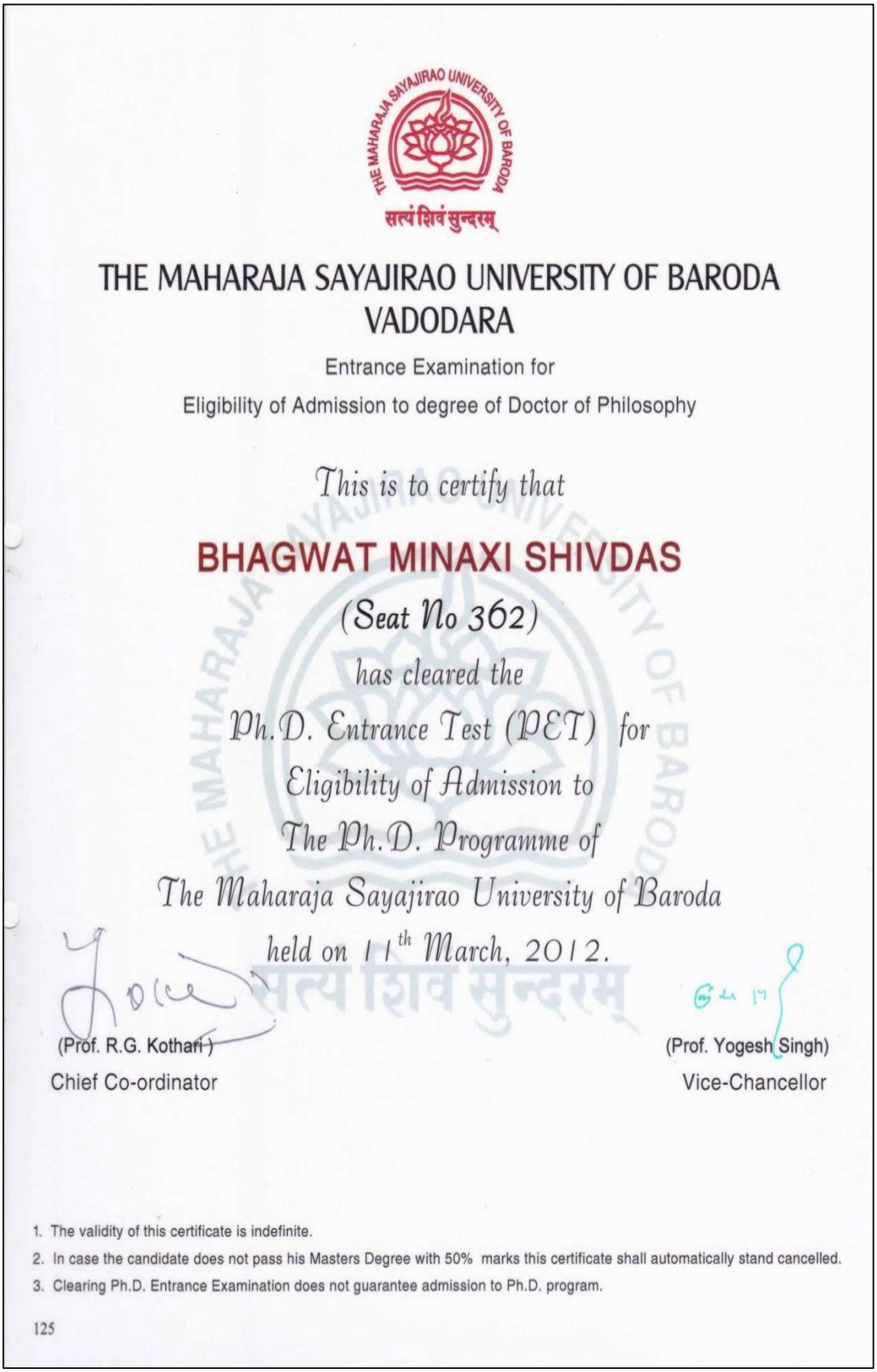
●●●●●●●●●●●●●●●●●●●●

APPENDIX – I

CERTIFICATES

APPENDIX – I(i)



THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

सत्यं शिवं सुन्दरम्

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA
VADODARA

Entrance Examination for

Eligibility of Admission to degree of Doctor of Philosophy

This is to certify that

BHAGWAT MINAXI SHIVDAS

(Seat No 362)

has cleared the

Ph.D. Entrance Test (PET) for

Eligibility of Admission to

The Ph.D. Programme of

The Maharaja Sayajirao University of Baroda

held on 11th March, 2012.

(Prof. R.G. Kothari)
Chief Co-ordinator

(Prof. Yogesh Singh)
Vice-Chancellor

1. The validity of this certificate is indefinite.
2. In case the candidate does not pass his Masters Degree with 50% marks this certificate shall automatically stand cancelled.
3. Clearing Ph.D. Entrance Examination does not guarantee admission to Ph.D. program.

