Activity 21

Objective

To construct different types of conic sections.

Material Required

Transparent sheet, scissors, hard-board, adhesive, white paper.

Method of Construction

1. Take a hardboard of convenient size and paste a white paper on it.
2. Cut a transparent sheet in the shape of sector of a circle and fold it to obtain a right circular cone as shown in Fig.21.1.
3. Form 4 more such cones of the same size using transparent sheet. Put these cones on a hardboard.
4. Cut these cones with a transparent plane sheet in different positions as shown in Fig. 21.2 to Fig. 21.5.

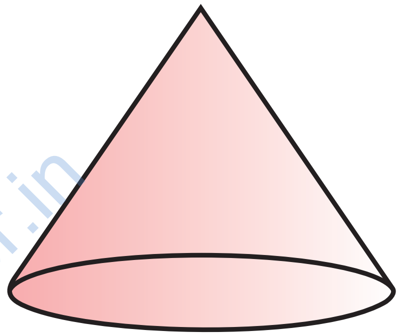

Fig 21.1

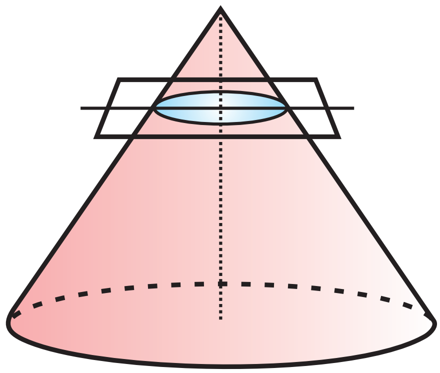

Fig 21.2

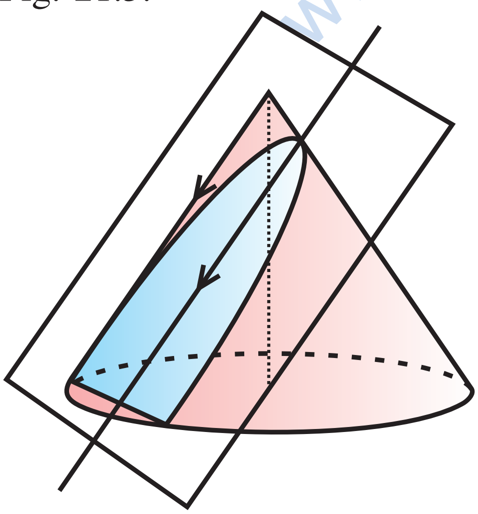

Fig 21.4

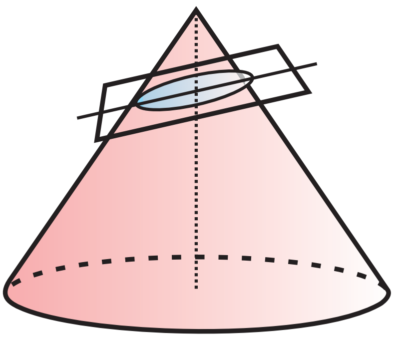

Fig 21.3

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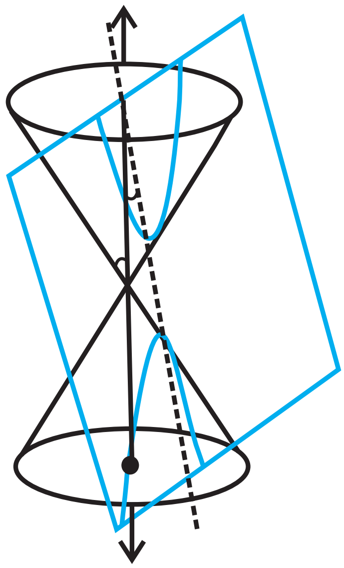

Fig 21.5

Demonstration

1. In Fig. 21.2, the transparent plane sheet cuts the cone in such a way that the sheet is parallel to the base of the cone. The section so obtained is a circle.
2. In Fig. 21.3, the plane sheet is inclined slightly to the axes of the cone. The section so obtained is an ellipse.
3. In Fig. 21.4, the plane sheet is parallel to a generator (slant height) of the cone. The section so obtained is a parabola.
4. In Fig. 21.5 the plane is parallel to the axis of the cone. The sections so obtained is a part of a hyperbola.

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Observation

1. In Fig. 21.2, the transparent plane sheet is _______ to the base of the cone. The section obtained is ______.
2. In Fig. 21.3, the plane sheet is inclined to _______. The conic section obtained is __________.
3. In Fig. 21.4, the plane sheet is parallel to the __________. The conic section so obtained is _______.
4. In Fig. 21.5, the plane sheet is _________ to the axis. The conic section so obtained is a part of _______.

