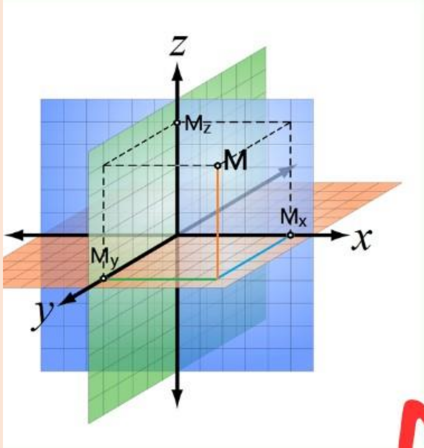
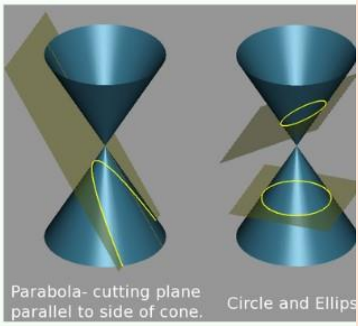
KENDRIYA VIDYALAY SANGATHAN

तत् त्वं पूषन् अपावृणु

केन्द्रीय विद्यालय संगठन



MATHEMATICS LAB MANUAL



CLASS 11

ZONAL INSTITUTE OF EDUCATION AND TRAINING
MYSURU

COURSE DIRECTOR

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DEPUTY COMMISSIONER
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DIRECTOR'S MESSAGE……

It gives me immense pleasure that we present the Manual of Mathematics Lab activities for **CLASS 11** prepared by the PGTs (Mathematics) of the feeder regions during the 3-day online workshop on **“Enhancement of Mathematics Lab Activities and Resource Material**”. This collective vision will enable the students and teachers with the tools for success and intellectual growth through learning by doing.

The PGTs (Mathematics) from the feeder Regions namely Bangalore, Chennai, Ernakulam and Hyderabad, evincing their interest and involvement, have invested their knowledge and expertise in preparation of the Manual of Mathematics Lab activities.

I extend my sincere appreciation for the commitment and dedication of the team of PGT(Mathematics) from the four feeder Regions, Mr. Agimon A Chellamcott, Principal, KV Idukki, Ernakulam Region & Associate Course Director, the Resource persons Mr. M. Srinivasan, PGT(Maths), K V Ashok Nagar, Chennai Region & Mr. Jaseer K P, PGT(Maths), No2, Mangalore, Bengaluru Region and Mr. D. Sreenivasulu, Training Associate (Mathematics) from ZIET Mysore who has been the Coordinator of this assignment.

I hope that the knowledge shared here will inspire others also to make meaningful changes in the classroom and to achieve excellence in Mathematics.

With Best wishes.

MENAXI JAIN
DIRECTOR
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ACTIVITY – 1

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NAME OF THE ACTIVITY:

FINDING THE NUMBER OF SUBSETS OF A GIVEN SET AND VERIFY THAT IF A SET HAS n NUMBER OF ELEMENTS, THEN THE TOTAL NUMBER OF SUBSETS IS 2^n.

OBJECTIVE:

- To Understand the Concept of a Subset.
- To find the number of subsets of a given set and verify that if a set has n number of elements, then the total number of subsets is 2^n.

PRE-REQUISITE KNOWLEDGE:

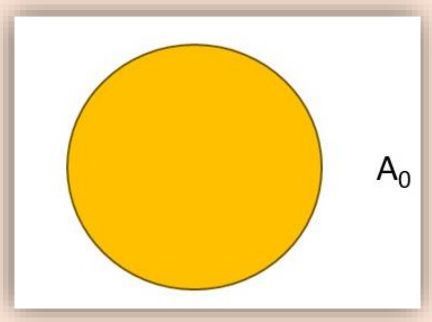
Definition of a set, subset, total number elements of a set

MATERIALS REQUIRED:

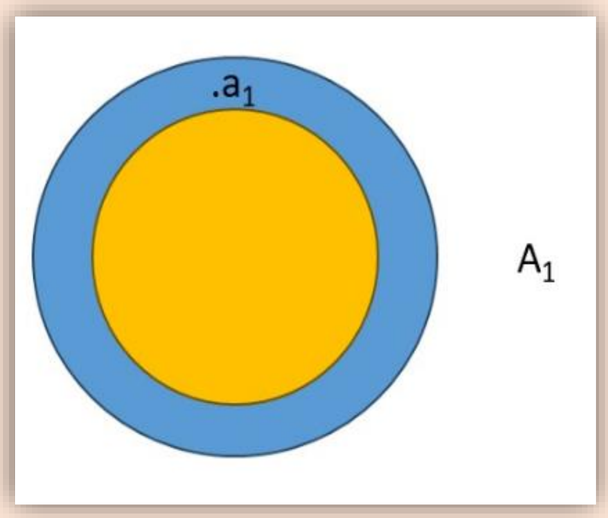
- Hardboard
- White thick sheets of paper
- Pencils
- Colours
- Scissors
- Adhesive

METHOD OF CONSTRUCTION:

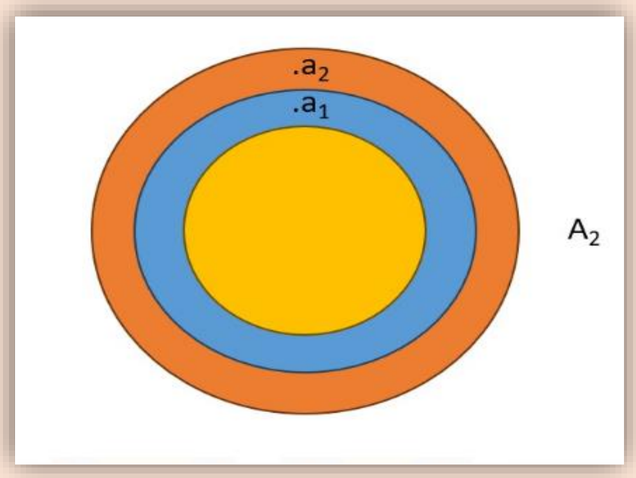
1. Take the empty set (say) A_0 which has no element.



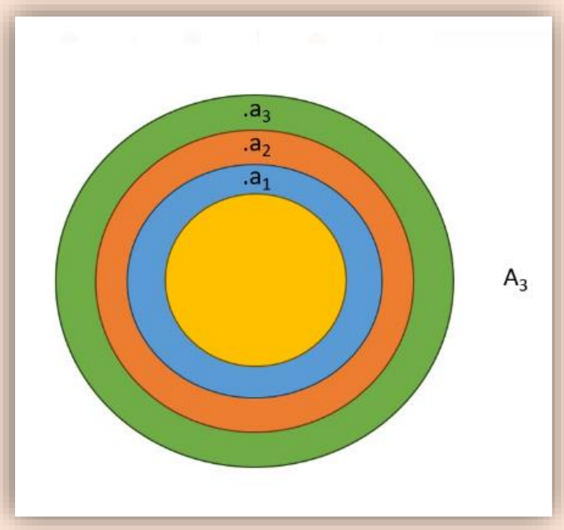
2. Take a set (say) A_1 which has one element (say) a_1.



3. Take a set (say) A_2 which has two elements (say) a_1 and a_2.



4. Take a set (say) A_3 which has three elements (say) a_1, a_2 and a_3.



DEMONSTRATION

- Represent A_0 as shown in first figure. Here the possible subsets of A_0 is A_0 itself only, represented symbolically by φ. The number of subsets of A_0 is 1 = 2^{0}.
- Represent A_1 as in second figure. Here the subsets of A_1 are φ, $\{a_1\}$. The number of subsets of A_1 is 2 = 2^1
- Represent A_2 as in third figure. Here the subsets of A_2 are φ, $\{a_1\}$, $\{a_2\}$, $\{a_1, a_2\}$. The number of subsets of A_2 is 4 = 2^2.
- Represent A_3 as in fourth figure. Here the subsets of A_3 are φ, $\{a_1\}$, $\{a_2\}$, $\{a_3\}$, $\{a_1, a_2\}$, $\{a_2, a_3\}$, $\{a_3, a_1\}$ and $\{a_1, a_2, a_3\}$. The number of subsets of A_3 is 8 = 2^3.
- Continuing this way, the number of subsets of set A containing n elements $a_1, a_2, ..., a_n$ is 2^n.

OBSERVATION:

1. The number of subsets of A_0 is ___________ = 2^0

2. The number of subsets of A_1 is ___________ = _____

3. The number of subsets of A_2 is _____4_____ = _____

4. The number of subsets of A_3 is ___________ = _____

5. The number of subsets of A_{10} is = 2^{10}.

6.The number of subsets of A^n is =

APPLICATION:

The activity can be used for calculating the number of subsets of a given set.

CONCLUSION:

The total number of subsets of set X_n having n elements is 2^n.

LEARNING OUTCOMES:

Knowledge of sets, subsets and number of subsets of a given set.

SOURCES OF ERROR AND PRECAUTIONS:

To find the number of subsets of the set from the figures.

VIVA QUESTIONS AND ANSWERS

1. Define a set

   Answer. A set is a well-defined collection of objects
2. Define a subset.

   Answer. A set A is said to be subset of a set B, if every element of A is also an element of B.
3. Define proper subset of a given set.

   Answer. A set X is said to be a proper subset of set Y if X is a subset of Y and X is not equal to Y. ie. $X \subset Y$ and $X \neq Y$.
4. If A and B are two sets and $A \subset B$, $B \subset A$, then what do you conclude about two sets A and B.?

   Answer. A = B
5. Is every set the subset of itself?

   Answer. Yes
6. Name the set which is the subset of all the sets.

Answer. Empty set.

7. If A = {1, 3, 5, 9, 18}, then the number of proper subsets of A is --------------

Answer. $2^5 - 1$.

8. If P = {x: x < 7, xϵN} and Q = {x: $x^2 < 49$, xϵN}, then

(a) P ⊂ Q (b) Q ⊂ P (c) P = Q (d) P∪ {7} = Q

Answer. P = Q

9. If B ⊂ A, then A ∩ B = ?

Answer. B

10. For non-empty sets A, B and C the following two statements are given:

Statement P : $A \cap (B \cup C) = (A \cap B) \cup C$

Statement Q : C is a subset of A

Which one of the following is correct?

(a) $Q \Rightarrow P$ (b) $P \Leftrightarrow Q$ (c) $P \Rightarrow Q$ (d) More than one of the above

Answer. (b) $P \Leftrightarrow Q$

ACTIVITY – 2

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NAME OF THE ACTIVITY: REPRESENT SET THEORETIC OPERATIONS USING VENN DIAGRAMS

OBJECTIVE:

- To visualize and understand set operations by representing them using Venn diagrams.
- To understand of complex set relationships by displaying the operations in an intuitive, pictorial form.
- To understand of concepts like union, intersection, and complement, and helps them grasp abstract ideas through visualization

MATERIAL REQUIRED:

- Hardboard
- White thick sheets of Paper
- Pencils
- Colours
- Scissors
- Adhesive

PRE-REQUISITE KNOWLEDGE:

Definition of set, union and intersection of sets, complement of set, subset, disjoint sets

METHOD OF CONSTRUCTION:

1. Cut rectangular strips from a sheet of paper and paste them on a hardboard. Write the symbol U in the left/right top corner of each rectangle.
2. Draw circles A and B inside each of the rectangular strips and shade/colour different portions as shown in Fig. 3.1 to Fig. 3.10.

DEMONSTRATION:

- U denotes the universal set represented by the rectangle.
- Circles A and B represent the subsets of the universal set U as shown in the figures 3.1 to 3.10.
- A′ denote the complement of the set A, and B′ denote the complement of the set B as shown in the Fig. 3.3 and Fig. 3.4.
- Coloured portion in Fig. 3.1. represents A U B.