125

APPENDIX – I(ii)

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

CERTIFICATE

Date of Registration: **20/07/2013**

Registration No.: **FoEdu./3/ 195**

Certified that **Bhagwat Minaxi Shivdas** has registered the name as a post-graduate student of this University for the Degree of Ph.D. under the guidance of **Prof. Rameshchandra G. Kothari**, in Department of **Education** in the Faculty of **Education and Psychology.**

The title of the thesis is **"DEVELOPING AND IMPLEMENTING INSTRUCTIONAL STRATEGY ON THE STRUCTURE OF OBSERVED LEARNING OUTCOMES (SOLO) TAXONOMY FOR MATHEMATICS OF CLASS-IX".**

VADODARA
DATE: 26-07-2013

DY. REGISTRAR
(Academic)

APPENDIX – I(iii)

5/15

THE MAHARAJA SAYAJIRAO UNIVERSITY OF BARODA

CERTIFICATE

[As per O.Ph.D. 2 under UGC (Minimum Standards and Procedure for Awards of M.Phil./Ph.D. Degree) Regulation, 2009 for 15 Credits to be earned by Ph.D. Scholars]

This is to certify that **Bhagwat Minaxi Shivdas,** Research Scholar, registered under UGC *(Minimum Standards and Procedure for Awards of M.Phil./Ph.D. Degree) Regulation, 2009,* vide Registration Certificate Number **195** dated **20/07/2013**, for pursuing Ph.D. on has undertaken and completed the course work with the Grade A.

STATEMENT OF CREDITS EARNED

Name of Research Scholar: **Bhagwat Minaxi Shivdas**

Faculty/Institution: Faculty of Education And Psychology

Department: Department of Education

Paper Number	Course Title	Course Credits	Grade Earned
Core Courses – 09 Credits *[Offered At University Level]*			
I.	Introduction To Research & Research Writings	3	B
II.	Introduction To Basic Computer Functions & Application For Research Purposes	3	O
III.	Quantitative Research Techniques & Data Analysis	3	D
Departmental Courses – 06 Credits *[Offered at Departmental Level]*			
IV.	Review and Report of Research	3	A
V.	Conceptual Framework of Research Problem	3	A
		Overall Grade	**A**

ACA3/39

Date of Issue: 02-06-2015

Place: Vadodara

22/6/15

Registrar (OSD)

Grade Conversion Table and Grade Calculation Formula

Grade	Grade Points	Range
O	10	Above 9.01
A	9	8.01 – 9.00
B	8	7.01 – 8.00
C	7	6.01 – 7.00
D	6	5.01 – 6.00
E	5	4.01 – 5.00
F	4	Below 4.00

$$Overall\ Grade = \frac{\sum (Grade\ Points \times Credits)}{\sum Credits}$$

****

APPENDIX – J

PERMISSION LETTERS

APPENDIX – J(i) : LETTER - 1

From:
Ms. Minaxi S. Bhagwat,
Researcher (Ph.D. in Education)**,**
Centre for Advanced Studies in Education,
The M. S. University of Baroda,
Vadodara.
Contact : -
Date :

To,
The Principal / Director / Managing Trustee,

Subject: **Seeking Permission For The Observation Of Teaching –Learning Processes In Class – IX Mathematics Of Your School.**

Respected Sir / Madam,

I Minaxi Bhagwat, am pursuing Ph.D. Study in Department of Education-CASE under the guidance of **Prof. R. G. Kothari, The Dean, Faculty of Education and Psychology, The M. S. University of Baroda, Vadodara.** As a part of the field work of the research study, primarily it is required to observe the Mathematics teaching-learning processes of Class-IX.

In the aforesaid reference, I request you to permit me to observe two to five periods of Class-IX Mathematics. Data collected from your school will be used for research purpose only and I promise for the confidentiality of the data collected personally by me from your school.

Kindly grant the permission and necessary support to fulfil the objectives of the said research study.

Looking for your positive forwarding. Thanking You.

Through: **Prof. R. G. Kothari (Guide)**
The Dean,
Faculty of Education. & Psychology,
The M. S. University of Baroda.

Yours Truly,

[**Minaxi Bhagwat**]
(**Researcher**)

Enclosure:

APPENDIX – J(ii) : LETTER - 2

From:
Ms. Minaxi S. Bhagwat,
Researcher (Ph.D. in Education)**,**
Centre for Advanced Studies in Education,
The M. S. University of Baroda,
Vadodara.

Date :

To,
The Principal,

Subject: **Seeking Permission To Conduct A Pilot Study For The Developed Instructional Strategy In Class – IX Mathematics Of Your School**

Respected Sir / Madam,

I Minaxi Bhagwat, am pursuing Ph.D. Study in Department of Education (C.A.S.E.) under the guidance of **Prof. R. G. Kothari, The Dean, Faculty of Education and Psychology, The M. S. University of Baroda, Vadodara.** As a part of the Experimentation of the research study, it is required to conduct a Pilot Study on the developed Instructional Strategy for the selected chapter/s of the Class-IX Mathematics. Following is the plan for a Pilot Study on developed Instructional Strategy for one chapter.