APPLICATION

This activity helps in understanding various types of conic sections which have wide spread applications in real life situations and modern sciences. For example, conics have interesting geometric properties that can be used for the reflection of light rays and beams of sound, i.e.

1. Circular disc reflects back the light issuing from centre to the centre again.
2. Elliptical disc reflects back the light issuing from one focus to the other focus.
3. Parabolic disc reflects back the light issuing from one focus parallel to its axis.
4. Hyperbolic disc reflects back the light issuing from one focus as if coming from other focus.

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Activity 22

Objective

To construct a parabola.

Material Required

Cardboard, white paper, sketch pen, pencil, compass, ruler etc.

Method of Construction

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Mark a point S on the white paper on the board (see Fig. 22).
3. 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.

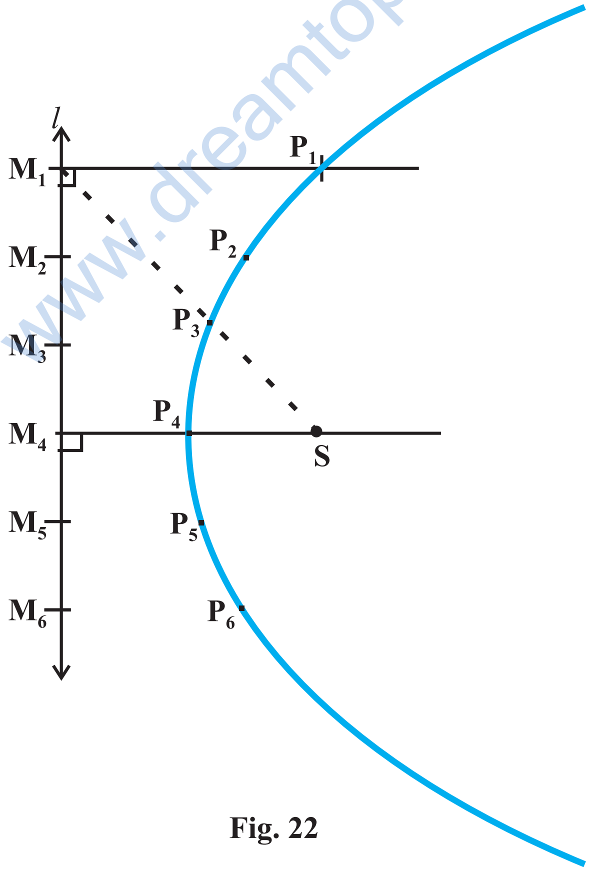

Fig. 22

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4. Take any point M_1 on the line l. Draw the perpendicular to l at this point.
5. Join M_1S and draw perpendicular bisector of M_1S meeting the perpendicular through M_1 at the point P_1.
6. Take another point M_2 on the line l and repeat the process as explained in (5) above to obtain the point P_2.
7. Take some more points M_3, M_4, M_5, ... on the line l and repeat the above process to obtain points P_3, P_4, P_5, ..., respectively.
8. Draw a free hand curve through the points P_1, P_2, P_3, P_4, ... (see Fig. 22)

Demonstration

The points P_1, P_2, P_3, ... 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

1. P_1M_1 = ________ P_1S = __________
2. P_2M_2 = ________ P_2S = __________
3. P_3M_3 = ________ P_3S = __________
4. P_4M_4 = ________ P_4S = __________
5. P_5M_5 = ________ P_5S = __________
6. The distance of the point P_1 from M_1 = The distance of P_1 from _______.
7. The distance between the points P_2 and M_2 = The distance of P_2 from _______.

   The distance of the point _______ from M_3 = The distance of the point P_3 from ______.
8. Distances of the points P_1, P_2, P_3 .... from the line l are ______ to the distances of these points from the point S.
9. Therefore, the free hand curve obtained by joining P_1, P_2, P_3, ... is a _______ with directrix _________ and focus _______.

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10. Distance of the vertex P_4 and S = ______.

11. Distance of the vertex of parabola from the directrix = ______.

APPLICATION

1. This activity is useful in understanding the terms related to parabola, like directrix, focus, property of the point on the parabola.
2. Parabolas have applications in Science and Engineering.

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Activity 23

Objective

An alternative method of constructing a parabola.

Material Required

Cardboard, white paper, sketch pen, pencil, compasses, ruler, nails, thread.

Method of Construction

1. Take a cardboard of a convenient size and paste a white paper on it.
2. Take any point S on the white paper fixed on the cardboard.
3. Draw a line through S.
4. Draw another line l perpendicular to the line through S at a distance of k units to the left of S. Let the two lines meet at the point C.