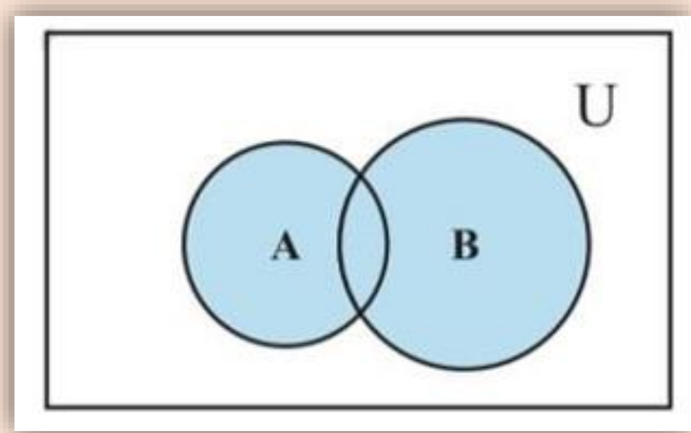


Fig. 3.1

- Coloured portion in Fig.3.2. represents A ∩ B

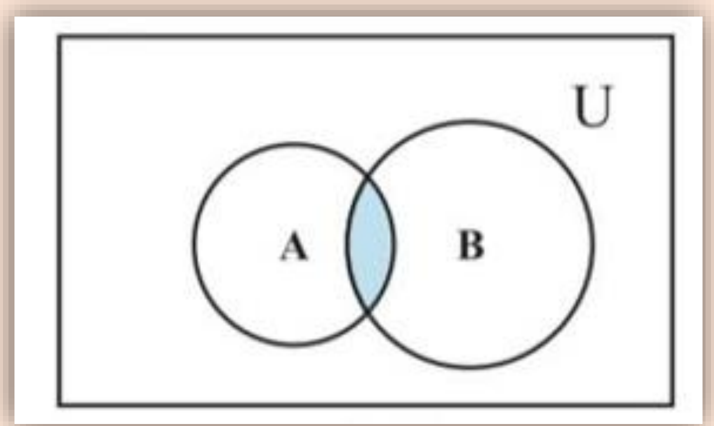


Fig. 3.2

- Coloured portion in Fig. 3.3 represents A′

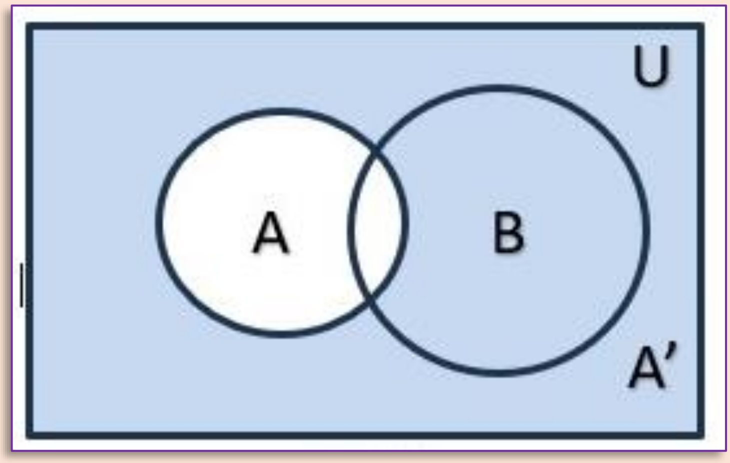


Fig. 3.3

- Coloured portion in Fig. 3.4 represents B′

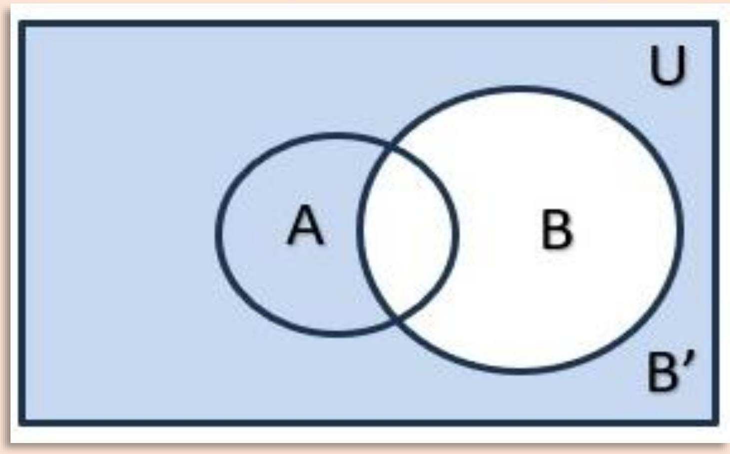


Fig. 3.4

- Coloured portion in Fig. 3.5 represents (A ∩ B)′

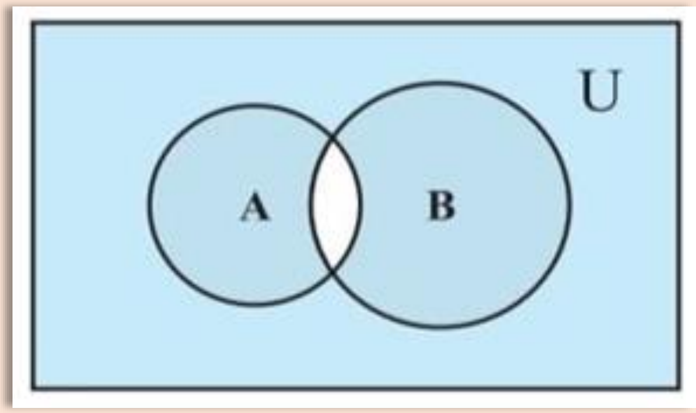


Fig.3.5

- Coloured portion in Fig. 3.6 represents (A U B)´

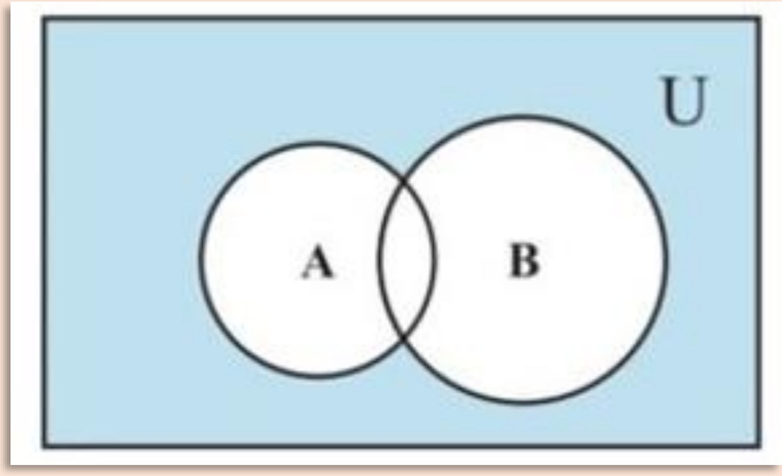


Fig. 3.6

- Coloured portion in Fig. 3.7 represents A´ ∩ B which is same as B – A

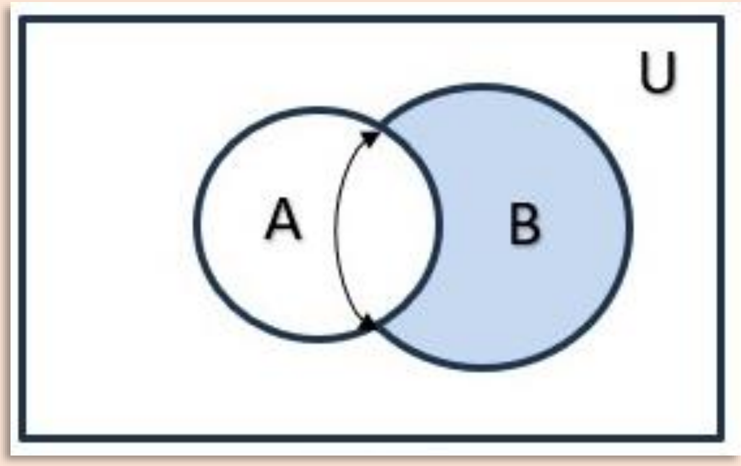


Fig.3.7

- Coloured portion in Fig. 3.8 represents A´ U B.

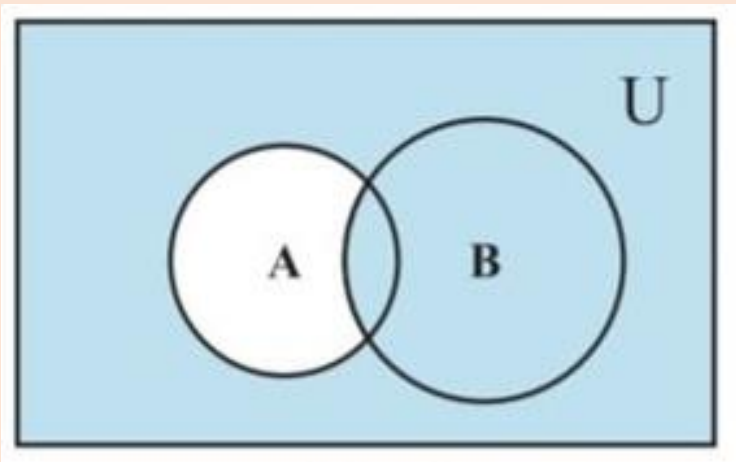


Fig. 3.8

➢ Fig. 3.9 shows A ∩ B = ϕ

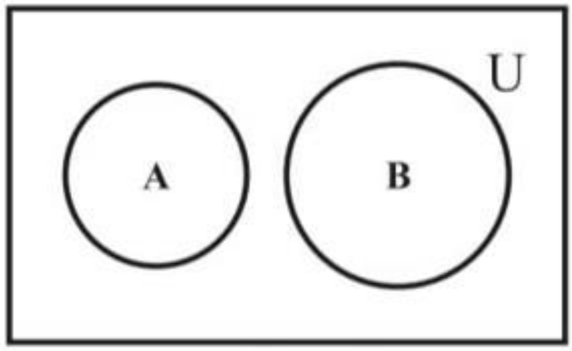


Fig. 3.9

➢ Fig. 3.10 shows $A \subset B$

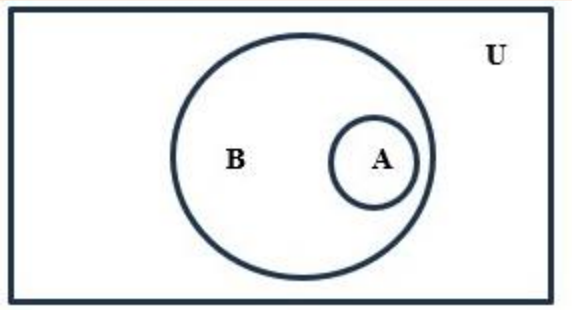


Fig. 3.10

OBSERVATION:

1. Coloured portion in Fig. 3.1, represents______________
2. Coloured portion in Fig. 3.2, represents______________
3. Coloured portion in Fig. 3.3, represents______________
4. Coloured portion in Fig. 3.4, represents______________
5. Coloured portion in Fig. 3.5, represents______________
6. Coloured portion in Fig. 3.6, represents______________
7. Coloured portion in Fig. 3.7, represents______________
8. Coloured portion in Fig. 3.8, represents______________
9. Fig. 3.9, shows that (A ∩ B) = ______________
10. Fig. 3.10, represents A ______________B.

APPLICATION

Set theoretic representation of Venn diagrams are used in Logic and Mathematics.

CONCLUTION

Various operations on sets were learnt using Venn diagram.

SOURCES OF ERROR AND PRECAUTIONS

1. Shading to be done carefully
2. Operations to be used carefully

LEARNING OUTCOMES

- Students will learn about universal set, union and intersection of sets, difference of sets, complement of sets using Venn diagram.
- Students will learn types and various operations on sets using Venn diagram.

VIVA QUESTIONS AND ANSWERS

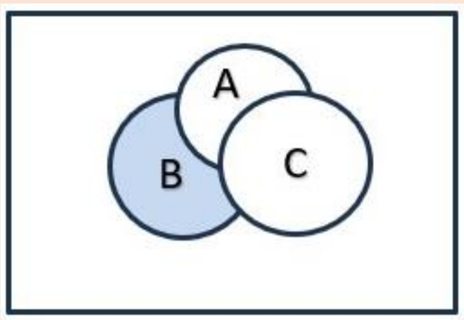
1. If A and B are two sets in the same universal set, then A - B =?

   Answer: A ∩ B’

2. If as set contains 6 elements, then the total number of proper subsets are ____?

   Answer: 63

3. The Shaded region in the given figure is?



Answer: $B - (A \cup C)$.

4. If B = {x: x is a student presently studying in both classes X and XI}. Then, the number of elements in set B are____?
   Answer: 0

5. If A is Subset of B and A ≠ B then A is called ______ of B
   Answer: Proper Subset.

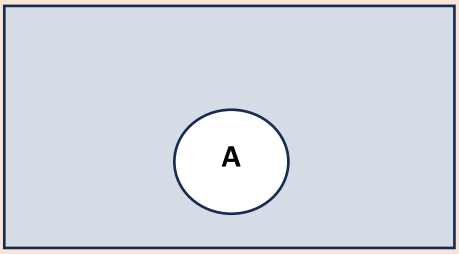
6. If A and B are two given sets then $A \cap (A \cap B)^C$ ______
   Answer: $A \cap B^C$

7. If A and B are any two sets, then $A \cup (A \cap B)$______

   Answer: A

8. If A and B are two sets, then $A \cap (A \cup B)'$________
   Answer: ϕ

9. In the Venn diagram, the shaded portion represents?



Answer: Complement of A

10. If A and B are sets, then $A \cap (B - A)$ is _____
   Answer: ϕ

ACTIVITY – 3

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NAME OF THE ACTIVITY: Verification of distributive law of sets.

OBJECTIVE:

- To verify distributive law for three given non-empty sets A, B and C, that is, $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$.
- To verify the distributive laws of sets through practical examples using specific sets.
- To develop a deeper understanding of how union and intersection operations relate to one another.
- To enhance problem-solving and critical thinking skills by exploring different set combinations and their outcomes.

PRE-REQUISITE KNOWLEDGE:

Knowledge about operation of sets like union, intersection.

MATERIAL REQUIRED:

- Hardboard
- White thick sheets of paper
- Pencil
- Colours
- Scissors
- Adhesive.

METHOD OF CONSTRUCTION:

- Cut five rectangular strips from a sheet of paper and paste them on the hardboard in such a way that three of the rectangles are in horizontal line and two of the remaining rectangles are also placed horizontally in a line just below the above three rectangles. Write the symbol U in the left/right top corner of each rectangle as shown in Fig. 4.1, Fig. 4.2, Fig. 4.3, Fig. 4.4 and Fig. 4.5.

- ❖ 2 Draw three circles and mark them as A, B and C in each of the five rectangles as shown in the figures.
- ❖ Colour/shade the portions as shown in the figures.

DEMONSTRATION:

- ❋ U denotes the universal set represented by the rectangle in each figure.
- ❋ Circles A, B and C represent the subsets of the universal set U.

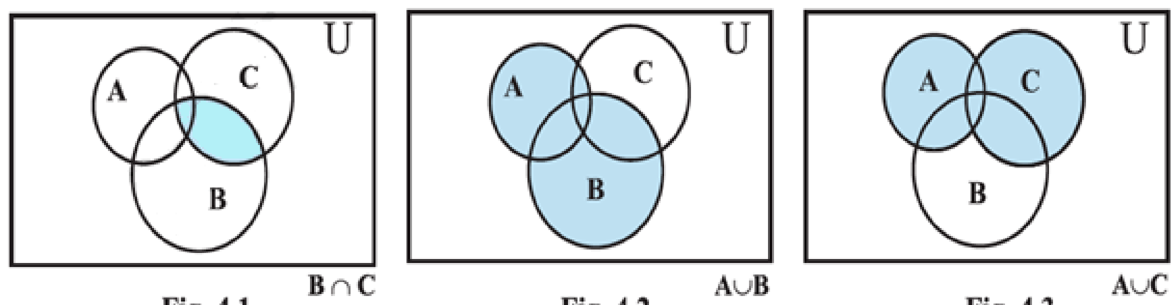

Fig. 4.1 Fig. 4.2 Fig. 4.3

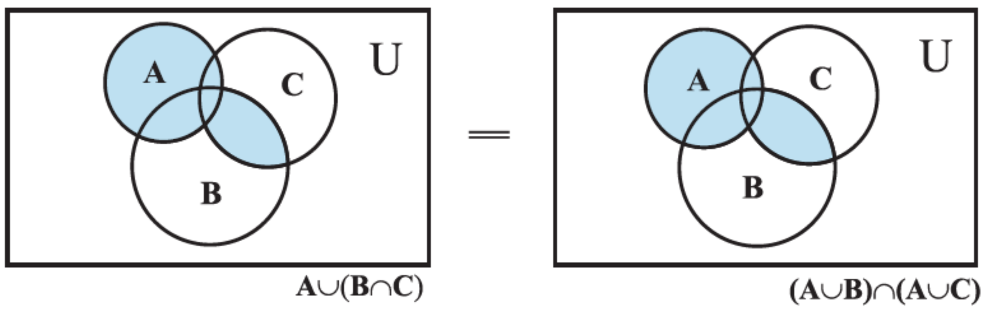

Fig. 4.4 Fig. 4.5

- ❋ In Fig. 4.1, coloured/shaded portion represents B ∩ C, coloured portions in Fig. 4.2 represents A ∪ B, Fig. 4.3 represents A ∪ C, Fig. 4.4 represents A∪(B ∩ C) and coloured portion in Fig. 4.5 represents (A ∪ B) ∩ (A∪ C).

OBSERVATION:

1. Coloured portion in Fig. 4.1 represents________________

2. Coloured portion in Fig. 4.2, represents ________________

3. Coloured portion in Fig. 4.3, represents ________________

4. Coloured portion in Fig. 4.4, represents ________________

5. Coloured portion in Fig. 4.5, represents ________________

6. The common coloured portions in Fig. 4.4 and Fig. 4.5 are ________________

7. $A \cup (B \cap C) =$ ________________

Thus, the distributive law is verified.

APPLICATION:

Distributivity property of set operations is used in the simplification of problems involving set operations.

CONCLUSION:

For three given non-empty sets A, B and C,

$A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$

LEARNING OUTCOMES:

- ✓ Students acquire skill in drawing Venn diagrams
- ✓ Students learn to verify distributive law of sets using Venn diagram.

SOURCES OF ERROR AND PRECAUTIONS:

Precaution must be taken while using scissors.

VIVA QUESTIONS:

1. What is $A \cup \phi$?

   Answer: A

2. What is $A \cup A$?

Answer: A

3. What is $U \cup A$?

   Answer: U

4. What is $A \cap \phi$

   Answer: ϕ

5. What is $A \cap A$

   Answer: A

6. What is $U \cap A$?

   Answer: A

7. If A= {1,2,3}, B= ϕ, what is $A \cup B$?

   Answer: A

8. Let A= {x: x is an odd natural number}, B= {x: x is an even natural number}, what is $A \cap B$?

   Answer: ϕ

9. $A \cup (B \cap C) = (A \cup B) \cap (A \cup C)$, Name the property used

   Answer: Distributive property of sets

10. $A \cap B = B \cap A$, name the property which makes this operation true.

    Answer: Commutative property of sets

ACTIVITY – 4

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NAME OF THE ACTIVITY: TO IDENTIFY A RELATION AND A FUNCTION.

OBJECTIVE:

- To differentiate between relations and functions through practical examples and visual representations.
- To develop an understanding of the criteria that define a function.
- To explore the concepts of domain and range in the context of relations and functions.
- To enhance problem-solving skills by identifying and classifying different sets of data as relations or functions.

PRE-REQUISITE KNOWLEDGE:

- Sets, Ordered pairs, definition of Relation, Function**.**
- Ordered pair A pair of elements grouped together in a particular order.
- Cartesian product A × B of two sets A and B is given by

  $A \times B = \{(a, b): a \in A, b \in B\}$ In particular $R \times R = \{(x, y): x, y \in R\}$

- Relation: A relation R from a set A to a set B is a subset of the Cartesian product A × B.
- Note For identify relation ensure each first element of ordered pairs in R must belongs to set A and each second element of ordered pair in R must belong to B.
- Function: A function f from a set A to a set B is a specific type of relation for which every element x of set A has one and only one image y in set B.