Chapter No.	Chapter Name	Semester	Tentative Required Periods
5	Linear Equation in Two Variables	I	5-6

In the aforesaid reference, I request you to permit me and give necessary support to conduct a Pilot study for the said chapter in Class-IX Mathematics of your school. The Pilot Study will be conducted by me personally as a Teacher-Experimenter. I promise for the confidentiality of the data collected personally by me from your school.

Looking for your positive forwarding. Thanking You.

Through: _____
Guide
Prof. R. G. Kothari (Dean)
Department of Education – CASE,
Faculty of Education. & Psychology,
The M. S. University of Baroda.

Yours Truly,
_____
[**Minaxi Bhagwat**]
(**Researcher**)

APPENDIX – J(iii) : LETTER - 3

From:
Ms. Minaxi S. Bhagwat,
Researcher (Ph.D. in Education)**,**
Centre for Advanced Studies in Education,
Faculty of Education & Psychology,
The M. S. University of Baroda,
Vadodara.

Date :

To,
The Principal,

Subject: **Seeking Permission To Implement The Developed Instructional Strategy In Class – IX Mathematics Of Your School**

Respected Sir / Madam,

I Minaxi Bhagwat, am pursuing Ph.D. Study in Department of Education (C.A.S.E.) under the guidance of **Prof. R. G. Kothari, The Dean, Faculty of Education and Psychology, The M. S. University of Baroda, Vadodara.** As a part of the Experimentation of the research study, it is required to implement the developed Instructional Strategies on the selected chapters of the Class-IX Mathematics within the time period of 3-6 months. Following table represents the plan for the Implementation of developed Instructional Strategies.

Sr. No.	Chapter No.	Chapter Name	Semester	Tentative Required Periods
1.	12	Heron's Formula	I	06
2.	4	Linear Equation in Two Variables	II	10
3.	8	Quadrilaterals	II	08
4.	14	Statistics	II	11
5.	15	Probability	II	10
			Total Classes	45

(01 period meant to of 35-40 minutes)

In the aforesaid reference, I request you to permit me to implement the developed Instructional Strategies in Class-IX Mathematics of your school. These Instructional Strategies for the selected chapters are developed by me as a Researcher and will be implemented by me personally as a Teacher-Experimenter. I promise for the confidentiality of the data collected personally by me from your school and will be used for the purpose of research study only.

Kindly grant the permission and necessary support to fulfil the objectives of the said experimental research study.

Looking for your positive forwarding. Thanking You.

Yours Truly,

_____

[**Minaxi Bhagwat**]
(**Researcher**)

Through: _____

Guide
Prof. R. G. Kothari (Dean)
Department of Education – CASE,
Faculty of Education. & Psychology,
The M. S. University of Baroda.

APPENDIX – J(iv) : LETTER - 4

From:
Ms. Minaxi S. Bhagwat,
Researcher (Ph.D. in Education)**,**
Centre for Advanced Studies in Education,
Faculty of Education & Psychology,
The M. S. University of Baroda,
Vadodara.

Date :

To,
The Principal,

Subject: **Seeking Permission To Administer the Achievement Tests for Selected Chapters In Class – IX Mathematics Of Your School**

Respected Sir / Madam,

I Minaxi Bhagwat, am pursuing Ph.D. Study in Department of Education (C.A.S.E.) under the guidance of **Prof. R. G. Kothari, The Dean, Faculty of Education and Psychology, The M. S. University of Baroda, Vadodara.** As a part of the Experimentation of the research study, it is required to Administer the Achievement Tests on the selected chapters in Class-IX Mathematics after the completion of the relevant chapter. Following table represents the plan for conducting the Post-tests.

Sr. No.	Chapter No.	Chapter Name	Semester	Tentative Required Periods
1.	12	Heron's Formula	I	01
2.	4	Linear Equation in Two Variables	II	01
3.	8	Quadrilaterals	II	01
4.	14	Statistics	II	01
5.	15	Probability	II	01
			Total Classes	05

(01 period meant to of 35-40 minutes)

In the aforesaid reference, I request you to permit me to Administer the Achievement Tests in Class-IX Mathematics of your school. These Achievement Tests for the selected chapters are developed by me as a Researcher and will be administer by me personally as a Teacher-Experimenter. I promise for the confidentiality of the data collected personally by me from your school and data will be used for the purpose of research study only.

Kindly grant the permission and necessary support to fulfil the objectives of the said experimental research study.

Looking for your positive forwarding. Thanking You.

Yours Truly,

_____

[**Minaxi Bhagwat**]
(**Researcher**)

Through: _____

Guide
Prof. R. G. Kothari (Dean)
Department of Education – CASE,
Faculty of Education. & Psychology,
The M. S. University of Baroda.