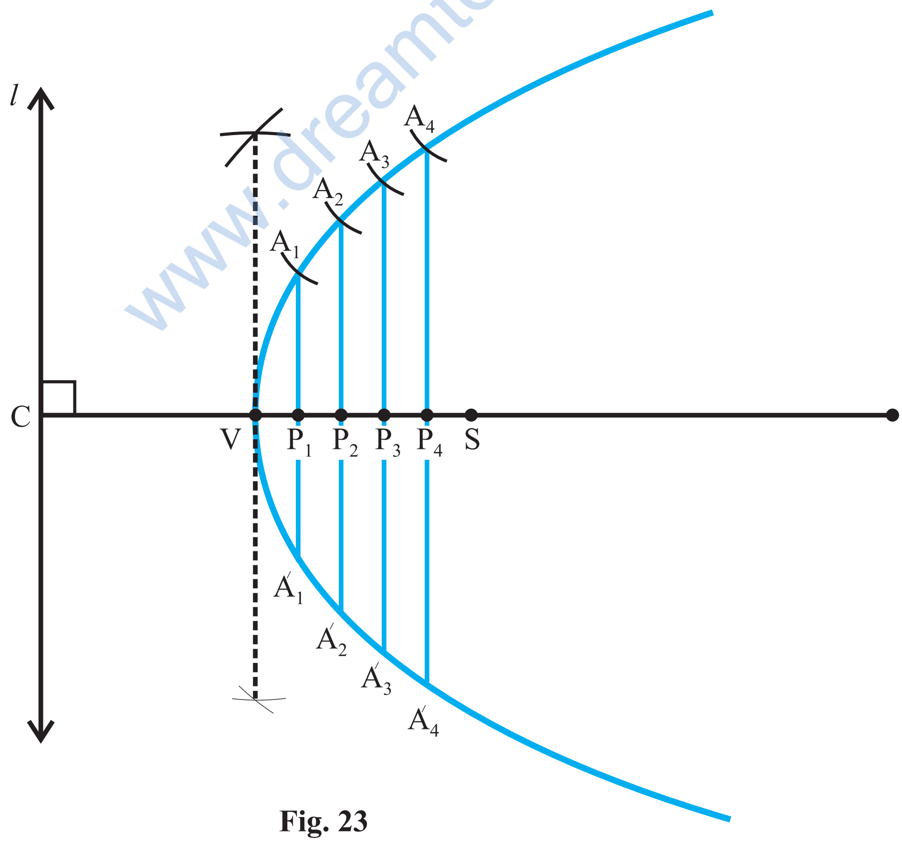

Fig. 23

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5. Bisect CS at the point V.
6. Mark the points P_1, P_2, P_3, ... on VS and draw perpendiculars through these points as shown in the Fig. 23.
7. Take S as centre and radius equal to CP_1, draw an arc cutting the perpendicular through P_1 at the point A_1 and A_1'. Similarly with S as the centre and CP_2 as radius, obtain points A_2 and A_2'. Repeat this process for some more points P_3, P_4, ... and obtain points A_3 and A_3', A_4 and A_4';...
8. Fix nails at these points, i.e., A_1, A_2, ... A_1', A_2', ... and join the foot of the nails by a thread to get a curve as shown in the figure.

Demonstration

Distance of the point A_1 from $l = CP_1 = SA_1$
Similarly, distance of the point A_2 from $l = CP_2 = SA_2$
distance of the point A_3 from $l = CP_3 = SA_3$ and so on.

Also distance of the point A_1' from $l = CP_1 = SA_1'$

distance of the point A_2' from $l = CP_2 = SA_2'$ and so on.

Thus, every point on the curve is equidistant from the line l and the point S. So, the curve is a parabola, with focus S and directrix l.

Observation

By actual measurement

1. Distance of A_1 from l = __________, A_1S = _________.
2. Distance of A_2 from l = __________, A_2S = _________.
3. Distance of A_3 from l = __________, A_3S = _________.
4. Distance of A_4 from l = __________, A_4S = _________.
5. Distance of A_1' from l = __________, $A_1'S$ = _________.

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6. Distance of A_2' from l = __________, $A_2'S$ = _________.

7. Distance of A_3' from l = __________, $A_3'S$ = _________.

8. Distance of A_4' from l = __________, $A_4'S$ = _________.

9. Distance of any point on the curve from l = Distance of the point from ________.

10. So, the curve is _______ with directrix ________ and focus _________.

APPLICATION

1. This activity is useful in understanding the terms related to a parabola, such as directrix and focus of the parabola.

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Activity 24

OBJECTIVE

To construct an ellipse using a rectangle.

MATERIAL REQUIRED

A hardboard, white paper, coloured paper, nails, nylon wire/thread, ruler, adhesive.

METHOD OF CONSTRUCTION

1. Take a rectangular hardboard of a convenient size and paste a white paper on it.
2. Cut a rectangle MNBL of suitable dimensions from a coloured paper and paste it on the hardboard.
3. Divide this rectangle into four congruent rectangles as shown in the Fig.24.