MATERIAL REQUIRED:

- Hardboard
- Battery
- Electric bulbs of two different colours
- Testing screws
- Tester
- Electrical wires
- Switches.

METHOD OF CONSTRUCTION:

1. Take a piece of hardboard of suitable size and paste a white paper on it.
2. Drill eight holes on the left side of board in a column and mark them as A, B, C, D, E, F, G and H as shown in the Fig.5.

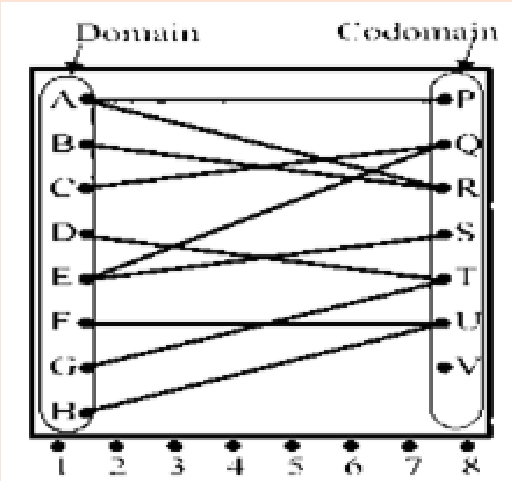

Fig. 5

3. Drill seven holes on the right side of the board in a column and mark them as P, Q, R, S, T, U and V as shown in the Figure 5.
4. Fix bulbs of one colour in the holes A, B, C, D, E, F, G and H.
5. Fix bulbs of the other colour in the holes P, Q, R, S, T, U and V.
6. Fix testing screws at the bottom of the board marked as 1, 2, 3, 4, 5, 6, 7 and 8.
7. Complete the electrical circuits in such a manner that a pair of corresponding bulbs, one from each column glow simultaneously.

8. These pairs of bulbs will give ordered pairs, which will constitute a relation which in turn may /may not be a function [see Fig. 5].

DEMONSTRATION/ PROCEDURE/ACTION PLAN:

1. Bulbs at A, B, C, D, E, F, G and H, along the left column represent domain and bulbs along the right column at P, Q, R, S, T, U and V represent co-domain.
2. Using two or more testing screws out of given eight screws obtain different order pairs. In Fig.5, all the eight screws have been used to give different ordered pairs such as (A, P), (B, R), (C, Q) (A, R), (E, Q), etc.
3. By choosing different ordered pairs make different sets of ordered pairs.

OBSERVATION:

1. In Fig.5, ordered pairs are **(A, P), (A, R), (B, R), (C, Q), (D, T), (E, Q), (E, S), (F, U), (G, T) and (H,U)**.
2. These ordered pairs constitute a **Relation**.
3. The ordered pairs (A, P), (B, R), (C, Q), (E, Q), (D, T), (G, T), (F, U), (H, U) constitute a relation which is also a **function**.
4. The ordered pairs (B, R), (C, Q), (D, T), (E, S), (E, Q) constitute a **Relation** which is not a **Function**.

APPLICATION: The activity can be used to explain the concept of a relation or a function. It can also be used to explain the concept of one-one, onto functions

CONCLUSION: Students understand the concept.

LEARNING OUTCOMES: After completion this activity students able to :

1. identify a relation and a function.
2. distinguish between relation and function.

SOURCES OF ERROR AND PRECAUTIONS:

- Take care the drilling holes.
- Take care electrical circuits

VIVA QUESTIONS AND ANSWERS

1. Defined ordered pair.

   Ans. Ordered pair: A pair of elements grouped together in a particular order.

2. Define relation.

   Ans. A relation R from a non-empty set A to a non-empty set B is a subset of the cartesian product A×B

3. Define function.

   Ans. A relation f from a set A to a set B is said to be a function if every element of set A has one and only one image in set B.

4. Different between relation and function.

   Ans. In function $f: A \to B$, domain is function is A where as in relation domain will be set of all first element of ordered pair in the given relation. it may be less then no. of element in set A. also in function each element of set a as one and only one image in B whereas in relation elements of sets A may have more images as well.

5. Are all functions being relation or all relations are function?

   Ans. All function is a relation.

6. If A= {a, b} and B = {1, 2} then find the number of functions from set A to set B.
   Ans. 2 ×2 =4
7. Let A = {x, y} and B = {1, 2} then number of non-empty relations from set A to set B

   Ans. 2^4 -1 =15

8. Which of the following relations are functions? Give reason.
   R = {(1,1), (2,2), (3,3), (4,4), (4,5)}
   R = {(2,1), (2,2), (2,3), (2,4)}
   R = {(1,2), (2,5), (3,8), (4,10), (5,12), (6,12)}

   Ans. R = {(1,2), (2,5), (3,8), (4,10), (5,12), (6,12)}

9. Find a and b if (a – 1, b + 5) = (2, 3)
   Ans. ‘a=3 and b = 2

10. Write the relation R = {(x, x^3): x is a prime number less than 10} in roster form.

    Ans. $R = \{(2,8), (3,27), (5,125), (7,343)\}$

ACTIVITY – 5

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NAME OF THE ACTIVITY : TO DISTINGUISH BETWEEN A RELATION AND A FUNCTION.

OBJECTIVE:

- To identify and differentiate between relations and functions through diagrams.
- To understand the characteristics that define a function.
- To explore how to represent relations and functions visually.
- To reinforce the concepts of domain and range in the context of relations and functions.

PREREQUISITE KNOWLEDGE:

Cartesian Product, Relations, Functions.

MATERIALS REQUIRED:

- Drawing Board
- Coloured Drawing Sheets
- Scissors
- Adhesive
- Strings
- Nails Etc…

METHOD OF CONSTRUCTION

- Take a drawing board/a piece of plywood of convenient size and paste a coloured sheet on it.

- Take a white drawing sheet and cut out a rectangular strip of size 6 cm × 4 cm (convenient size) and paste it on the left side of the drawing board (see Fig. 1).
- Fix three nails on this strip and mark them as *a*, *b*, *c* (see Fig. 1).

  Let it be set A.

  A = { a, b, c}

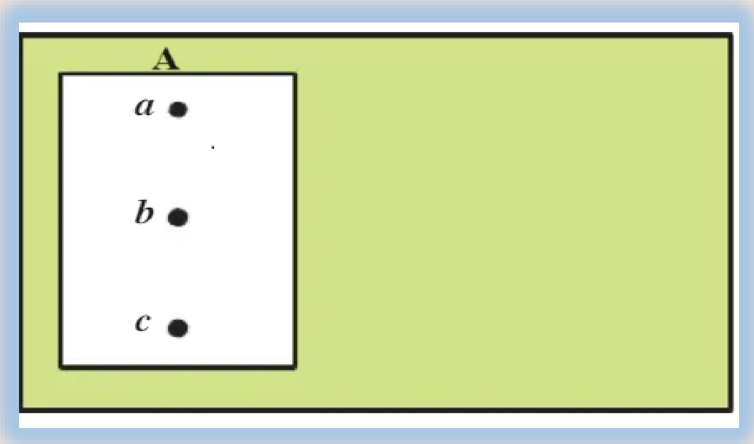

Fig .1

- Cut out another white rectangular strip of size 6 cm × 4 cm (convenient size) and paste it on the right hand side of the drawing board.
- Fix two nails on the right side of this strip (see Fig. 2) and mark them as 1 and 2 let it be Set B. B = {1,2 }.

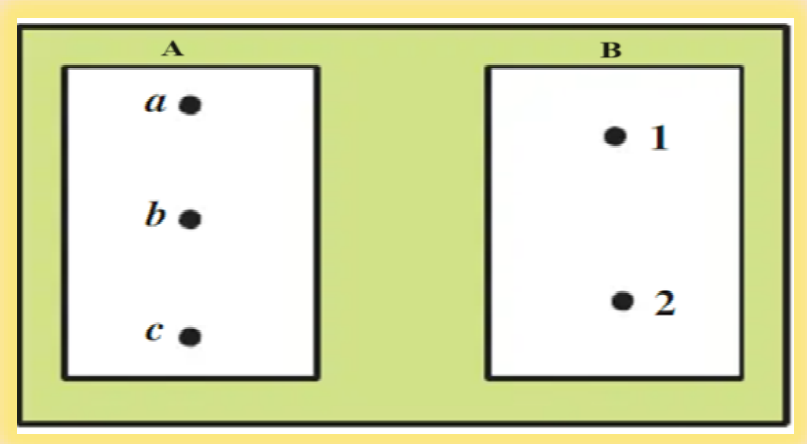

Fig 2

DEMONSTRATION

- Join nails of the left-hand strip to the nails on the right-hand strip by strings in different ways. Some of such ways are shown in Fig. 3 to Fig. 6.

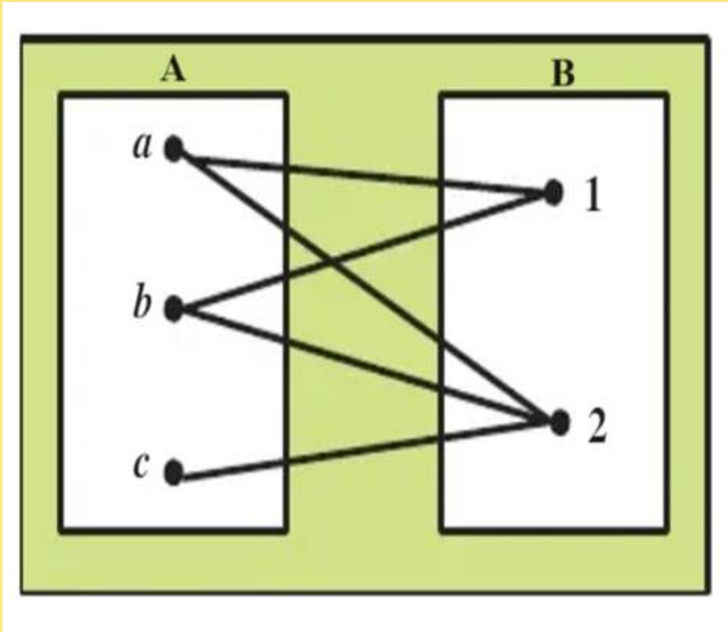

Fig. 3

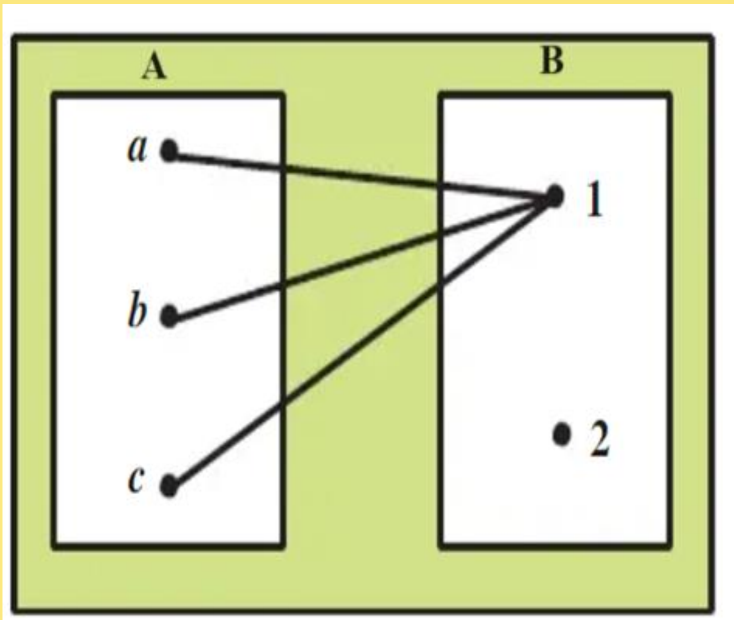

Fig. 4

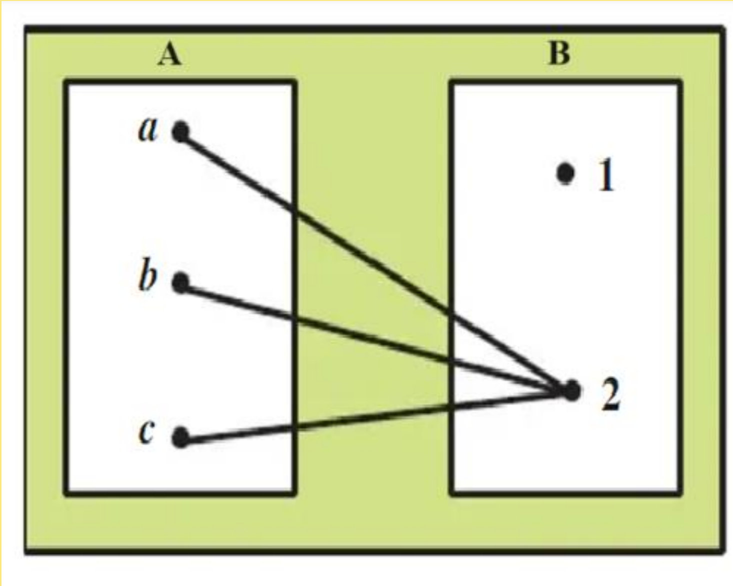

Fig 5

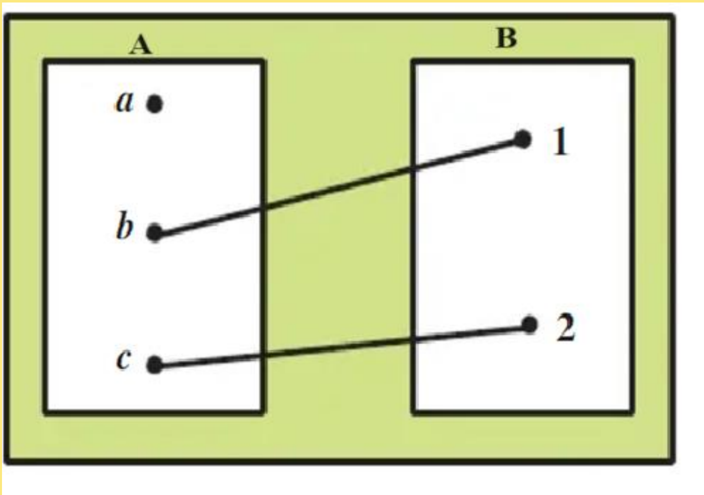

Fig 6

- Joining nails in each figure constitute different ordered pairs representing elements of a relation.

OBSERVATION:

- In Fig. 3, ordered pairs are (a,1), (a,2), (b,1), (b,2), (c,2). These ordered pairs constitute a relation but not a function. Since the elements a, b of set A has more than one image.
- In Fig. 4, ordered pairs are (a, 1) (b, 1) (c, 1). These constitute a relation as well

as a function. Every element of A has a unique element in B.

- ✶ In Fig 5, ordered pairs are (a, 2), (b,2), (c,2). These ordered pairs constitute a relation as well as functions. Every element of A has a unique element in B.
- ✶ In Fig. 6, ordered pairs are (b, 1), (c, 2). These ordered pairs do not represent a function but represent a relation. Since the element a in A has no image.

APPLICATION

Such activity can also be used to demonstrate different types of functions such as constant function, identity function, injective and surjective functions by joining nails on the left-hand strip to that of right-hand strip in suitable manner.

CONCLUSION:

From the observations (Fig 3 to Fig 6) we can conclude that

- A relation may not be a function but every function is a relation.

LEARNING OUTCOMES:

The children

- ✓ understands that a relation can have multiple outputs for a single input, while a function has a single output for a single input.
- ✓ Child able to identifies that all functions are relation. And Functions are the subsets of relations.
- ✓ Child can able to find out the relationship between different life situations: for example

The relationship between a teacher and their students.

The connection between friends in a social circle.

The correspondence between a customer and a sales representative in a store.