●●●●●●●●●●●●●●●

APPENDIX – K

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TEACHING & LEARNING S.O.L.O. TAXONOMY

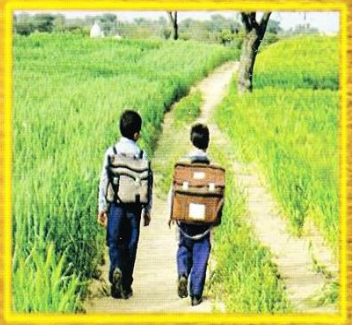
BIOMETRIC SYSTEM CLASSROOM MANAGEMENT

WORD RECOGNITION SKILLS IN ENGLISH

EDUCATIONAL ADMINISTRATION SCHOOL TEACHERS' ATTITUDE

TEACHING-LEARNING CLASSROOM TECHNOLOGY

PHONIC METHOD MONTESSORI CHILDREN



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EDUTRACKS
December, 2015 Vol. 15 No. 4

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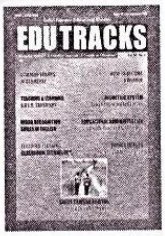

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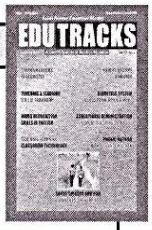
Articles

Personality Development

Research

Minaxi S. Bhagwat, R.G. Kothari



Viewing Teaching & Learning Through New Scaffold: The S.O.L.O. Taxonomy with Reference to the Conceptual Understanding in Mathematics

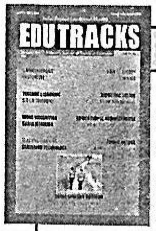
Article

Learning of Mathematics is important as it is a subject of Logic and is strongly concerned with the way of developing thinking (logical, critical, creative thinking) as well as the way of reasoning and solving the problems. Also it is understood that being poor in Mathematics rationally affects the learning of other subjects / areas too and this why it is called as Science of all the sciences as well as an art of all the Arts. Thus any misconceptions in any concepts of Mathematics at any level of the school education certainly cause major learning difficulties and affect the solving of the real life problems too. To minimize such problems, it is necessary to have constructive and effective teaching-learning in Mathematics from school level itself. Moreover, some bridges of more efficient mechanism are required for assessment / evaluation to quickly detect the misconceptions in understanding / comprehension at any level as well as to observe the learners' progressive learning of the Mathematics or Mathematical concepts. With the same concerns, S.O.L.O. (SOLO) Taxonomy as the new scaffold has been taken up for the study. As S.O.L.O. which stands for the ***Structure of Observed Learning Outcomes****, advocates the progressive learning and comprehensions through Constructive Alignment which can be observed with the five levels of the SOLO framework. Thus, this paper / article is developed to present the perspectives with reference to the conceptual understanding and making Mathematics teaching-learning easy and without fear through the concepts of Constructivism, Constructive Alignment and the SOLO framework.*

Mathematics today is a diversified discipline, which deals with data, measurement, observations, deduction and proof, mathematical models, natural phenomena, human behavior and social systems. This is also evident from the statements stated by the National Council of Educational Research and Training (NCERT) (2010) in an insight about the relativity of the Mathematics, that the Mathematics reveals hidden patterns that help us to understand the world around us. Also, Mathematics relies on logic rather than on observation as its standard of truth, simulations and even experimentation as means of discovering the truth. Such logic helps us in solving the problems of other subjects or field or areas and better logic could be developed by better/deep understanding. Hence, it seems that Mathematics is a very logical subject (logical means valid reasoning), that seeks good understanding rather than mechanical practices of the Mathematical concepts in terms of learning Mathematics properly.

Learning of Mathematics is important as it is a subject of Logic and is strongly concerned with the way of developing thinking (logical, critical, creative thinking) as well as the way of reasoning and solving the problems. Also, it is understood that being poor in Mathematics rationally affects the learning of other subjects/ areas too and this is why it is called as Science of all the sciences as well as an art of all the Arts. Thus any misconception that remains in any concept of Mathematics at any level of the school education certainly causes major learning difficulties and affects the solving of real life problems too. To minimize such problems, it is necessary to have constructive and effective teaching-learning in Mathematics from school level itself. Moreover, some bridges of more efficient mechanism are required for assessment/evaluation in terms of quickly detecting the misconceptions or misunderstanding/ incomprehension at any level as well as to observe the learners' progressive learning of the Mathematics or Mathematical concepts. The next section throws light on some problems encountered with Mathematics teaching-learning and

Minaxi S. Bhagwat *is a Research Scholar, CASE, The M.S. University of Baroda, Vadodara.*
Prof. R.G. Kothari *is Dean, Faculty of Education and Psychology, The M.S. University of Baroda, Vadodara.*



with misconception or incomprehension in the same.

Problems with Mathematics Teaching and Learning

As NCERT (2010) stated, in Mathematics, many concepts are needed to be learnt sequentially, since each theme is built on another result in a 'Tall Shape'. This makes it difficult for children if someone who finds one stage difficult finds it hard to catch up later. In such a case, it's really necessary to redesign the aims, objectives and instructional strategies accordingly to deal with the *tall shape* learning of Mathematics and to inculcate deep understanding among the learners from school level itself. Now, it's essential to understand in a correct manner what it means by deep understanding or Mathematical Comprehension.