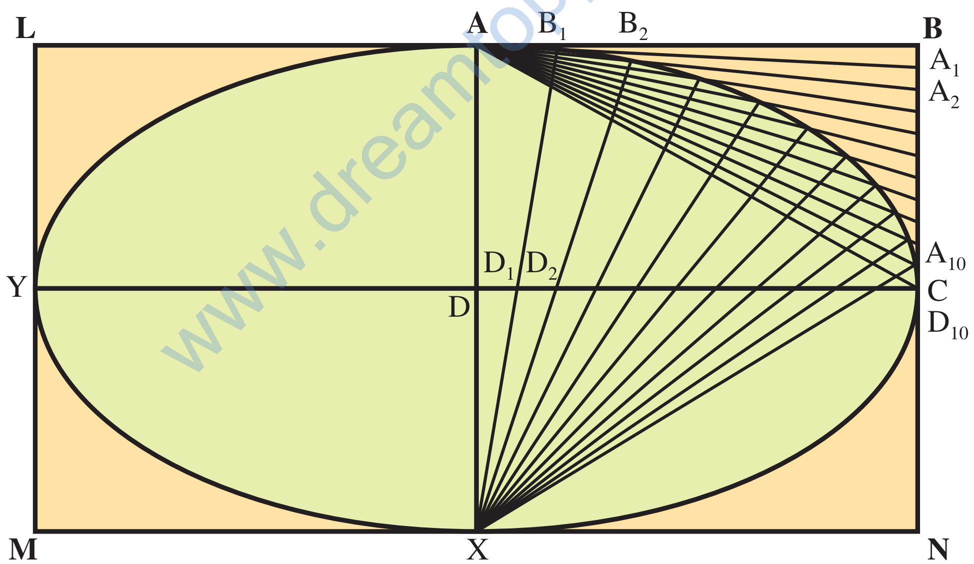

Fig. 24

4. Divide each of the sides BC and DC of the rectangle ADCB, into some equal parts, (say, 11)
5. Mark the point of subdivisions of BC as A_1, A_2, ... and that of DC as D_1, D_2, (See Fig. 24)

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6. Join the point A to points, A_1, A_2, ... and draw the lines joining the point X to D_1, D_2, ... (See Fig. 24)
7. Mark the point of intersection of AA_1 and XD_1 as B_1, AA_2 and XD_2 as B_2 and so on.
8. Fix nails at the points B_1, B_2, ..., B_{10}.
9. Join the feet of nails with a nylon wire/thread, as shown in the figure.
10. Repeat the same activity for remaining three congruent rectangles and obtain a curve as shown in Fig. 24.

Demonstration

The curve obtained looks like an ellipse. The major axis of this ellipse is the length of the rectangle MNBL and the minor axis of the ellipse is the breadth of the rectangle.

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Observation

1. Length of the rectangle MNBL = __________________.
2. Breadth of the rectangle MNBL = __________________.
3. Major axis of the ellipse is __________________.
4. Minor axis of the ellipse is __________________.

Application

This activity may be helpful in understanding the concept such as major and minor axis of an ellipse. It is also useful in drawing elliptical designs such as in swimming pools, tables, etc.

Activity 25

Objective

To construct an ellipse with given major and minor axes.

Material Required

A hardboard, white paper, nylon wire/thread, adhesive, chart paper.

Method of Construction

1. Take a rectangular sheet of a hardboard of a convenient size and paste a white paper on it.
2. Mark a point O on it and draw two concentric circles with centre O and radii as given semi-major and semi-minor axis of the ellipse. Mark one of the diameter of bigger circle as AOB and call it a horizontal line (see Fig. 25)