Students and their grades: The relation between students and their grades is a function, where each student is assigned a specific grade for a given course.

- ✓ Develop drawing skill, develop logic.
- ✓ Develop interest in Mathematics when it connected to real life situations.

SOURCES OF ERRORS AND PRECAUTIONS:

- Common sources of error in experiments include human error in identifying relation and function.
- Precaution must be taken while cutting and using nails.

VIVA QUESTIONS AND ANSWERS

1. Is the given relation a function?

   (i) h= {(4,6), (3,9), (-11,6), (3,11)} Answer: No

   (ii) f = {(x, x) | x is a real number} Answer: Yes

   (iv) s= {(n, n2) | n is a positive integer} Answer: Yes

   (v) t= {(x, 3) | x is a real number} Answer: Yes

2. Let f : x $\rightarrow$ 5x +2, x ∈ R define the function f. Then:

   Find the image of 3 under f.

   Answer: f (3) = 17

3. The formula to convert x° C to Fahrenheit units is the function f(x)= $\frac{9x}{5}$ + 32.

   Calculate: f (0).

   Answer: f(0) = 32

4. Let f and g be real functions defined by f(x) = 2x+ 1 and g(x) = 4x – 7.

   For what real numbers x, f(x)= g(x)?

   Answer: 2x + 1 = 4x -7 $\Rightarrow$ x =4.

5. The Cartesian product A × A has 9 elements among which are found (–1, 0) and (0,1).

   Find the set A .

   Answer: A = {0,1, -1}

6. Let f(x) = x^2 and g(x) = 2x + 1 be two real functions. Find (f + g)(x) ?

   Answer: (f +g)(x) = x^2 + 2x +1 = $(x +1)^2$

7. **Let f= {(2,4), (5,6), (8, -1), (10, -3)} and g = {(2, 5), (7,1), (8,4), (10,13), (11, 5)} be two real functions. Then match the following:'**

Column I		Column II	
(a)	$f-g$	(i)	$\left\{\left(2,\frac{4}{5}\right),\left(8,\frac{-1}{4}\right),\left(10,\frac{-3}{13}\right)\right\}$
(b)	$f+g$	(ii)	{(2, 20), (8, –4), (10, –39)}
(c)	$f\times g$	(iii)	{(2, –1), (8, –5), (10, –16)}
(d)	$\frac{f}{g}$	(iv)	{(2, 9), (8, 3), (10, 10)}

Answer: (a) (iii) (b) (iv) (c) (ii) (d) (i)

8. A relation R is defined from a set A= {2,3,4,5 }to a set B= {3,6,7,10 }as follows: (x,y) ∈ R ⇔ x is relatively prime to y. Express R as a set of ordered pairs.

Answer: R={(2,3),(2,7),(3,7),(3,10),(4,3),(4,7),(5,3),(5,6),(5,7)}

9. Let f : x → 5x +2, x ∈ R define the function f. Then: Find x such that f(x) = 22.

Answer: x = 4

10. Let A = {x, y, z} and B = {1, 2}. Find the number of relations from A to B.

Answer: 2^6

ACTIVITY – 6

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NAME OF THE ACTIVITY: SIGN OF TRIGONOMETRIC FUNCTIONS IN 2nd QUADRANT.

OBJECTIVE:

- To identify and understand the signs of the six trigonometric functions (sine, cosine, tangent, cosecant, secant, and cotangent) specifically in the 2nd quadrant.
- To develop a conceptual understanding of how the coordinates of points on the unit circle relate to the signs of the trigonometric functions.
- To enhance skills in using the unit circle to evaluate trigonometric functions and their signs in different quadrants.
- To find the values of sine and cosine functions in second quadrant using their given values in first quadrant.

PRE-REQUISITE KNOWLEDGE:

Student should be familiar with Algebra and Geometry concepts before learning Trigonometry.

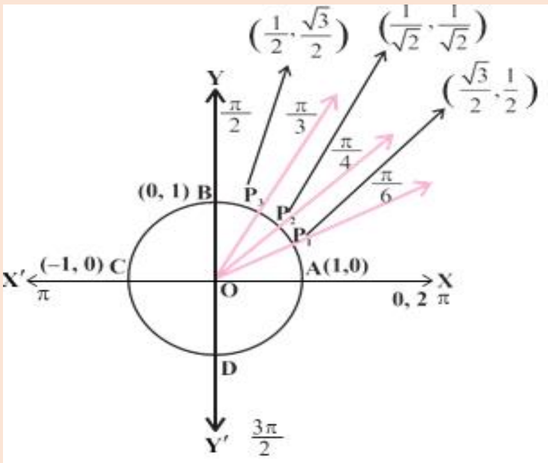
MATERIAL REQUIRED:

- Cardboard,
- White Chart Paper,
- Ruler,
- Coloured Pens,
- Adhesive,
- Steel Wires

♦ Needle.

METHOD OF CONSTRUCTION:

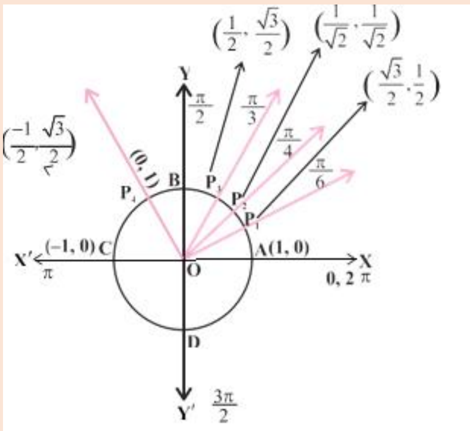
1. Take a cardboard of convenient size and paste a white chart paper on it.
2. Draw a unit circle with centre O on chart paper.
3. Through the centre of the circle, draw two perpendicular lines X'OX and YOY' representing *x*-axis and *y*-axis, respectively, as shown in Fig.



4. Mark the points as A, B, C and D, where the circle cuts the *x*-axis& *y*-axis, respectively, as shown in Fig.
5. Through O, draw angles P_1OX, P_2 OX, and P_3 OX of measures $\frac{\pi}{6}$, $\frac{\pi}{4}$, $\frac{\pi}{3}$, respectively.
6. Take a needle of unit length. Fix one end of it at the centre of the circle and the other end to move freely along the circle.

DEMONSTRATION/ PROCEDURE/ACTION PLAN:

1. The coordinates of the point P_1 are $\left(\frac{\sqrt{3}}{2},\frac{1}{2}\right)$because its *x*-coordinate is $\cos\frac{\pi}{6}$ and *y*-coordinate is $\sin\frac{\pi}{6}$. The coordinates of the points P_2 and $P_3$are $\left(\frac{1}{\sqrt{2}},\frac{1}{\sqrt{2}}\right)$ and $\left(\frac{1}{2},\frac{\sqrt{3}}{2}\right)$ respectively.



2. To find the value of sine or cosine of some angle in the second quadrant

(say) $\frac{2\pi}{3}$, rotate the needle in anti-clockwise direction making an angle P_4OX of measure $\frac{2\pi}{3}$= 120º with the positive direction of x-axis.

3. Look at the position OP_4 fig. Since $\frac{2\pi}{3} = \pi - \frac{\pi}{3}$, OP_4 is the mirror image of OP_4 with respect to y-axis. Therefore, the coordinate of P_4 are $\left(\frac{-1}{2}, \frac{\sqrt{3}}{2}\right)$. Thus sin $\frac{2\pi}{3} = \frac{\sqrt{3}}{2}$ and cos $\frac{2\pi}{3} = \frac{-1}{2}$.

OBSERVATION:

1. Angle made by the needle in one complete revolution is______________.
2. Cos $\frac{\pi}{6}$ = ____________= cos $(-\ \frac{\pi}{6})$.
3. Sine function is non- negative in ___________and _____________quadrant.
4. Cosine function is non- negative in ___________and _____________quadrant.

APPLICATION:

1. The activity can be used to get the values for tan, cot, sec, and cosec functions also.
2. From this activity students may learn that sin (– θ) = – sin θ and cos (– θ) = cos θ.

This activity can be applied to other trigonometric functions also.

CONCLUSION:

With the help of this activity student will be able to learn the sign and values of trigonometric functions in second quadrant.

LEARNING OUTCOMES:

Students will be able to identify the values of sin, cos, and tan in the first quadrant are all positive. Only positive sin values are seen in the second quadrant.

SOURCES OF ERROR AND PRECAUTIONS:

Students are not thorough in basic operations when solving problems based on an appropriate formula. The factors which causes difficulties for students in finding the value of trigonometric functions in different quadrants.

VIVA QUESTIONS AND ANSWERS

1. The value of cos 1° cos 2° cos 3° ... cos 179° is______ (Answer: 0)
2. If tan θ = 3 and θ lies in third quadrant, then the value of sin θ is ______

   (Answer: $\frac{3}{\sqrt{10}}$)
3. Sign of sin 135^0 is____ (Answer: $\frac{1}{\sqrt{2}}$)
4. The value of tan 1° tan 2° tan 3° ... tan 89° is______ (ans: 1)
5. tan function is non- negative in __________and ____________quadrant. (Answer:I and III)
6. What is a positive or negative angle?
7. Sign of sin, cos, tan in all four quadrants.
8. If 4sinθ+3 = 0, then θ lies in which quadrant? (Answer: III or IV)
9. If tanθ+3 = 0, then θ lies in which quadrant? (Answer: II or IV)
10. What is the sign of cot (- 206°). (Answer: negative)

ACTIVITY – 7

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NAME OF THE ACTIVITY: TO PREPARE A MODEL TO ILLUSTRATE THE VALUES OF SINE FUNCTION AND COSINE FUNCTION FOR DIFFERENT ANGLES.

OBJECTIVE:

- To visualize and illustrate the values of sine and cosine functions for different angles using a hands-on model.
- To enhance understanding of how the values of sine and cosine change as the angle varies from 0^0 *to* 360^0.
- To reinforce knowledge of the unit circle and its role in defining the sine and cosine functions.
- To develop skills in creating mathematical models and interpreting their representations.
- To verify the Trigonometric values of sine and cosine functions

PRE-REQUISITE KNOWLEDGE:

Trigonometric functions and trigonometric values of some specific angles

MATERIAL REQUIRED:

- Circular Cardboard
- White Chart Paper, Ruler
- Coloured Pens
- Adhesive
- Coloured Pins
- Nail

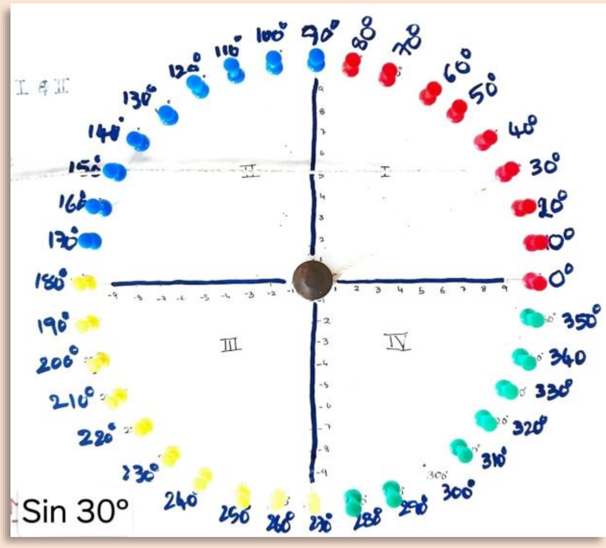
- Thread

METHOD OF CONSTRUCTION:

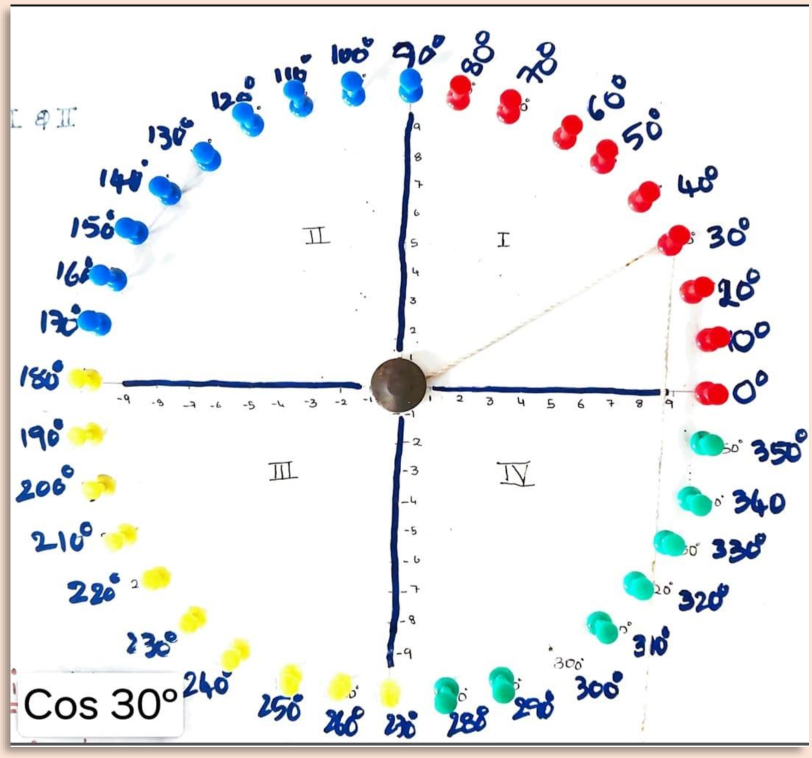
- Take a circular card board and paste white chart on it
- Consider the radius of circle as 10 units
- Draw two lines, perpendicular to each other x axis and Y axis .
- Mark the ends of 0°-180° line as (1,0) at 0°, (–1, 0) at 180° and that of 90° - 270° line as (0,1) at 90° and (0, –1) at 270°
- Fix the different coloured pins in different quadrants on the 0^o-360^o and one big Nail on the centre
- Tie a thread to the big Nail fixed at centre of the circle leave the other end free.

DEMONSTRATION:

- if we want to find sin 30^0 place the other end of the thread on the Y axis along the 300 as shown in figure 1 which will be at 5. Then sin $30^0 = \frac{5}{10} = \frac{1}{2}$.



- Similarly, if we want to find cosine of any angle place the other end of thread perpendicular to X axis along the angle as shown in figure



Note that in first quadrant all trigonometric values are positive, in second quadrant Sin and Cosec are positive, in third quadrant tan and cot are positive and in fourth quadrant Cos and Sec are positive

OBSERVATION:

- ✓ When thread is at 0º indicating the point A (1,0),
  cos 0 = ______ and sin 0 = _______.
- ✓ When thread is at 90º indicating the point B (0, 1),
  $\cos\frac{\pi}{2}$ = _______ and $\sin\frac{\pi}{2}$ = _______
- ✓ When thread is at 180º indicating the point C (–1,0),
  $\cos\pi$ = ______ and $\sin\pi$ = _________.
- ✓ When thread is at 270º indicating the point D (0, – 1)
  which means $\mathrm{Cos}\,\frac{3\pi}{2}$ = _______ and $\sin\frac{3\pi}{2}$ = _______
- ✓ When thread is at 360º indicating the point again at A(1,0),
  $\cos 2\pi$ = _______ and $\sin 2\pi$ = ________.

Now fill in the table:

TRIGONOMETRIC FUNCTION	**0^0**	**10^0**	**100^0**	**200^0**	**300^0**	**180^0**	**270^0**
sin							
cos							

APPLICATION:

This activity can be used to determine the values of other trigonometric functions for different angle

CONCLUSION:

By completing this activity, students will have a tangible understanding of how sine and cosine functions relate to angles. They will be able to visualize and interpret the values of these functions for various angles, enhancing their grasp of trigonometric concepts. This hands-on experience will also foster creativity and engagement in learning mathematical principles, providing a foundation for more advanced studies in trigonometry and calculus.

LEARNING OUTCOMES:

Students will be able to find the any angle of any Trigonometric function

SOURCES OF ERROR AND PRECAUTIONS:

Students need to know the trigonometric values of at least some specific angles to verify whether using this model correct or not.