As per the Education Initiatives (2010), understanding of Mathematics in primary classes is largely limited to 'procedural or rote-based learning' and falling averages as we move from the primary to the elementary classes and so on and it indicates an increase in the level of incomprehension of children. Mostly during the Mathematics learning, the students at the initial steps of the logical explanations try to understand and grasp, but slowly the gap is created between the explanations transmitted by teacher and received by students which lead to the poor understanding on part of students and they develop a fear of the subject-"Mathsphobia".

This way, somehow mechanical teaching-learning /rote-learning is practiced generally. Such phenomenon regularized normally in terms of getting ad hoc academic success keeps aside/ignores the actual aim and objectives set by the GOI (1966)-Education Commission (1964-66) viz. "In the teaching of Mathematics emphasis should be more on the understanding of basic principles than on the mechanical teaching of Mathematical computations".

Regarding Mathematics teaching and learning, an important consequence is of directing our focus of assessment from quantity to quality. Our focus should be changed from asking 'How many objective questions can the learner answer?' or 'Which particular skills can the learner demonstrate?' to the asking of 'How well does the learner understand important concepts, theories and principles?' and 'How expertly can the learner integrate a range of skills into a complex performance?' This kind of mechanism could be essential for Mathematics to improve the teaching-learning processes and to a great extent to reduce the Mathematical misconceptions.

Mathematical Misconceptions: Incomprehension/Misunderstanding of Mathematical Concepts

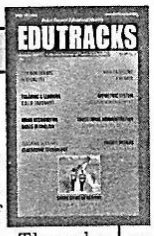
Giving good understanding about the subject and its concepts is the most preferable phenomenon to develop the interest/motivation/thinking of the learners in the subject. To get a more complete picture of how students learn and why they respond in particular ways to the questions we ask them, we need to focus on and think how they structure or construct their thinking. Let's understand this by some research-based examples.

According to Hart (1981a), for example, students often calculate the volume of a box by counting the number of cubes involved. When this approach is used on a picture of a box, students tend to count only the cubes that are visible. The counting strategy also fails if the dimensions of the box are fractions. Clements & Battista (1992) found from their research study that student' misconceptions in geometry lead to a "depressing picture" of their geometric understanding. Some examples are: 1) An angle must have one horizontal ray. 2) A figure can be a triangle only if it is equilateral. 3) The angle sum of a quadrilateral is the same as its area. 4) The area of a quadrilateral can be obtained by transforming it into a rectangle with the same perimeter. As Gal (1995) stated, students can calculate the average of a data set correctly, either by hand or with a calculator, and still not understand when the average (or other statistical tools) is a reasonable way to summarize the data. Herscovics (1989) reported in his research study that students experience difficulty with functions often because of the different notations. For example, 98 percent of the students could evaluate the expression a+7 when a=5 when only 65 percent of this same group could evaluate f(5) when f(a)=a+7. Rawool (1988) found that students failed to use concepts at the understanding and application levels. Raman (1989) has identified that the errors most students committed were conceptual errors. Wagh (1991) has also found that students committed common errors in the basic concepts.

There are many research studies which reveal the problems of misconceptions or understanding the Mathematics due to poor conceptual understanding in Mathematics.

Mathematical Comprehension: Enforcement for Conceptual Understanding

As Cetin et al. (2005) investigated through their research on 'Study on 8th Grade Students' Thoughts about the Mathematics Course' in Turkey. They found that out of the 831 respondent, 14% of the respondents consider Maths as an enjoyable course, while 7% respondents stated their dislike. 56% preferred the choice of "sometimes I like; sometimes I have difficulty in understanding."; 23% of the students stated that it is a course that they usually have difficulty in understanding. Thus, from this study it's revealed that majority of the students have problem with understanding of Mathematics and it could be generalized for any population. Sharma (1978) found that all the pupils did not acquire understanding and application of different topics because of undue emphasis on the mechanical learning of Mathematics. He has found that a major factor responsible for low achievement in Mathematics was the impartation of limited knowledge and



absence of the methodological approach to the classroom teaching.

Joseph & Yoe (2010) and McLaren (2010), stated that, teachers' central role in promoting deeper learning requires them to understand and practice some of the basic principles of the conceptual learning in Mathematics. These principles include teaching general knowledge or generic concepts in the subject and helping students in overcoming the difficulties they face while learning Mathematical concepts. Teachers can use a wide variety of activities and techniques such as discussion, stories, songs, role-play, visual illustrations, patterns seeking, using examples from real life, use of analogy and explanations, to help build prerequisite knowledge and strengthen connections between what students already know about a concept and what they need to know more about it.