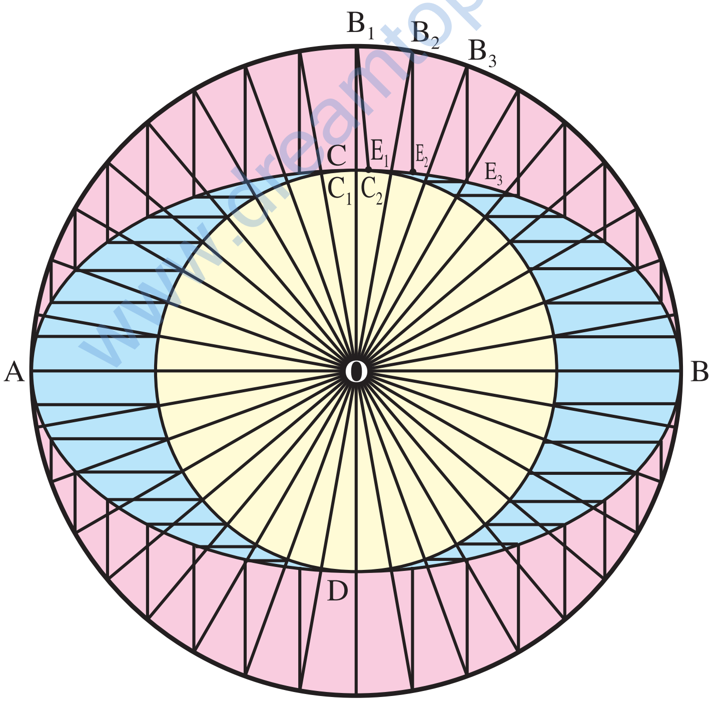

Fig. 25

3. Draw radii of the circles in such a way that the angle between two consecutive radii is the same, say 10º.

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4. Take any radius OB_1 of the bigger circle cutting the smaller circle at C_1. Draw a horizontal line through C_1 and draw a perpendicular (vertical line) from B_1 to this horizontal line and obtain point E_1 (see Fig. 25).
5. Repeat this process for all the radii OB_2, OB_3, and so on of the bigger circle and obtain the points E_2, E_3, ... and so on.
6. Fix the nails at the points E_1, E_2, E_3, ... and join the feet of the nails by a nylon wire/thread and obtain a curve (see Fig. 25).

Demonstration

1. The curve obtained looks like an ellipse.
2. Major axis of the ellipse is AOB and the minor axis of the ellipse is COD, where COD is the diameter of the smaller circle perpendicular to diameter AOB.

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Observation

1. OA = _______, OB = _________.
2. OC = _______, OD = _________.
3. Major axis of the ellipse _________, Minor axis of the ellipse = ________.
4. Points E_1, E_2, ... lie on ____________ .

Application

This activity may be used in constructing elliptical designs using thread work and also in explaining concepts such as major and minor axis of an ellipse.

Activity 26

OBJECTIVE

To construct an ellipse when two fixed points are given.

MATERIAL REQUIRED

Rectangular cardboard, coloured chart paper, nails, strings, pen, pencil.

METHOD OF CONSTRUCTION

1. Take a rectangular cardboard and paste a chart paper on it.
2. Draw a horizontal line on the chart paper and mark two fixed points F_1 and F_2 on it such that the distance between them is (say) 6 cm. Fix two nails at the points F_1 and F_2.
3. Take a string whose length is more than the distance between the two fixed points (say) 9 cm.

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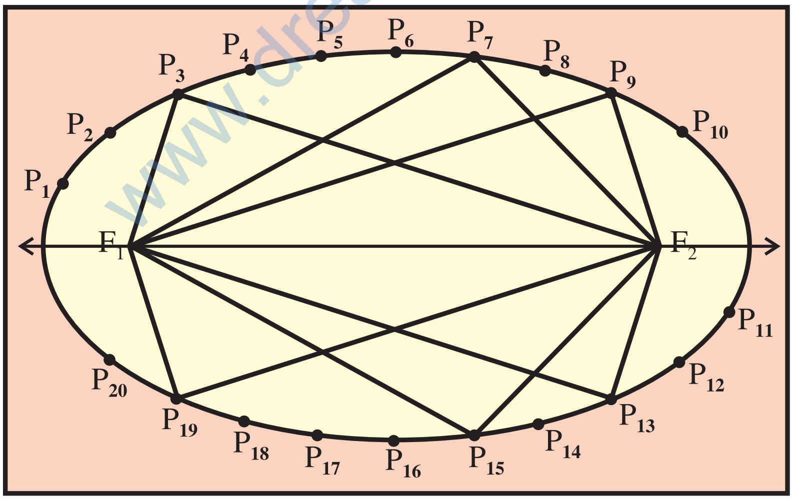

Fig. 26

DEMONSTRATION

1. Fix the two ends of the string at the two nails at F_1 and F_2.

2. With a pencil, stretch the string in the loop without slack and mark at least 10 points P_1, P_2, P_3, ..., etc., on both sides of the line segment joining F_1 and F_2.
3. Join all the points P_i, $i = 1, 2, \ldots 20$ to form an ellipse.

Observation

1. $P_1F_1 + P_1F_2 =$ ____ .
2. $P_2F_1 + P_2F_2 =$ ____ .
3. $P_3F_1 + P_3F_2 =$ ___ , $P_4F_1 + P_4F_2 =$ ___, $P_6F_1 + P_6F_2 =$ ___, $P_9F_1 + P_9F_2 =$ ___.
4. $P_3F_1 + P_3F_2 =$ ____ $+ P_4F_2 = P_{19}F_1 +$ ____.
5. Sum of the distances of each of the points P_1, P_2, P_3,... from the points F_1 and F_2 is _______.