VIVA QUESTION AND ANSWERS

1) If a line joining the point (2,3) make an angle of x^0 with positive X axis in anti-clock wise direction then cos x =______

   Answer: 2

2) Sin 60^0 = _______

   Answer: $\frac{\sqrt{3}}{2}$

3) Cos $120^{0=}$ _______

   Answer: $(-\frac{1}{2})$

4) Cos $180^{0=}$ ______

   Answer: -1

5) Sin 270^0 =_____

   Answer: -1

6) Cos 360^0 = ______

   Answer: 1

7) Tan 0^0 =_____

   Answer: 0

8) If a line joining the point (-5, -6) make an angle of x^0 with positive X axis in anti-clock wise direction then sin x =______

   Answer: -6

9) Cos 0^0 = ______

   Answer: 1

10) Sin 90^0 = ______

   Answer: 1

ACTIVITY – 8

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NAME OF THE ACTIVITY: THE GRAPHS OF sinx, Sin2x, 2sinx AND sin $\frac{x}{2}$, USING SAME COORDINATE AXES

OBJECTIVE:

- To analyse and compare the graphs of the sine function and its variations: $\sin x, \sin 2x, 2\sin x$ and $\sin\frac{x}{2}$
- To understand the impact of amplitude and frequency on the shape and position of the sine wave.
- To develop skills in graphing trigonometric functions and recognizing patterns in their behaviour.
- To visualize the relationships between the functions by plotting them on the same coordinate axes.

PRE-REQUISITE KNOWLEDGE:

How to plot the points on the graph and he can able to draw the different graphs.

MATERIAL REQUIRED:

- Plyboard,
- Squared Paper
- Adhesive
- Ruler
- Coloured Pens
- Eraser

METHOD OF CONSTRUCTION:

- Take a plywood of size 30 cm × 30 cm.

- On the plywood, paste a thick graph paper of size 25 cm × 25 cm.
- Draw two mutually perpendicular lines on the squared paper, and take them as coordinate axes.
- Graduate the two axes as shown in the Fig. 10.
- Prepare the table of ordered pairs for sinx, sin2x, 2snx and sin $\frac{x}{2}$ for different values of x shown in the table below.

T. ratios	0^0	$\frac{\pi}{12}$	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{5\pi}{12}$	$\frac{\pi}{2}$	$\frac{7\pi}{12}$	$\frac{2\pi}{3}$	$\frac{9\pi}{12}$	$\frac{5\pi}{6}$	$\frac{11\pi}{12}$	π
$sinx$	**0**	**0.26**	**0.50**	**0.71**	**0.86**	**0.97**	**1.00**	**0.97**	**0.86**	**0.71**	**0.50**	**0.26**	**0**
$sin2x$	**0**	**0.50**	**0.86**	**1.00**	**0.86**	**0.50**	**0**	**-0.5**	**-0.86**	**-1.00**	**-0.86**	**-0.50**	**0**
$2sinx$	**0**	**0.52**	**1.00**	**1.42**	**1.72**	**1.94**	**2.00**	**1.94**	**1.72**	**1.42**	**1.00**	**0.52**	**0**
$sin\frac{x}{2}$	**0**	**0.13**	**0.26**	**0.38**	**0.50**	**0.61**	**0.71**	**0.79**	**0.86**	**0.92**	**0.97**	**0.99**	**1.00**

DEMONSTRATION:

Plot the ordered pair (x, sin x), (x, sin 2x), (x, sin x/2) and (x, 2sin x) on the same axes of coordinates, and join the plotted ordered pairs by free hand curves in different colours as shown in the Fig.1.

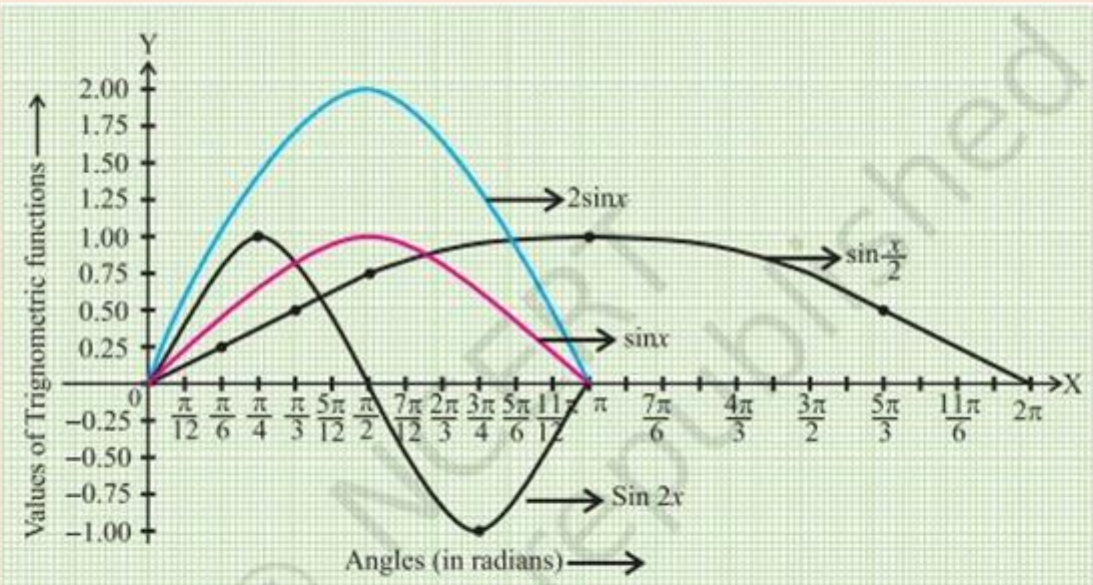

Fig. 1

OBSERVATION:

- Graphs of sin x and 2 sin x are of same shape but the maximum height of the graph of 2sin x is **2** the maximum height of the graph of sin x is 1 at $x = \frac{\pi}{2}$.
- The maximum height of the graph of sin 2x is 1 at $x = \frac{\pi}{4}$.
- The maximum height of the graph of 2 sin x is 2 at $x = \frac{\pi}{2}$.
- The maximum height of the graph of sin x/2 is 1 at $x = \pi$.
- In the interval [0, π], the graphs of sin x and 2 sin x are lies above the x – axes.
- In the interval [0, 2π], the graph of sin x/2 is lies above the x – axes.
- In the interval [0, $\frac{\pi}{2}$], the graph of sin 2x is lies above the x – axes and In the interval [$\frac{\pi}{2}$, π] the graph is lies below the x-axes.
- Graphs of sin x and sin 2x intersect at $x = \frac{\pi}{3}$.
- Graphs of sin x and sin x/2 intersect at $x = \frac{2\pi}{3}$.

APPLICATION:

- This activity may be used in comparing graphs of a trigonometric function of multiples and sub multiples of angles.
- This activity may be used in comparing graphs of a trigonometric function of sin^2x, cos^2x and odd powers like sin^3x and cos^3x.

CONCLUSION:

The inequality is satisfied by only one of the half plane

LEARNING OUTCOMES:

- ✓ Students will develop a solid understanding of graphs of sin x and different graphs of trigonometric functions.

✓ Students will learn to draw the graph different functions. They will gain the ability to visually interpret and analyze the solutions of trigonometric functions on graph.

VIVA QUESTIONS AND ANSWERS

1. The maximum value of $sinx$ is
   Answer: 1
2. The range of $sin4x$ is
   Answer: $[-1, 1]$
3. The minimum and maximum value of $cos^4 7x$ is
   Answer: $0, 1$
4. If $tan\theta = \frac{-4}{3}$, then $sin\theta$ is
   Answer: $\frac{-4}{5}$ or $\frac{4}{5}$
5. The greatest value of $sinx\ cosx$ is
   Answer: $\frac{1}{2}$
6. If $\alpha + \beta = 90^0$ then find the maximum value of $sin\alpha . sin\beta$.
   Answer: $\frac{1}{2}$
7. Which of the following is not correct?
   (A) $sin\theta = -\frac{1}{5}$ (B) $cos\theta = 1$
   (C) $sec\theta = \frac{1}{2}$ (D) $tan\theta = 20$
   Answer: C
8. The value of $\frac{1-tan^2 15^0}{1+tan^2 15^0}$ is
   Answer: $\frac{\sqrt{3}}{2}$
9. The value of $cos1^0 . cos2^0 . cos3^0 \dots\dots cos179^0$ is
   Answer: 0
10. If $tan\theta = 3$ and θ lies in third quadrant, then the value of $sin\theta$ is
    Answer: $\frac{-3}{\sqrt{10}}$
11. The minimum value of $3cos\theta + 4sin\theta + 8$ is
    Answer: 3
12. The value of $sin\frac{\pi}{10} . sin\frac{13\pi}{10}$ is
    Answer: $\frac{-1}{4}$

ACTIVITY – 9

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PM SHRI KENDRIYA VIDYALYA NO.1
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BENGALURU REGION

NAME OF THE ACTIVITY: GRAPH OF A GIVEN INEQUALITY OF THE FORM $ax + by + c < 0,\ a, b > 0, c < 0$ REPRESENT ONLY ONE OF THE TWO HALF PLANES

OBJECTIVE:

- To graphically represent the inequality $ax + by + c < 0$ on a Cartesian coordinate system.
- To understand the significance of the coefficients $a, b, and\ c$ in determining the orientation and position of the line and the half-plane it represents.
- To analyse the resulting graph and identify which half-plane is the solution set for the inequality.
- To reinforce the concept of half-planes and how they relate to linear inequalities in two-dimensional geometry.

PRE-REQUISITE KNOWLEDGE:

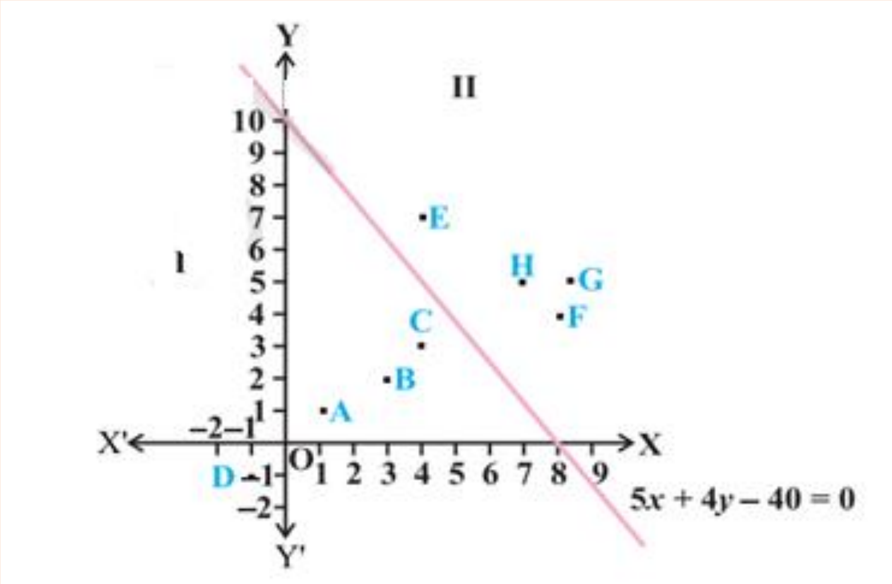
How to plot a linear equation on a graph?

MATERIAL REQUIRED:

- Cardboard,
- Thick White Paper
- Sketch Pen
- Ruler,
- Adhesive
- Pencil or Pen
- Two Different Coloured Markers or Pencils.

METHOD OF CONSTRUCTION:

- Take a graph paper of a convenient size and paste on a white paper.
- Draw two perpendicular lines X'OX and Y'OY to represent x-axis and y-axis, respectively.
- Draw the graph of the linear equation corresponding to the given linear inequality.
- Mark the two half planes I and II as shown in the fig. below



DEMONSTRATION/ PROCEDURE/ACTION PLAN:

- Rewrite the inequality as an equation by setting $(5x + 4y - 40 \ = 0)$. This equation represents the boundary line that separates the two half planes.
- Use the equation to determine at least two points on the boundary line. For instance, you can find the intercepts by setting $(x = 0)$ to find the $y - intercepts$ and $(y = 0)$ to find the $x - intercept$.
- First we solve $5x + 4y \ \leq 40$

  Let first draw graph of $5x + 4y = 40$.

Putting x=0 we get

5(0) + 4y=40.

4y=40

Y=10

Putting y=0 we get

5x+4(0) =40

5x=40

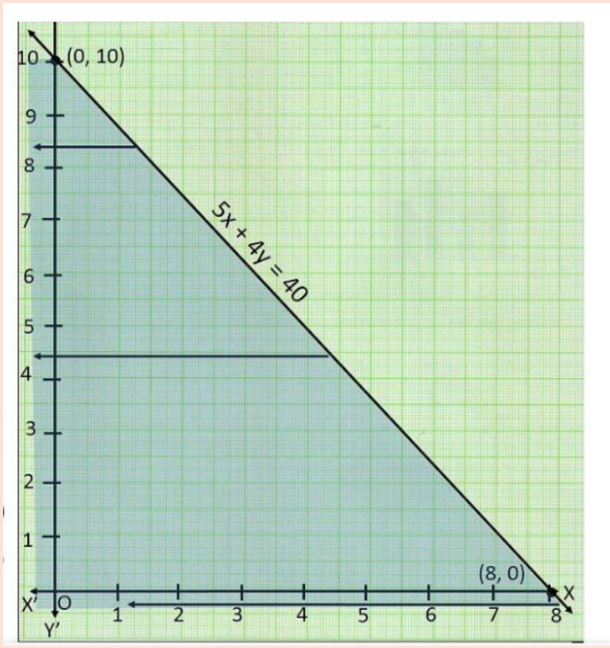
x=8

x	0	8
y	10	0

- Draw graph points to be plotted are (0,10) (8,0) Plot these points on the graph paper and draw the line.
- **Determine the Half-Plane**: The inequality $(5x + 4y - 40 < 0)$ represents one of the two half-planes divided by the boundary line.
- To determine which half-plane the inequality represents, choose a test point that is not in the boundary line (common choice is the origin (0,0), if it is not on the line).

  Substitute the coordinates of the test point into the inequality

  $(5x + 4y - 40 < 0)$
- If the inequality holds true for the test point, then the half-plane containing this point is the solution region. If the inequality does not hold, the opposite halfplane is the solution region.
- Checking for (0,0) putting x=0, y=0 we have 5(0) +4(0) < 40 which is true . Hence origin lies in the plane $5x + 4y < 40$. So, we shade left side of the plane.



- **Shade the Solution Region:** Based on the results of the test point, shade the appropriate half-plane that satisfies the inequality (5x+4y-40<0**).** Use one of the coloured markers or pencils to shade this region. The shaded region is the set of all points (x, y) that satisfy the inequality.
- **Verification**: Pick another point from the shaded region and substitute its coordinates into the inequality. It should satisfy the inequality.

  Point A (1,1) we have 5(1) +4(1)-40 = 9-40 = -31< 0 which is true. So, A lies in shaded part.

  Point B (3,2) we have 5(3) +4(2)-40 = 23 40 = -17 <0 which is true. So, B lies in shaded part.

  Point C (4,3) we have 5(4) +4(3)-40 = 32-40 = -8 < 0 which is true. So, C lies in shaded part. Pick a point from the non-shaded region, and it should not satisfy the inequality, confirming that the inequality represents only one half-plane.

  Point E (5,7) we have 5(5) +4(7) -40 =54-40 = 14<0 which is not true.

  So, E does not lie in shaded part.

  Point F (8,4) we have 5(8) +4(4)-40 = 56-40 = 16<0 which is not true.

  So, F does not lie in the shaded part.

  Point G (8,5) we have 5(8) +4(5)-40 = 60-40 = 20 <0 which is not true.

  So, G does not lie in the shaded part.