Doshi (1989) has studied the positive relationship between achievements in Mathematics and cognitive preference styles. For all the students, the questioning style was the last, while for the majority of arts and commerce students; the recall style was the first. No significant relationship was found between cognitive preference styles and Mathematics. It is an open question worth investigation whether by changing teaching strategies we can change the cognitive preference style and whether this can lead to significantly improved learning of Mathematics.

With this focus, this article is developed to highlight the new scaffold as the S.O.L.O. Taxonomy. The S.O.L.O. (SOLO) that stands for the *Structure of Observed Learning Outcomes* is developed by Biggs & Collis (1982) and advocates the progressive learning as well comprehension through Constructive Alignment which can be observed with the five levels of SOLO framework. Thus, this paper/article attempts to present the perspectives on making Mathematics teaching-learning easy and without fear through the concepts of Constructivism, Constructive Alignment and the SOLO framework.

The New Scaffold: The SOLO Taxonomy

The teaching-learning of any subject requires a basic understanding of how children learn. Though, "Learning to Learn" requires the learner to think about the strengths and weaknesses of their own thinking when they are learning and to make thoughtful decisions on what to do next, where students can use SOLO levels, rubrics and frameworks need to answer the following basic questions:: (i) What am I learning?, (ii) How is it going?, (iii) What do I do next?

As per the founders Biggs & Collis (1982), SOLO Taxonomy provides a simple, reliable and robust model consisting of five levels aligned in terms of approaching the three stages of understanding–surface, deep and conceptual which are further designed with a Framework of five levels as given below. Hook & Mills (2011) have given an explanation on understanding all the five levels of the SOLO Taxonomy as follows.

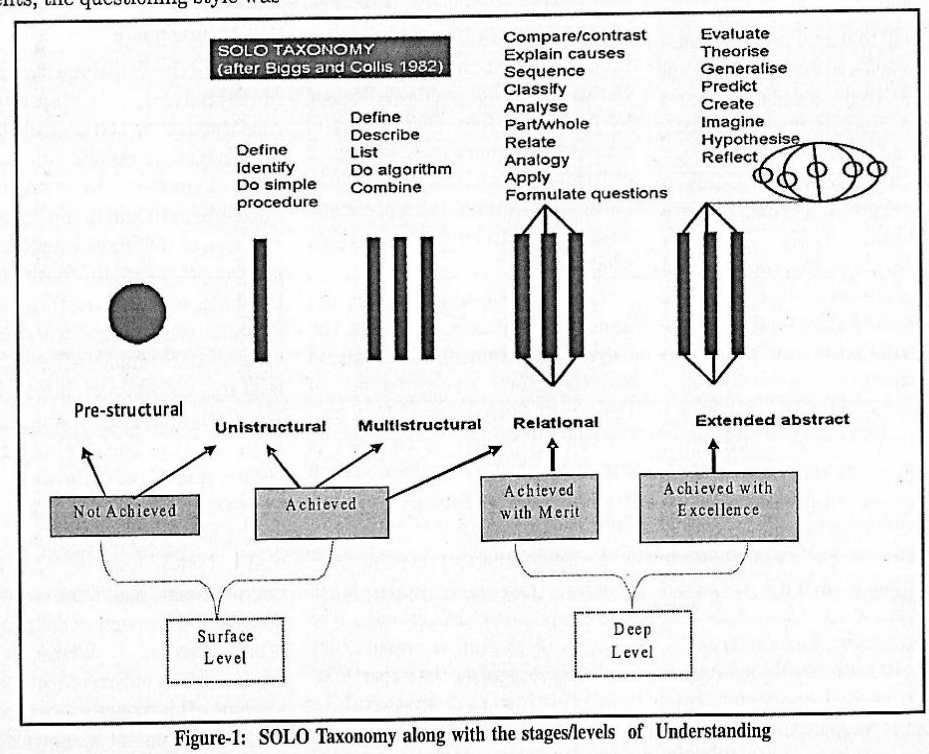


Figure-1: SOLO Taxonomy along with the stages/levels of Understanding

Source: http://pamhook.com/wiki/The_Learning_Process

- The *Level-I* named as **Prestructural** level of understanding, which means a student does not have any kind of understanding but uses irrelevant information and/or misses the point altogether. Scattered pieces of information may have been acquired, but they are unorganized, unstructured, and essentially void of actual content or relation to a topic or problem. The student needs help to start. The next two levels, **unistructural** and **multistructural** are associated with bringing in information (surface understanding).
- At the *Level-II* that is **Unistructural** level the student can deal with one single aspect and make obvious connections. The student can use terminology, recite (remember things), perform simple instructions/algorithms, paraphrase, identify, name, count, etc.
- At *Level-III* known as **Multistuctural** level, the student can deal with several aspects of the task that are known but these are considered independently and not in their connections as a whole. Metaphorically speaking; the student sees the many trees, but not the forest. He is able to enumerate, describe, classify, combine, apply methods, structure, execute procedures, etc. The progression to the next levels that are Relational and Extended-Abstract for outcomes is qualitative.
- At the *Level-IV*, **Relational** level, the student may understand relations between several aspects and how they are linked, integrated and fit together to form a whole and thus it contributes to a deeper and more coherent understanding of the whole. The understanding forms a structure and he does see how the many trees form a forest. A student may thus have the competence to compare, relate, analyze, apply theory, explain in terms of cause and effect, etc.
- At the *Level-V*, **Extended Abstract** level, which is the highest, the new understanding at the relational level is re-thought at another conceptual level, looked at in a new way, and used as the basis for prediction, generalization, reflection, or creation of new understanding.