   So, the curve obtained is an ________.

Application

This activity can be used to explain the property of an ellipse , i.e., the sum of the distances of any point on the ellipse from its two focie is constant and is equal to length of major axis.

Note

Construct another ellipse by taking different length of the string and also by changing the distance between F_1 and F_2.

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Activity 27

Objective

To explain the concept of octants by three mutually perpendicular planes in space.

Material Required

A piece of plywood, saw, wires, rulers wooden-board, coloured papers, scissors, cutter, thin sheet of wood, wires.

Method of Construction

1. Cut out three square sheets each of size 30 cm × 30 cm from a piece of plywood and paste chart paper of different colours on both sides of sheets.
2. Fix two sheets in such a way that they intersect orthogonally in the middle of each other (see Fig. 27)
3. Cut the third sheet into two equal rectangles.

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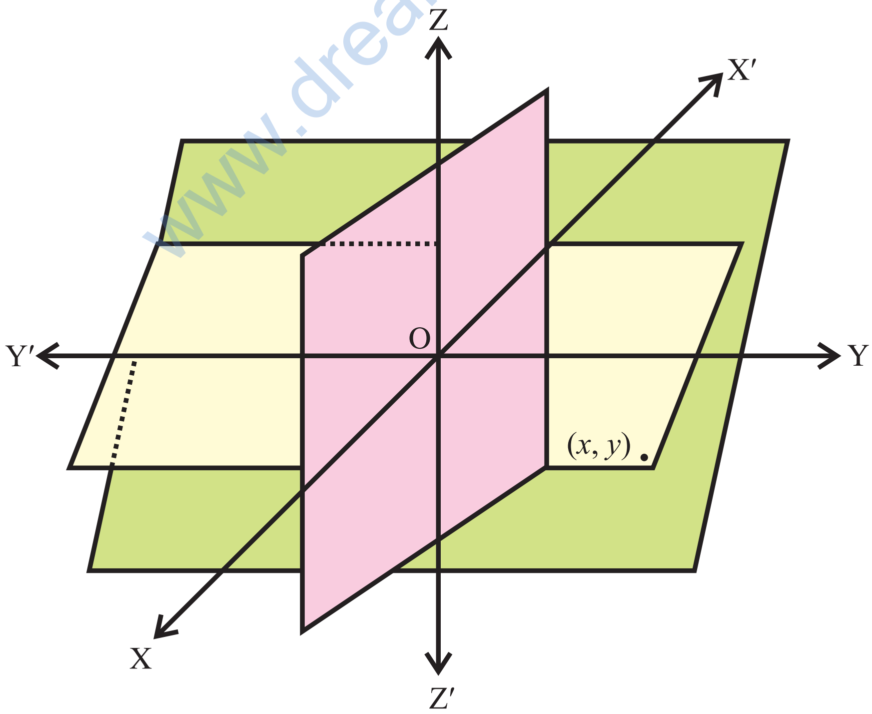

Fig. 27

4. Insert one rectangle from one side in the middle cutting the two orthogonally, and the other rectangle from the other side (see Fig. 27). The space is divided into eight parts by these three sheets. Each part is referred to as an octant.
5. Fix the model on a wooden board.
6. In one of the octants, fix rulers to represent x-axis, y-axis and z-axis. Extend each of the axis piercing to other sides to represent XX', YY' and ZZ'. Mark the point of intersection of XX', YY' and ZZ' as origin O.

Demonstration

1. Fix a rod perpendicular to xy-plane at a point P (x, y) and parallel to z-axis.
2. Fix a wire joining the origin to the upper tip P′ (x, y, z) of this perpendicular rod.
3. The distance of point P on xy-plane with coordinates (x, y) from the origin is $\sqrt{x^2+y^2}$.
4. The distance of P′ with coordinates (x, y, z) in space from the origin is $\sqrt{\left(\sqrt{x^2+y^2}\right)^2+z^2}=\sqrt{x^2+y^2+z^2}$.

Observation

1. The three planes are intersecting at right angles at a point and they divide the space into ___________ parts. Each part is called an ___________.
2. Distance of the point (5, 4) on the xy plane from origin is _______.
3. Distance of the point (3, 2, 1) from the origin is _______.
4. If we fix a wire perpendicular to any of the planes, then it will represent ___________ to plane.
5. If two normals are drawn to any two of the planes, then these normals are _______ to each other.

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APPLICATION

1. Model can be used to visualise the position and coordinates of a point in space.
2. Model can be used to explain the distance of the origin from a point in the plane or in the space.
3. Model can also be used to explain the concept of a normal to a plane.

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Activity 28

OBJECTIVE

To find analytically $\lim_{x \to c} f(x) = \dfrac{x^2 - c^2}{x - c}$

MATERIAL REQUIRED

Pencil, white paper, calculator.