OBSERVATION:

- Coordinates of point A **satisfies** the given inequality.
- Coordinates of point G **satisfies** the given inequality.
- Coordinates of point H **satisfies** the given inequality.
- Coordinates of point E **satisfies** the given inequality.
- Coordinates of point F **satisfies** the given inequality.
- The inequality is only satisfied by the points of half plane I. Hence it is the solution of this Inequality.

APPLICATION:

Optimization Problems: Linear inequalities form the basis of linear programming, where businesses and organizations of optimize resources, such as minimizing transportation costs, maximizing production efficiency, or determining the best allocation of limited resources.

CONCLUSION:

By completing this activity, students will gain hands-on experience in graphing linear inequalities and understanding the geometric representation of solutions in a two-dimensional plane. They will learn how to analyze the effects of coefficients on the inequality and identify the solution regions.

LEARNING OUTCOMES:

Students will develop a solid understanding of linear inequalities, recognizing that they represent a set of solutions confined to one half of a coordinate plane, divided by a boundary line.

Students will learn to graph linear inequalities by identifying the boundary line and determining which side of the line represents the solution set. They will gain the ability to visually interpret and analyze the solutions of inequalities on a graph.

SOURCES OF ERROR AND PRECAUTION

Error can be developed to shade the area which satisfies the linear inequality only by seeing the inequality sign.

Precaution: Always check the point of that plane satisfies the inequality or not.

VIVA QUESTIONS AND ANSWERS

Question1. What does the inequality ($ax + by + c < 0$) represent geometrically?

Answer: It represents a half-plane in the coordinate plane, excluding the boundary line ($ax + by + c = 0$).

Question 2. What is the significance of the coefficients (a) and (b) being greater than zero and (c) being less than zero?

Answer: ($a, b > 0$ ensures that the line has a positive slope, while ($c < 0$) shifts the line downward, affecting which half-plane is represented by the inequality.

Question 3. How would you graph the boundary line corresponding to the inequality? $ax + by + c= 0$?

Answer: The boundary line is drawn by finding the intercepts or by using the slope-intercept form and plotting points on the graph.

Question 4. How do you determine which side of the boundary line satisfies the inequality $ax + by + c < 0$)?

Answer: You can test a point that is not on the line (typically the origin if it is not on the line) by substituting its coordinates into the inequality. If it satisfies the inequality, that half-plane is the solution.

Question 5. Is the point (1,1) satisfies the linear inequality $3x-2y<1$.

Answer: No

Question 6. Why is the boundary line not included in the solution of the inequality $ax + by + c < 0$?

Answer: Because the inequality is strict ($<$), the points on the line itself do not satisfy the inequality and are therefore not included in the solution set.

Question 7. Explain why the inequality represents exactly one half-plane, not the entire plane.

Answer: The inequality defines a region where the expression ($ax + by + c$) is negative. This restricts the solution to only one half of the plane divided by the line ($ax + by + c = 0$).

Question 8. If the inequality were ($ax + by + c > 0$), how would the graph change?

Answer: The half-plane represented would be on the opposite side of the boundary line compared to the inequality ($ax + by + c < 0$).

Question 9. How would the graph and solution set change if ($c > 0$)?

Answer: If ($c > 0$), the line would shift upward, altering which half-plane satisfies the inequality.

Question 10. How can this type of inequality be applied in real-world problems

Answer: Such inequalities can be used in optimization problems, economics for representing feasible regions, or in any context where a condition must be met within a defined boundary.

ACTIVITY – 10

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NAME OF THE ACTIVITY: To find the number of ways in which three cards can be selected from given five cards.

OBJECTIVE:

- To explore and apply the concept of combinations in a practical context.
- To understand the formula for combinations and how it is derived.
- To enhance problem-solving skills by calculating the number of ways to select a subset from a larger set.
- To develop the ability to visualize combinatorial problems using real objects (cards) for better conceptual understanding.

PRE- REQUISITE KNOWLEDGE:

- Combination
- Factorials
- Binomial Coefficient

MATERIAL REQUIRED:

- Cardboard sheet,
- white paper sheets,
- sketch pen,
- cutter.

METHOD OF CONSRTUCTION:

- Take a cardboard sheet and paste white sheet on it.
- Cut out 5 identical cards of convenient size from the cardboard.
- Mark these cards as C_1, C_2, C_3, C_4 and C_5 of different colours.

DEMONSTRATION:

- Select one card from the give five cards.
- Let the first selected card be C_1.

  Then other two cards from the remaining four cards can be: C_2C_3, C_2C_4, C_2C_5, C_3C_4, C_3C_5 and C_4C_5. Thus, the possible selections are: $C_1C_2C_3$,$_1C_2C_4$,$C_1C_2C_5$,$C_1C_3C_4$,$C_1C_3C_5$,$C_1C_4C_5$. Record these on a paper sheet.
- Let the first selected card be C_2.

  Then the other two cards from the remaining four cards can be : C_1C_3,C_1C_4,C_1C_5,C_3C_4,C_3C_5,C_4C_5.Thus, the possible selections are : $C_2C_1C_3$, $C_2C_1C_4$, $C_2C_1C_5$, $C_2C_3C_4$, $C_2C_3C_5$, $C_2C_4C_5$. Record these on the same paper sheet.
- Let the selected card be C_3.

  Then the other two cards can be : C_1C_2, **C_1C_4,** C_1C_5, C_2C_4, C_2C_5, C_4C_5. Thus, the possible selections are : $C_3C_1C_2$, $C_3C_1C_4$, $C_3C_1C_5$, $C_3C_2C_4$, $C_3C_2C_5$, $C_3C_4C_5$. Record them on the same paper sheet.
- Let the first selected card be C_4.

  Then the other two cards can be : C_1C_2, C_1C_3, C_2C_3, C_1C_5, C_2C_5, C_3C_5, Thus, the possible selections are : $C_4C_1C_2$, $C_4C_1C_3$, $C_4C_2C_3$, C_4C_1C5, $C_4C_2C_5$, $C_4C_3C_5$. Record these on the same paper sheet.
- Let the first selected card be C5.

  Then the other two cards can be : C_1C_2, C_1C_3, C_1C_4, C_2C_3, C_2C_4, C_3C_4 Thus, the possible selections are : $C_5C_1C_2$, $C_5C_1C_3$, $C_5C_1C_4$, $C_5C_2C_3$, $C_5C_2C_4$, $C_5C_3C_4$. Record these on the same paper sheet.
- Now look at the paper sheet on which the possible selections are listed. Here, there are in all 30 possible selections and each of the selections is repeated thrice. Therefore, the number of distinct selections = $\frac{30}{3}$=10 which is same as $5C_3$.

OBSERVATION:

1. $C_1C_2C_3$, $C_2C_1C_3$ and $C_3C_1C_2$ represent the _______ selection.
2. $C_1C_2C_4$, _______ , _______ represent the same selection.
3. Among $C_2C_1C_5$, $C_1C_2C_5$, $C_1C_2C_3$, _______ and _______ represent the same selection.
4. $C_2C_1C_5$, $C_1C_2C_3$, represent _______ selections.
5. Among $C_3C_1C_5$, $C_1C_4C_3$, $C_5C_3C_4$, $C_4C_2C_5$, $C_2C_4C_3$, $C_1C_3C_5$,
   $C_3C_1C_5$, _______ represent the same selections.
   $C_3C_1C_5$, $C_1C_4C_5$, _______, ______, represent different selections.

APPLICATION:

Activities of this type can be used in understanding the general formula for finding the number of

possible selections when ***r*** objects are selected from given ***n*** distinct object ,

i.e., $n_{C_r} = \frac{n!}{r!(n-r)!}$.

CONCLUSION:

The number of ways to select three cards from a set of five cards is found using the combination formula.

The formula for combination is :

$$n_{C_r} = \frac{n!}{r!\,(n-r)!}$$

In this case: $n = 5,\ r = 3$

So, the number of ways to choose 3 cards from 5 is $5C_3 = 1$

LEARNING OUTCOMES:

- ✓ Calculate Combinations.
- ✓ Apply Formulae.
- ✓ Understand the Concept.

SOURCE OF ERROR:

- Incorrect factorial calculations.
- Formula Misuse.
- Arithmetic error.

PRECAUTION:

Handle the cutter carefully.

VIVA QUESTIONS AND ANSWERS

1. What's the type of problem we are dealing with here permutation or combination, why?

Answer: Combination, because the order of selection doesn't matter.

2. What's the formula for calculating combinations? Explain the variables involved.

Answer:

$$n_{c_r} = \frac{n!}{r!\,(n-r)!}$$

n = Total number of items, r = number of items selected.

3. How many ways can 3 cards be selected from 5 cards if the order of selection matters?

Answer: $5P_3 = 60$

4. What's the difference between $5C_3$ and $5P_3$?

Answer: $5C_3$ is the number of ways to select 3 cards from 5 without regard to order, while $5P_3$ is the number of ways to select 3 cards from 5 with regard to order.

5. Can we use the formula for permutations to solve this problem? Why or why not?

Answer: No, because the order of selection doesn't matter and formula for permutation would over count the number of ways.

6. what will be the answer, if we select 2 cards instead of 3?

Answer: $5C_2 = 10$

7. How does the concept of combination apply to real life sceneries?

Answer: combinations are used in various field such as probability, statistics, computer science

to calculate the number of ways to choose items from a larger set.

8. How do you compute the factorial of a number?

Answer: The factorial of a number is product of all positive integers up to n.

9. n_{C_r} can also be written as ________.

Answer: $n_{C_{n-r}}$

10. If $n_{C_a} = n_{C_b}$, What is $a + b$?

Answer: n.

ACTIVITY – 11

Ms. SHIPRA
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BENGALURU REGION

NAME OF THE ACTIVITY: TO CONSTRUCT A PASCAL'S TRIANGLE AND TO WRITE BINOMIAL EXPANSION FOR A GIVEN POSITIVE INTEGRAL EXPONENT.

OBJECTIVE:

- To construct Pascal's Triangle up to a specified number of rows and understand its structure.
- To identify the pattern of binomial coefficients within the triangle.
- To derive the binomial expansion $(a + b)^n$ using the coefficients from Pascal's Triangle.
- To enhance problem-solving skills by applying the binomial theorem to expand expressions with positive integral exponents.

PRE-REQUISITE KNOWLEDGE:

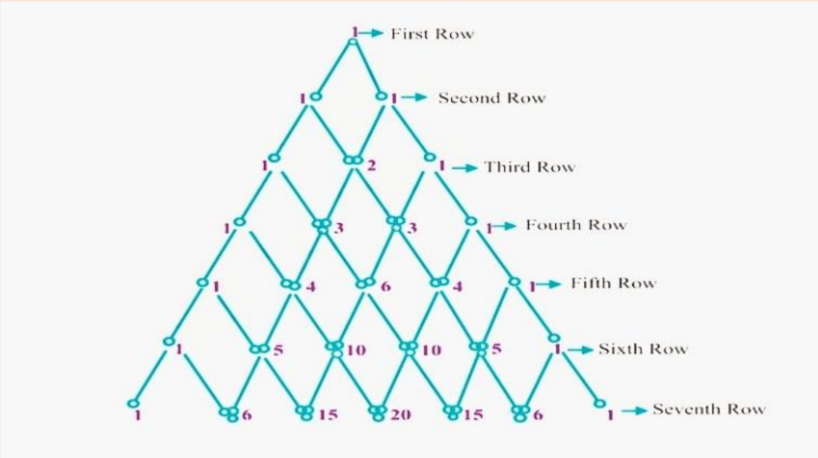
Familiarity with the concept of "n_{C_r}" , Knowledge of factorial notation, Understanding of binomial expressions.

MATERIAL REQUIRED:

- Drawing Board
- White Paper
- Matchsticks
- Adhesive

METHOD OF CONSTRUCTION:

- Take a drawing board and paste a white paper on it.
- Take some matchsticks and arrange them as shown below and paste it.



- After pasting the matchsticks, write ‘1’ at the top, then write ‘1’ twice in the second row and then in the third row, place ‘1’ at each end of the row and the middle term will be obtained by adding two ‘1’s of the previous row.
  Similarly, for the fourth row, place ‘1’ at each end and the middle two terms will be obtained by adding the terms of the previous third row (depicted using arrows).
  Continue the process like this, as shown below :

1 (first row) $(a+b)^0 = 1$

1 1 (second row) $(a+b)^1 = a+b$

1 2 1 (third row) $(a+b)^2 = a^2 + 2ab + b^2$

1 3 3 1 (fourth row) $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$

1 4 6 4 1 (fifth row) $(a+b)^4 = a^4 + 4a^3b + 6a^2b^2 + 4ab^3 + b^4$

And so on.

- To write binomial expansion of $(a+b)^n$, use the numbers given in $(n+1)^{th}$ row.

DEMONSTRATION:

- We place the matchsticks in each row as shown in the above figure and we get a triangle. This triangle is called as **PASCAL'S TRIANGLE.**
- Numbers in the second row gives the coefficients of the term of the binomial expansion $(a+b)^1$, Numbers in the third row gives the coefficients of the term of the binomial expansion $(a+b)^2$, Numbers in the fourth row gives the coefficients of the term of the binomial expansion $(a+b)^3$ and so on.

OBSERVATION:

1. Numbers in the fifth row are ______________ , which are coefficients of the binomial expansion of _____________.
2. Numbers in the seventh row are ______________ , which are coefficients of the binomial expansion of _____________.
3. $(a+b)^3 = \_\_\ a^3 + \_\_\ a^2b + \_\_\ ab^2 + \_\_\ b^3$.
4. $(a+b)^5 = \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_$.
5. $(a+b)^6 = \_\_\ a^6 + \_\_\ a^5b + \_\_\ a^4b^2 + \_\_\ a^3b^3 + \_\_\ a^2b^4 + \_\_\ ab^5 + \_\_\ b^6$.
6. $(a+b)^{10} = \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_ + \_\_$.
7. Total number of terms in the expansion of $(a+b)^8$ will be ______________ .

APPLICATION:

The activity can be used to write binomial expansion for $(a+b)^n$, where n is a positive integer.

CONCLUSION:

- By completing this activity, students will gain a deep understanding of Pascal's Triangle and its application in binomial expansions.

- Student will learn to construct the triangle, identify binomial coefficients, and apply the binomial theorem to expand expressions.

LEARNING OUTCOMES:

1. Students will be able to understand the concept of Pascal's Triangle.
2. Students will be able to recognise the patterns.
3. Students will be able to apply the concept of Combinatorics.
4. Through this activity, student's problem-solving skills will be enhanced.

SOURCES OF ERROR AND PRECAUTIONS:

1. Avoid mistakes in adding numbers while constructing Pascal's Triangle.
2. Be careful while calculating "n_{C_r}" and applying binomial theorem.
3. Misinterpreting or over-looking patterns might lead to incorrect conclusions.

VIVA QUESTIONS (WITH ANSWERS)

1. What is a Pascal's Triangle?

   Answer: It is a triangular array of numbers that represents the coefficients of the binomial expansion.

2. How is Pascal's Triangle `constructed?

   Answer: IDENTITIES CO-EFFICIENTS OF EACH TERM

IDENTITIES	CO-EFFICIENTS OF EACH TERM
$(a+b)^1 = a + b$	1 1
$(a+b)^2 = a^2 + 2ab + b^2$	1 2 1
$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$	1 3 3 1

   and so on.

3. What is the sum of the elements in the n^{th} row of Pascal's Triangle?

   Answer: It is given by the formula 2^n.

4. How can Pascal's Triangle be used in expanding binomials?

Answer: The coefficients of n^{th} power expansion comes by adding the coefficients of the previous i.e. $(n-1)^{th}$ power expansion.

5. Why is it called Pascal's Triangle?

Answer: Because this concept was given by the mathematician: Blaise Pascal.

6. What are the real-life applications of Pascal's Triangle ?

Answer: (i) Used in algorithms for generating combinations.
(ii) Used to calculate probabilities in various situations.

7. How many terms will you get if the binomial expansion has 'n' terms ?

Answer: We get (n+1) terms.