Through these five levels, how constructivist approach is addressed and how gradually it aligns with the progress of these successive levels of the taxonomy is explained by Biggs as elaborated below. The figure-1 describes the five levels of the SOLO Taxonomy with the typical characteristics related with each level of the framework.

Insights of Constructive Alignment with SOLO Levels

Biggs & Tang (2007) have defined the concept of Constructive alignment as a principle used for devising teaching-learning activities, and assessment tasks that directly address the learning outcomes intended in a way not typically achieved in traditional lectures, tutorial classes and examinations. Constructive alignment was devised by Professor John B. Biggs, and represents a bonding between a constructivist understanding of the nature of learning and an aligned design for outcome-based teaching education.

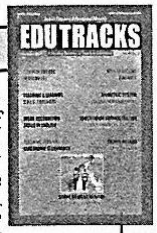
Constructive alignment is the underpinning concept behind the current requirements for program specification, declarations of Learning Outcomes (LOs) and assessment criteria, and the use of criterion-based assessment. There are two basic concepts behind Constructive alignment:

- Learners construct meaning from what they do to learn. This concept derived from cognitive psychology and constructivist theory recognizes the importance of linking new material to concepts, experiences in the learner's memory and extrapolation to possible future scenarios via the abstraction of basic principles through reflection.
- The teacher makes a deliberate alignment between the planned learning activities and the learning outcomes. This is a conscious effort to provide the learner with a clearly-specified goal, a well-designed learning activity or activities that are appropriate for the task, and well-designed assessment criteria for giving feedback to the learner.

A branch of educational evaluation theory has emerged that focuses on *Constructive Alignment* as a key element in effective educational design. Known as Design Focused Evaluation mentioned by Smith (2008), this approach seeks student-feedback/thoughts on the efficacy of the designed alignment between the intended learning outcomes and the teaching-learning activities which engage students during a course of study.

Viewing Mathematics Teaching & Learning through New Scaffold as SOLO Taxonomy

Due to the Tall-shaped nature of Mathematics, step-by-step construction or structuring of the knowledge requires micro-thinking of the aspects to minimize misconceptions and to emphasize the criterion of the understanding. The general practice of the Mathematics teaching-learning is to give the formula readily, apply with various values/figures and verify with the final answer-values. Hence, based on only such final answer-values, it is seen as the barometer of the achievement of the learners' understanding about the Mathematical concepts which may many times lead to the false interpretations. This is the traditional way of achievement of learning in Mathematics. While the Constructivist or Structuring way of learning of Mathematics emphasizes on the development of knowledge by the learners for the understanding on

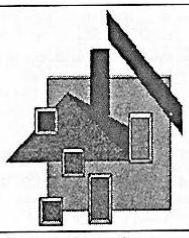
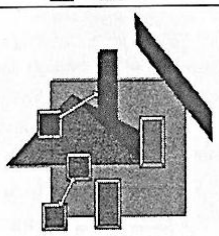
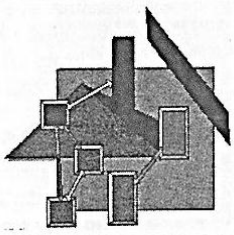
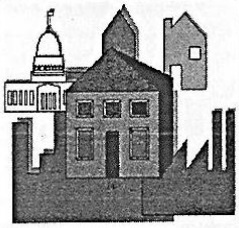


the logical derivations of the formulae/ concept with appropriate rationale justifications and to relate/think on the practice of it with applications to the real life/world. Such approaches become useful in regular increments of hierarchical learning-achievements and understanding which lead to go with the Tall-shape learning of Mathematics.

Going with the same thoughts and also it is understood as, in spite of our examination system, some more bridges of assessment/evaluation are required to observe learners' proper learning as well as understanding of the Mathematics. This paper is developed to focus on thoughts of making Mathematics teaching-learning easy and without any fear through the concepts of Constructivism, Constructive Alignment and using the SOLO framework. Below is the small example taken to understand the proceedings for the comprehension/ understanding of the given example through the levels of SOLO Taxonomy.