METHOD OF CONSTRUCTION

1. Consider the function f given by $f(x) = \dfrac{x^2 - 9}{x - 3}$
2. In this case $c = 3$ and the function is not defined at $x = 3$.

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DEMONSTRATION

1. Take some values of c less than $c = 3$ and some other values of c more than $c = 3$.
2. In both cases, the values to be taken have to be very close to $c = 3$.
3. Calculate the corresponding values of f at each of the values of c taken close to $c = 3$.

DEMONSTRATION : TABLE 1

1. Write the values of $f(x)$ in the following tables:

Table 1

x	2.9	2.99	2.999	2.9999	2.99999	2.999999
$f(x)$	5.9	5.99	5.999	5.9999	5.99999	5.999999

Table 2

x	3.1	3.01	3.001	3.0001	3.00001	3.000001
$f(x)$	6.1	6.01	6.001	6.0001	6.00001	6.000001

Observation

1. Values of $f(x)$ as $x \to 3$ from the left, as in Table 1 are coming closer and closer to _____.
2. Values of $f(x)$ as $x \to 3$ from the right, as in Table 2 are coming closer and closer to _____ from tables (2) and (3), $\lim_{x\to 3} f(x) = \dfrac{x^2-9}{x-3} =$ ______.

Application

This activity can be used to demonstrate the concept of a limit $\lim_{x\to c} f(x)$ when $f(x)$ is not defined at $x = c$.

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Activity 29

Objective

Verification of the geometrical significance of derivative.

Material Required

Graph sheets, adhesive, hardboard, trigonometric tables, geometry box, wires.

Method of Construction

1. Paste three graph sheets on a hardboard and draw two mutually perpendicular lines representing x-axis and y-axis on each of them.
2. Sketch the graph of the curve (circle) $x^2 + y^2 = 25$ on one sheet.
3. On the other two sheets sketch the graphs of $(x-3)^2 + y^2 = 25$ and the curve $xy = 4$ (rectangular hyperbola).