8. What is the binomial expansion of $(x+y)^n$?

Answer:$(x+y)^n = x^n + x^{n-1}\,y + x^{(n-2)}\,y^2 + x^{n-3}\,y^3 + ---+ x\,y^{n-1} + y^n$

9. What is the binomial expansion of $(x-y)^n$?

Answer:$(x+y)^n = x^n - x^{n-1}\,y + x^{(n-2)}\,y^2 - x^{n-3}\,y^3 + ---+ (-1)^{n-1}\,x\,y^{n-1} + (-1)^n\,y^n$

10. Use Pascal's Triangle to derive the formula for $(a+b)^3$.

Answer: $(a+b)^1 = a+b$ 1 1

$(a+b)^2 = a^2 + 2ab + b^2$ 1 2 1

$(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$ 1 3 3 1

Add the coefficients of the previous expansion to get the coefficients of next expansion.

ACTIVITY – 12

Ms. SHIPRA DIXITPGT(MATHS)
KENDRIYA VIDYALAYA
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CHENNAI REGION

NAME OF THE ACTIVITY: TO OBTAIN THE FORMULA FOR THE SUM OF SQUARES OF FIRST N NATURAL NUMBERS

OBJECTIVE:

- To **derive** and **prove** the formula for the sum of squares of the first nnn natural numbers: $S = \frac{n\,(n+1)\,(2n+1).}{6}$
- To develop problem-solving skills by using mathematical induction or other techniques to verify the formula.
- To enhance understanding of sequences, series, and their applications in mathematics.

PRE-REQUISITE KNOWLEDGE:

Square of natural numbers, area of square, volume of cube and cuboid.

MATERIAL REQUIRED:

- Wooden/plastic/paper unit cubes
- Coloured papers
- Pencil
- Ruler
- Scissors and glue

METHOD OF CONSTRUCTION:

Calculate Individual Sums:

- Sum of Squares: For each n, calculate the sum of the squares manually. For example, if n=4
- Draw a 1×1 square = 1 square unit
- Draw a 2×2 square = 4 square units
- Draw a 3×3 square = 9 square units
- Draw a 4×4 square = 16 square units
- Sum: 1+4+9+16=30

(Therefore 30 cubes will be the base for this activity.)

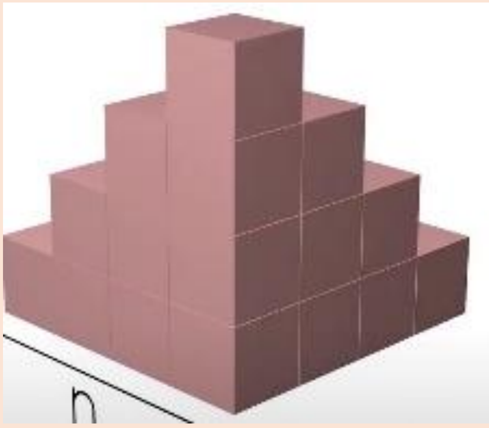
1. Take 1 (1 x 1) wooden/plastic/paper unit cube.

2. Now, take 4 (2 x 2) wooden/plastic unit cubes and form a cuboid as shown in fig

3. Take 9 (3x3) wooden/plastic unit cubes and form a cuboid as shown in Fig

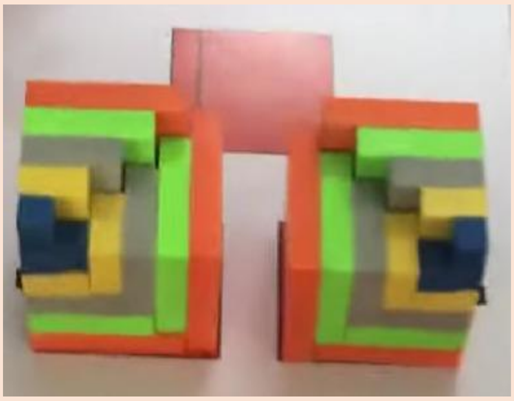
4. Similarly take 16 (4x4) wooden/plastic unit cubes and form a cuboid as shown in Fig and so on.

5. Now arrange all the cube and cuboids one over the other in ascending order (smallest on top)



6. Make six such echelon type structures.

7. Now take three structures and arrange them as shown in figure such that the base dimensions are n and n+1.



7. Now merge these two structure into one solid cuboid such that height of the cuboid comes out to be 2n+1(9 units for n=4). And base dimensions being n (n=4 units) and n+1(=5 units) respectively.

8. Hence we obtain a cuboid of volume 4 x5 x 9 cubic units.

DEMONSTRATION:

- Volume of the structure as given in the above figure =

  (1 + 4 + 9 + 16) cubic units = $(1^2 + 2^2 + 3^2 + 4^2)$ cubic units.

- Volume of 6 such structures = $6\,(1^2 + 2^2 + 3^2 + 4^2)$ cubic units.
- Volume of the cuboidal block finally formed (which is cuboid of dimensions = 4 × 5 × 9) = 4 × (4 + 1) × (2 × 4 + 1).
- Thus, $6\,(1^2 + 2^2 + 3^2 + 4^2) = 4 \times (4 + 1) \times (2 \times 4 + 1)$ i.e., $1^2 + 2^2 + 3^2 + 4^2 = \frac{4(4+1)\,(2 \times 4+1).}{6}$

OBSERVATION:

$1^2 + 2^2 + 3^2 + 4^2 = \frac{1}{6}$ (______) × (______) × (______).

2. $1^2 + 2^2 + 3^2 + 4^2 + 5^2 = \frac{1}{6}$ (______) × (______) × (______).

3. $1^2 + 2^2 + 3^2 + 4^2 + \cdots + 10^2 = \frac{1}{6}$ (______) × (______) × (______).

APPLICATION:

This activity may be used to obtain the sum of squares of first n natural numbers as $1^2 + 2^2 + 3^2 + ... + n^2 = \frac{n(n+1)(2n+1).}{6}$

CONCLUSION:

By completing this activity, students will gain a comprehensive understanding of how to derive the formula for the sum of squares of the first n natural numbers. They will learn to apply mathematical induction for proofs, enhancing their problem-solving skills and understanding of sequences and series.

LEARNING OUTCOMES:

- ✓ Students understand how this formula is derived and why it accurately represents the sum of squares.
- ✓ Students are able to apply the formula to compute the sum of squares for given values of n, and verify their results through direct computation.
- ✓ Students are able to compare and contrast the sum of squares with other types of series, understanding its properties and applications.

SOURCES OF ERROR AND PRECAUTIONS:

- ✶ Error: Misinterpreting the results obtained or not understanding what the sum of squares represents.
- ✶ Precaution: Analyse the results in the context of the problem. Verify the results by comparing them with direct summation for smaller values of n to ensure consistency.
- ✶ Error: Formation of paper cubes.
- ✶ Precaution: Plastic cubes can be used or paper cubes should be made with the help of square sheets precisely.

VIVA QUESTIONS AND ANSWERS

1. What is the formula for the sum of the squares of the first n natural numbers?

   Answer: $1^2 + 2^2 + 3^2 + \ldots + n^2 = \frac{n(n+1)(2n+1).}{6}$

2. How would you use the formula to find the sum of squares of the first 10 natural numbers?

   Answer: Substitute n=10 into the formula, SUM=385.

3. If the sum of squares of the first n natural numbers is 1, what is n?

   Answer: 1

4. What are some common applications of the sum of squares in real-world problems?

   Answer:The sum of squares is used in various fields such as statistics (e.g., variance and standard deviation calculations), physics (e.g., in moments of inertia), and computer science (e.g., in algorithms and data fitting).

5. How does the sum of squares of the first n natural numbers relate to the sum of the first n natural numbers?

   Answer: The sum of squares is a quadratic function, whereas the sum of the first n natural numbers is a linear function.

6. What is the significance of the sum of squares in mathematics and statistics?

   Answer: The sum of squares is used in statistics, physics, engineering, and other fields to calculate variances, standard deviations, and other quantities.

7. Can you derive the formula for the sum of squares of the first n natural numbers using mathematical induction?

   Answer: Yes, the formula can be derived using mathematical induction.

8. How does the sum of squares change when n increases by 1?

   Answer: The sum of squares increases by $(n + 1)^2$ when n increases by 1.

9. What is the connection between the sum of squares and the arithmetic series?

   Answer: The sum of squares is a special case of the arithmetic series.

10. Can you write a simple program or algorithm to calculate the sum of squares of the first n natural numbers?

    Answer: A simple program can be written using a loop to calculate the sum of squares.

11. How does the sum of squares relate to other mathematical concepts, such as geometry or calculus?

    Answer: The sum of squares relates to geometric concepts like area and volume, and calculus concepts like integration and differentiation.

ACTIVITY – 13

Ms. RENU MEENA
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NAME OF THE ACTIVITY: AN ALTERNATIVE APPROACH TO OBTAIN FORMULA FOR THE SUM OF SQUARES OF FIRST N NATURAL NUMBERS

OBJECTIVE:

- To derive the formula for the sum of squares using an alternative method, such as the use of summation formulas or geometric interpretation.
- To develop critical thinking skills by comparing different derivation methods and understanding their advantages and disadvantages.
- To reinforce the understanding of the relationship between algebraic expressions, geometric representations, and summation techniques.

PRE-REQUISITE KNOWLEDGE:

Addition of numbers and square of numbers

MATERIAL REQUIRED:

- Wooden/Plastic Unit Squares,
- Pens
- Scale
- Sketch Colours etc…

METHOD OF CONSTRUCTION:

- Take unit squares 1,4,9,16,25….as shown in figure1 and colour all of them with black colour

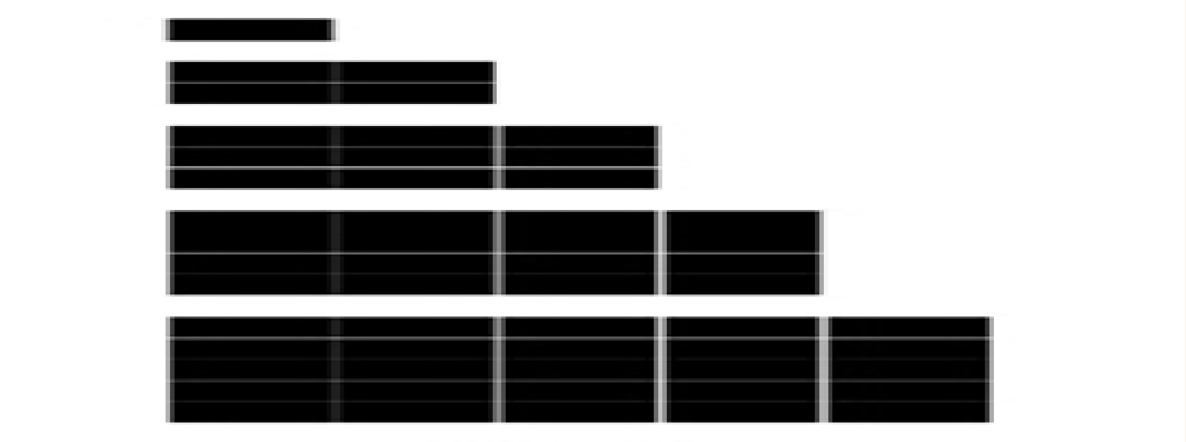

Figure 1

- Take another set of unit square 1,4,9,16, 25, ...as shown in figure 2 and colour all of them with green colour

Figure 2

- Take a third set of unit squares in figure 3 and colour unit squares with different colours

Figure 3

- Arrange these three set of unit squares as a rectangle as shown in figure 4

Figure 4

DEMONSTRATION:

- Area of one set as given in fig = (1+4+9+16+25) sq.units

  $= (1^2+2^2+3^2+4^2+5^2)$ sq.units

- Area of three such sets $= 3(1^2+2^2+3^2+4^2+5^2)$
- Area of rectangle $= 11 \times 15$

  $= [2(5) + 1] [(5\times 6)/2]$

- $(1^2+2^2+3^2+4^2+5^2) = ½ [5\times6] [2(5)+1]$

  Or $1^2+2^2+3^2+4^2+5^2 = ⅙ [5 \times(5+1)][2(5)+1]$

OBSERVATION:

- $3(1^2+2^2+3^2+4^2+5^2)=½ (5\times6)(2(5)+1)$
- $1^2+2^2+3^2+4^2+5^2 = \frac{1}{6} [5\times(5+1)][2(5)+1]$
- $1^2+2^2+3^2+4^2+5^2+6^2 =\frac{1}{6}$ (_____ × _____) (___+1)
- $1^2+2^2+3^2+......+10^2 =\frac{1}{6}$ (_____ × _____) (___+1)

APPLICATION:

This activity may be used to establish

$1^2+2^2+3^2+.....+n^2 = \frac{1}{6}[n(n+1)(2n+1)]$

COLEARNINGNCLUSION:

An alternative formula has been created for the sum of squares of first n natural numbers.

OUTCOMES:

Construction and understanding of the formula in students through an engaging activity.

VIVA QUESTIONS AND ANSWERS

1) What is the sum of the square of the first n natural numbers?

   Answer: Formula for Sum of squares of n natural numbers: [n(n+1)(2n+1)]/6

2) Find the sum of the squares of the first 15 natural numbers.

   Answer: Using the formula n(n+1)(2n+1)/6, we get:

   15(15+1)(2*15+1)/6 = 1240

3) Find the sum of the squares of the first 25 natural numbers.

   Answer: Using the formula n(n+1)(2n+1)/6, we get:

   25(25+1)(2*25+1)/6 = 5525

4) What is the sum of squares of the first n even natural numbers ?

   Answer:The formula for the sum of squares of the first n even natural numbers is: $2^2 + 4^2 + 6^2 + ... + (2n)^2 = n(n+1)(2n+1)/3$

5) Find the sum of the squares of first 10 even numbers?

   Answer: Using the formula:

   n(n+1)(2n+1)/3

   Where n = 10 (since we're considering the first 10 even numbers), we get:

   10(10+1)(2*10+1)/3

   = 10(11)(21)/3

   = 770

So, the sum of the squares of the first 10 even numbers is:

$2^2 + 4^2 + 6^2 + ... + 20^2 = 770$

6) What is the sum of squares of the first n odd numbers ?

Answer:The formula for the sum of squares of the first n odd natural numbers is: $1^2 + 3^2 + 5^2 + ... + (2n-1)^2 = n(2n-1)(2n+1)/3$

7) Find the sum of the squares of first 10 odd numbers

Answer: Using the formula: $n(2n-1)(2n+1)/3$

Where n = 10 (since we're considering the first 10 odd numbers), we get:

$10[2(10)-1][2(10)+1]/3$

$= 10(19)(21)/3$

$= 1330$

So, the sum of the squares of the first 10 odd numbers is:

$1^2 + 3^2 + 5^2 + ... + 19^2 = 1330$

8) Find the sum of the squares of the first 15 odd numbers.

Answer: Using the formula $n(2n-1)(2n+1)/3$, we get:

$15[2(15)-1][2(15)+1]/3 = 15(29)(31)/3 = 4485$

9) If the sum of the squares of the first n odd numbers is 780, find the value of n.

Answer: Using the formula $n(2n-1)(2n+1)/3$, we can solve for n:

$n(2n-1)(2n+1)/3 = 780$

Solving for n, we get n = 10

10) Find the mean of sum of squares of the first n natural numbers.

The formula for the sum of squares of the first n natural numbers is:

$1^2 + 2^2 + 3^2 + ... + n^2 = n(n+1)(2n+1)/6$

To find the mean, we divide the sum by n:

Mean = $n(n + 1)(2n + 1)/6n$

Simplifying:

Mean = $(n + 1)(2n + 1)/6$

ACTIVITY – 14

Mr. SREEJITH S
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PM SHRI KENDRIYA VIDYALAYA NO1
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ERNAKULAM REGION

NAME OF THE ACTIVITY: CONSTRUCTION OF A PARABOLA

OBJECTIVE:

- To construct a parabola using geometric methods and understand its properties.
- To explore the standard form of a parabola's equation and its graphical representation.
- To develop skills in using tools (like graph paper, rulers, and compasses) to create accurate geometric figures.
- To enhance problem-solving abilities by applying algebraic concepts to geometric constructions.