Example-1

Table-1: Understanding of Geometrical Shapes through SOLO Levels

Levels of S.O.L.O.	Pictorial Presentation of Understanding	Description
Pre-structural		Here students are simply acquiring bits of unconnected information, which have no organization and make no sense.
Uni-structural		Simple and obvious connections are made, but their significance is not grasped. (connections made based on shapes or colors like blue with blue as well red with red)
Multi-structural		A number of connections may be made, but the meta-connections between them are missed, as is their significance for the whole. (connections made using the ideas behind the colors and shapes)
Relational		The student is now able to appreciate the significance of the parts in relation to the whole. (ideas developed to arrange objects with the context of the whole object)
Extended Abstract		The student is making connections not only within the given subject area, but also beyond it, able to generalize and transfer the principles and ideas underlying the specific instance. (develop ideas for the surroundings or the relational thoughts of the object)

Source: http://www.learningandteaching.info/learning/solo.htm

Example of Mathematics with SOLO Levels

Here two examples have been taken to describe conceptual understanding progressing through the levels of SOLO Taxonomy, i.e. from the Pre-structural level to the Extended abstract level. Here example-1 is taken from Mathematics of lower grade to justify that these levels could be practiced at any grade-level or possibly for any concepts of the Mathematics. Let us take a basic example of Geometrical Shapes.

From example-1, it seems from the proceedings for the learning from Pre-structural to Extended abstract that such framework could be used in lower grades also in which all the levels of the SOLO taxonomy could be practiced.

Example 2

When teaching about understanding of patterns in number/algebra, a common task is to provide students with a diagram of a pattern (e.g., house outlines made with match sticks). It is then possible to devise a series of questions that explore both the surface and deep thinking around the objects and principles involved in pattern-making. Let us take an example of "Matchstick Houses: Patterns in Number".

Houses	1	2	3
Sticks	5	9	–

Figure–2: Matchstick Houses

A simple **Uni-structural** question (one idea) requires elicitation of a response based on handling one aspect of the given data; *"How many sticks are needed for 3 houses?"* This task can be answered most simply by counting the number of sticks shown in the diagram to come up with the answer of 13.

The next level, **Multi-structural**, requires two or more ideas that are handled independently or serially. For example, *"How many sticks are needed for each of these three houses?"* requires the learner to take the given pattern and count the sticks for each house (5 each).

To require deep thinking, the teacher needs to frame a question about finding a **Relationship** within the given material, rather than persist with surface approaches of count or draw-and-count: For example, *"If 52 houses require 209 sticks, how many sticks do you need to be able to make 53 houses?"* (Answer: 213). In order to respond, a child must detect that for every additional house four more sticks are required, regardless of how many houses there are.

Extended abstraction within the domain of algebra is commonly achieved through explicit attention to more general rules that apply in all cases, whether such rules are expressed in words or algebraic terminology. Such an extended abstract task would be *"Make up a rule to count how many sticks are needed for any number of houses"*. This demands a response that identifies not only the four sticks per house but also the need for one more to close off the last house in the series (e.g. $S = 4H + 1$). If a student provided this response, it would demonstrate understanding not only the relationship of sticks to houses but also the abstract extension that applies to all cases regardless of actual numbers.

Example 2 is taken in the context of chapter from Mathematics of class-IX – introducing the concept of 'Linear equation in two variables'. In the above example, a formula is formulated by using two variables S(sticks) & H(houses). From the explanation, it can be seen how knowledge is constructed according to all the levels of SOLO taxonomy and how interaction/responses lead the learning from known to unknown knowledge. At entry level it can be assumed that learners/students are familiar with the figures made by matchsticks, mathematical operations, concept of pattern/s and means of single variable/s. Such known knowledge can be utilized in further proceedings for the construction /discovery of unknown knowledge as 'Linear equation in two variables' within the framework of SOLO taxonomy. In the same manner, a whole lesson or unit could be planned according to the levels of SOLO Taxonomy.

Conclusion

Mathematics is the discipline which is strongly concerned with the way of developing thinking (logical, critical, creative thinking) as well as the way of reasoning. Given this nature of the subject, some Constructivist approaches are required to address many problems related to the practices of the Mathematics especially at school level. A majority of the problems identified with respect to the poor or disinterest of Mathematics is mainly the poor comprehension or understanding of the Mathematical concepts. Such problems could be minimized through the Constructivist or Structuring way of learning of Mathematics which largely emphasize on the development of the progressive understanding of the logical derivations of the formulae/ concept by the learners themselves with appropriate rationale justifications and to relate/think the same with the applications of real life/ world. While thinking in the same aforesaid directions, the authors came across a different taxonomy which is explained as the new scaffold -The SOLO Taxonomy.

The authors also have experimented with this taxonomy for the Mathematics teaching-learning though the research study and hence conclude that such approaches could become useful to regularize the increments of hierarchical learning -achievements and understandings which justify the Tall-shape learning of Mathematics. Also, in spite of our examination systems, some more bridges of assessment/evaluation are required to observe learners' progressive learning and understanding of the Mathematics where SOLO levels might help to judge the learning of the learners as well as the teaching of the teachers.

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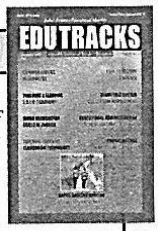

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THANK YOU