PRE-REQUISITE KNOWLEDGE:

Knowledge to plot points and lines on a Cartesian plane.

Any point on the perpendicular bisector of a line segment will be equidistant from their end points

MATERIAL REQUIRED:

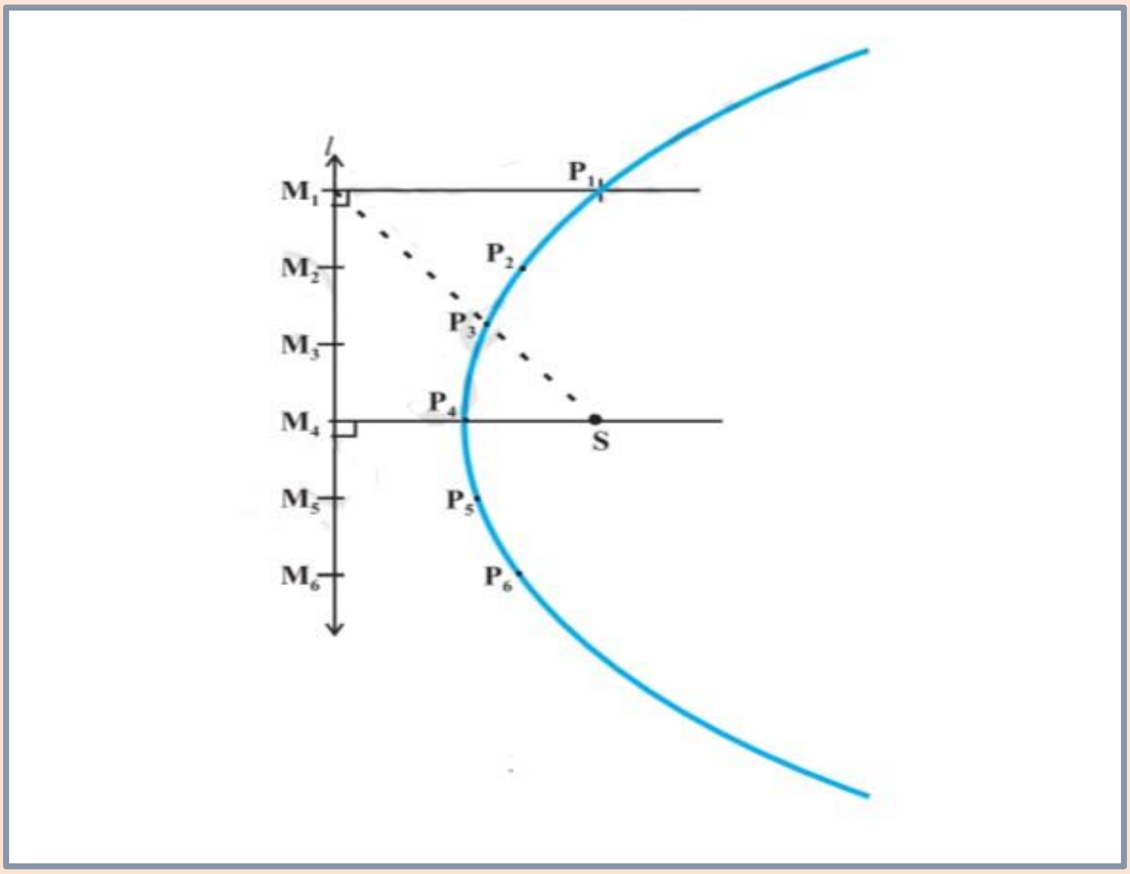
- A Piece of chart paper preferably A4 size,
- Sketch pen,
- Pencil,
- Compass,
- Ruler etc..

METHOD OF CONSTRUCTION:

- Take a white chart paper sheet
- Mark a point S on the white paper
- Through S draw a line. Draw another line l perpendicular to the line through S at some distance k units to the left of S.

- Take any point M1 on the line l. Draw the perpendicular to l at this point.
- Join M1 S and draw perpendicular bisector of M1 S meeting the perpendicular through M1 at the point P1.
- Take another point M2 on the line l and repeat the process as explained in (5) above to obtain the point P2.
- Take some more points M3, M4, M5, on the line l and repeat the above process to obtain points P3, P4, P5... respectively.
- Draw a free hand curve through the points P1, P2, P3, P4, ...

DEMONSTRATION:



The points P1, P2, P3, ... are such that the distance of each point from the fixed-point S is same as the distance of the point from the line l. So, the free hand curve drawn through these points is a parabola with focus S and directrix l.

OBSERVATION:

- ✓ P1M1 = ________ P1 S = _________
- ✓ P2M2 = ________ P2 S = _________
- ✓ P3M3 = ________ P3 S = _________
- ✓ P4M4 = ________ P4 S = _________
- ✓ P5M5 = ________ P5 S = _________
- ✓ The distance of the point P1 from M1 = The distance of P1 from _______.
- ✓ The distance between the points P2 and M2 = The distance of P2 from _______.
- ✓ The distance of the point _______ from M3 = The distance of the point P3 from ______.
- ✓ Distances of the points P1 , P2 , P3 .... from the line l are ______ to the distances of these points from the point S.
- ✓ Therefore, the free hand curve obtained by joining P1 , P2 , P3 , ... is a _______ with directory _________ and focus _______.
- ✓ Distance of the vertex P4 and S = ______.
- ✓ Distance of the vertex of parabola from the directrix = ______.

APPLICATION:

- This activity is useful in understanding how a parabola is constructed, The definition of the Parabola
- The activity helps to understand the terms Focus, Directrix and Vertex
- The concept of Parabola is used in the area of Architectural and engineering applications and various other fields

CONCLUSION:

By completing this activity, students will gain hands-on experience in constructing a parabola and understanding its properties. They will develop skills in geometric construction and deepen their understanding of the relationship between algebra and geometry.

LEARNING OUTCOMES:

- The students are able to understand the definition of the figure parabola
- The students are able to understand how to construct a parabola and they develop the skill of constructing geometric figures
- They get the knowledge about the terms focus, directrix, vertex etc

SOURCES OF ERROR AND PRECAUTIONS:

- Plotting the lines which are parallel and perpendicular
- The angle bisector should be plotted carefully.
- Joining the points with curves neatly.

VIVA QUESTIONS ANSWERS

1 What is conic section?

Answer: A conic section is the curve obtained by the intersection of a cone and a plane

2 Are focus and vertex same?

Answer: Vertex and focus are not same. One is the fixed point and the other one is the length between end point of the conic and centre

3 Define a parabola?

Answer: Parabola is a figure obtained by intersection of a cone with a plane parallel to its side

4 What is the diretrix of a Parabola?

Answer: A Parabola is the figure obtained by joining the points in the plane such a way that the distance from a fixed point is equal to the distance from a fixed line called diretrix

5 What is mean by focus?

Answer: The fixed point mentioned above is called focus

6 What is the standard equation of a Parabola?

Answer: $y^2 = 4ax$

7 For a point on the Parabola, what is the relation between distance from focus and distance from Directrix? Answer: Equal

8 Name any two Conic Sections other than Parabola?

Answer: Ellipse and Hyperbola

9 What is the focus of the Parabola $y^2 = 16x$ Answer: (4, 0)

10 If (5,0) is the focus of the parabola what is the equation of directrix

Answer: $x + 5=0$

11 What is mean by latus rectum of a parabola?

Answer: It is the line segment drown perpendicular from one end to the other end through focus

12 What is the length of latus rectum of the parabola $y^2 = 4ax$?

Answer: 4a

ACTIVITY – 15

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ARMY CANTT PANGODE
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NAME OF THE ACTIVITY: THE SAMPLE SPACE WHEN A DIE IS ROLLED ONCE, TWICE …

OBJECTIVE:

- To define and understand the concept of sample space in the context of rolling a die.
- To construct the sample space for rolling a die once and explore the outcomes.
- To extend the concept to rolling a die multiple times, analysing how the sample space expands with each roll.

PRE-REQUISITE KNOWLEDGE:

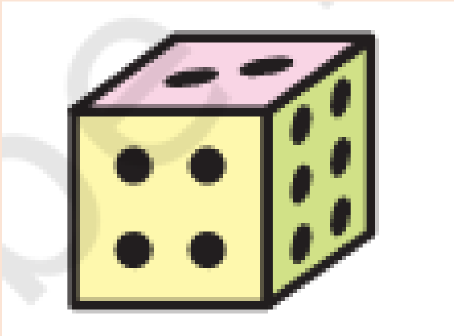
Random experiments, Outcomes of random experiments, Sample space

MATERIAL REQUIRED:

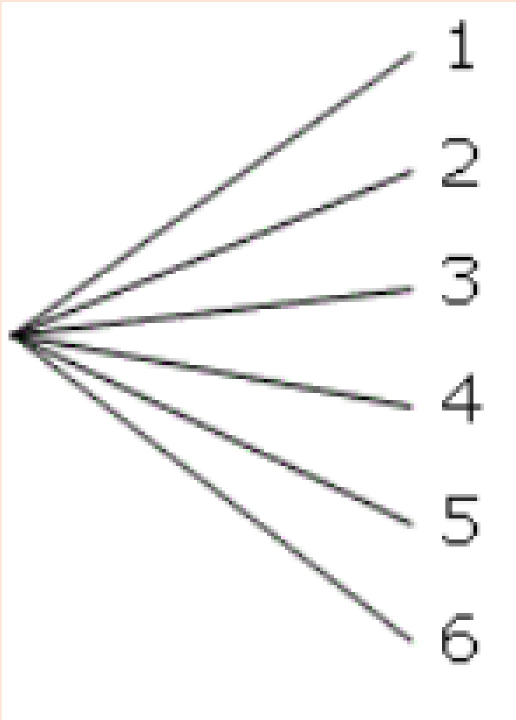
- A die
- Paper
- Pencil
- Scale
- Colour pencils
- Plastic discs marked with 1,2,3,4,5,6
- Drawing board

METHOD OF CONSTRUCTION

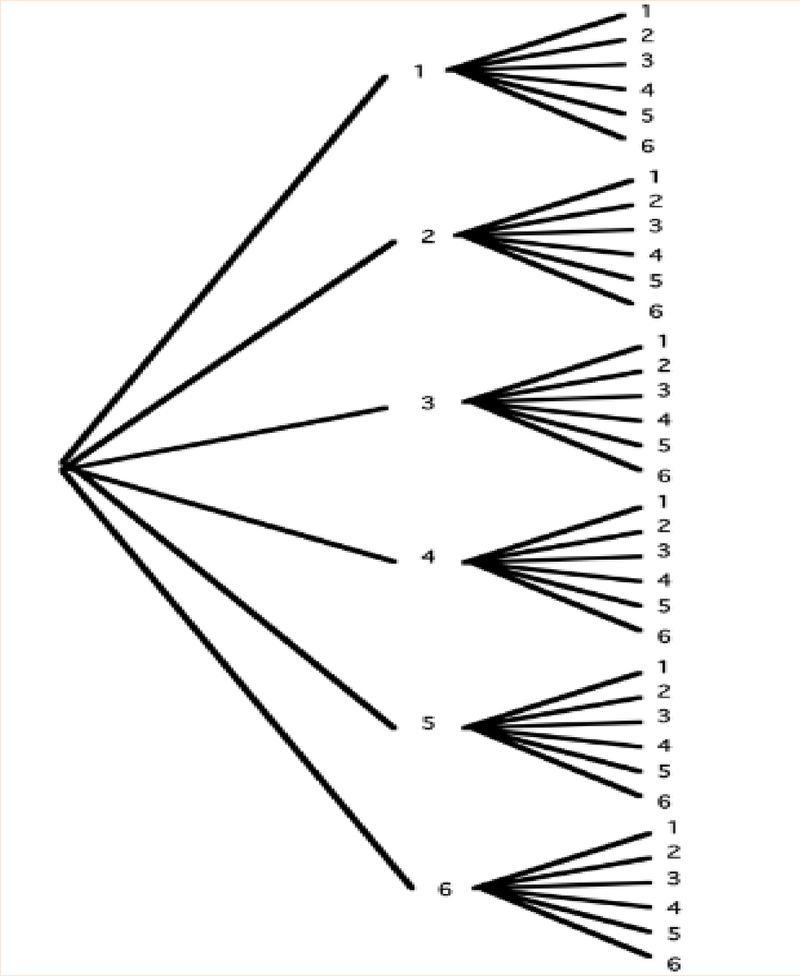
- Throw a die once . The number on its top will be 1,2,3,4,5 or 6.



- Make a tree diagram showing its six branches with number 1,2,3,4,5 or 6.



- Write the sample space of these outcomes.
- Throw the die twice. Draw the tree diagram. With the help of tree diagram write the sample space.



- Repeat the experiment by throwing a die 3 times, and write the sample space of the outcomes using a tree diagram.

DEMONSTRATION:

- If a die is thrown once, the sample space is S = {1,2,3,4,5,6 }
- Number of outcomes in the sample space = 6
- If a die is thrown twice the sample space is

S = { (1,1),(1,2),(1,3),(1,4),(1,5),(1,6), (2,1),(2,2),(2,3),(2,4), (2,5),(2,6),

(3,1),(3,2),(3,3),(3,4), (3,5),(3,6),(4,1),(4,2),(4,3),(4,4), (4,5),(4,6),

(5,1),(5,2),(5,3),(5,4).(5,5),(5,6),(6,1),(6,2),(6,3), (6,4),(6,5),(6,6)}

- Number of outcomes in the sample space = 36= 6^2
- Repeat the experiment by throwing the die thrice

The number of outcomes in the sample space = 216 = 6^3 and so on

OBSERVATION:

- ✓ Number of elements in sample space when a die is thrown
- ✓ Once = _________,
- ✓ Twice = -----------
- ✓ Thrice = _______,
- ✓ Four times = ________

APPLICATION:

Sample space of an experiment is useful in determining the probabilities of different events associated with the sample space

CONCLUSION:

- By completing this activity, students will gain a comprehensive understanding of the sample space in probability theory, specifically in the context of rolling a die. They will learn to construct and visualize sample spaces for single and multiple rolls, enhancing their problem-solving skills and foundational knowledge in probability.
- When a die is thrown n times the number of observations on the sample space is 6^n.

LEARNING OUTCOMES:

To understand the outcomes and number of outcomes in the sample space of the random experiments when a die is thrown once, twice … and application of it solving problems related to probability.

SOURCES OF ERROR AND PRECAUTIONS:

- Dice should be unbiased.
- Note the observations carefully.

VIVA QUESTIONS AND ANSWERS

1. The number of outcomes in the sample space when a coin is tossed 5 times

   Answer: 2^5 =32

2. One card is drawn from a well shuffled pack of 52 cards, find the probability of getting a Diamond

   Answer: $\frac{13}{52} = \frac{1}{4}$

3. From 20 cards ,2 cards are drawn at random then the number of outcomes in the sample space is

   Answer: $20C_2 = 190$

4. A die is rolled. Let E be the event "die shows 4" and F be the event "die shows even number ". Are E and F mutually exclusive?

   Answer: No

5. The sample space of the random experiment of tossing a coin and a die together

   Answer: { H1,H2,H3,H4,H5,H6,T1,T2,T3,T4,T5,T6}

6. The number of outcomes of a random experiment of drawing 3 cards from 10 cards

   Answer: $10C_3$ =120

7. If P(A) = $\frac{5}{11}$ then P (not A) is

   Answer: $\frac{6}{11}$

8. In a single throw of two dice, find the probability of obtaining a sum 8

   Answer: $\frac{5}{36}$

9. A die is rolled and then a coin is tossed only in case an even number shown on the die. Write the sample space

   Answer: {1,3,5,2H,2T,4H,4T,6H,6T}

10. If A and B are two mutually exclusive events then $P(A \cap B)$ is

    Answer: 0