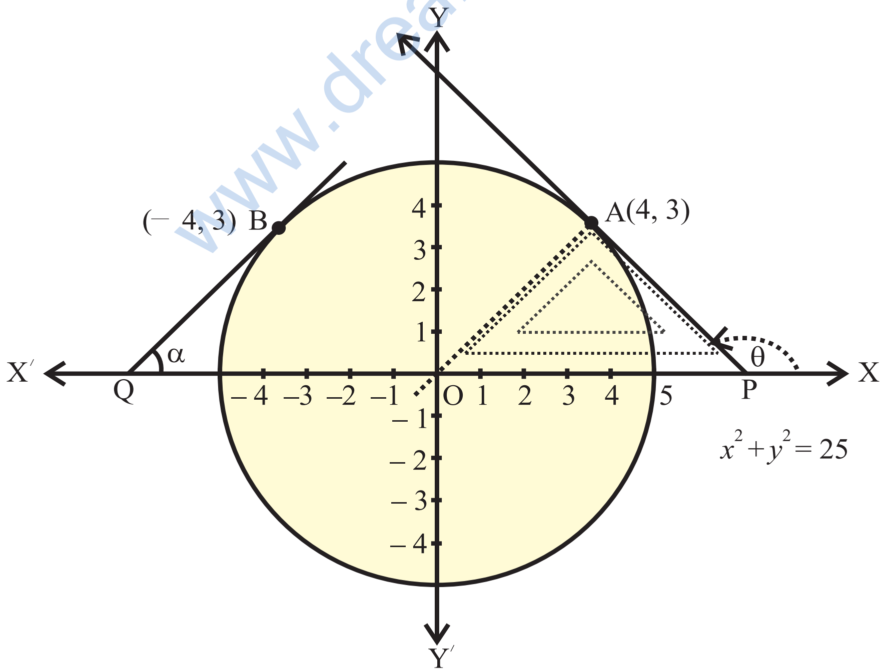

Fig. 29.1

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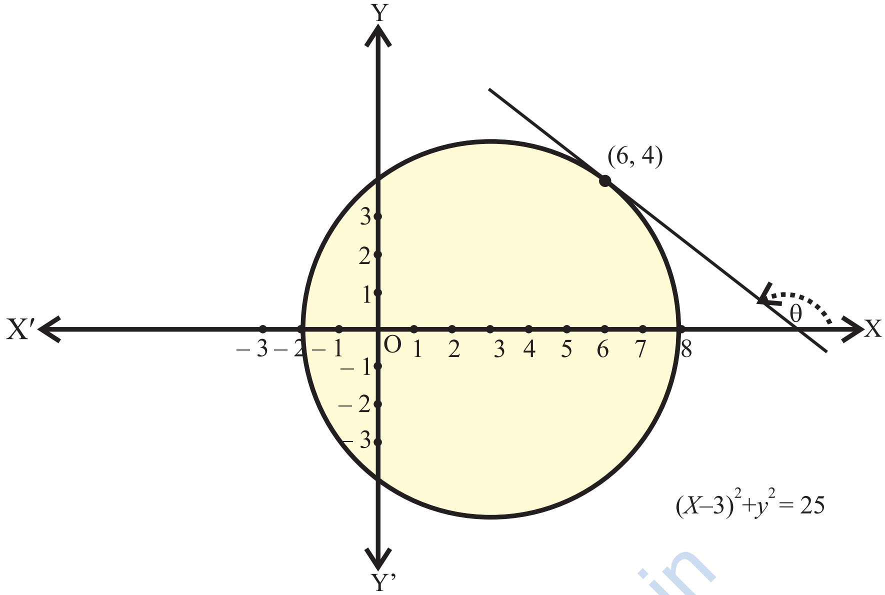

Fig 29.2

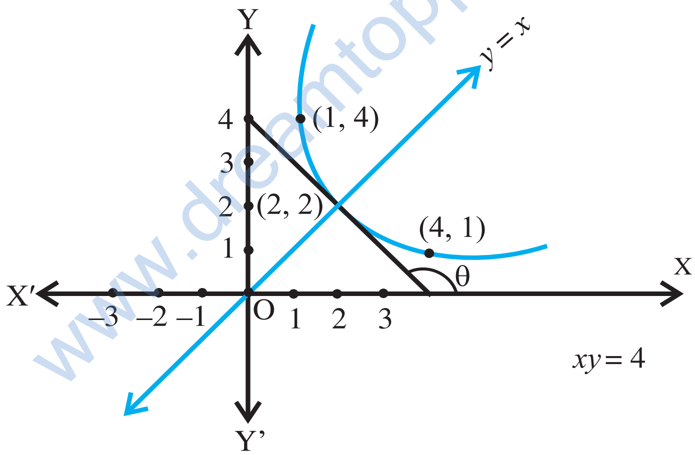

Fig. 29.3

DEMONSTRATION

1. Take first sheet on which, the graph of the circle $x^2 + y^2 = 25$ has been drawn (see Fig.29.1.
2. Take a point A (4, 3) on the circle.
3. With the help of a set square, place a wire in the direction OA and other perpendicular to OA at the point A to meet *x*-axis at a point (say P).

4. Measure the angle between the wire and the positive direction of x-axis at P (say θ).
5. Then find $\tan\theta$ (with the help of trigonometric tables)

   Now, $x^2 + y^2 = 25 \Rightarrow y = \sqrt{25 - x^2} \Rightarrow \frac{dy}{dx} = \frac{-x}{\sqrt{25 - x^2}}$.

   Find $\frac{dy}{dx}$ at the point (4, 3) and verify that $\left(\frac{dy}{dx}\right)$ at (4, 3) = $\tan\theta$.
6. Similarly, take another point (– 4, 3) on the circle. Verify that $\frac{dy}{dx}$ at (– 4, 3) = $\tan\alpha$ where α is the angle made by the tangent to the circle at the point (– 4, 3) with the positive direction of x-axis. (see Fig. 29.1).
7. Take other sheet with the graph of $(x - 3)^2 + y^2 = 25$ and take the point (6,4) on it and repeat the above process using set square and wires as shown in Fig. 29.2, i.e. verify that $\frac{dy}{dx}$ at (6, 4) = $\tan\theta$.
8. Now take the third sheet, showing the graph of the curve $xy = 4$. Take the point (2, 2) on it. Place one perpendicular side of set square along the line $y = x$ and a wire along the other side touching the curve at the point (2, 2) and find the angle made by the wire with the positive direction of x-axis as shown in Fig. 29.3. Let it be θ. Verify that $\frac{dy}{dx}$ at (2, 2) = $\tan\theta$.

OBSERVATION

1. For the curve $x^2 + y^2 = 25$, $\frac{dy}{dx}$ at the point (3, 4) = ________. Value of θ = ______ $\tan\theta$ = ________ $\frac{dy}{dx}$ at (3, 4) = _________.

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2. For the curve $x^2 + y^2 = 25$, $\frac{dy}{dx}$ at $(-4, 3)$ = ________, $\tan\alpha$ = ________

, $\frac{dy}{dx}$ at $(-4, 3)$ = ________.

3. For the curve $(x-3)^2 + y^2 = 25$, $\frac{dy}{dx}$ at $(6, 4)$ = _____ , value of θ = _______,

$\tan\theta$ = ______, $\frac{dy}{dx}$ at $(6, 4)$ = ________.

4. For the curve $xy = 4$, $\left(\frac{dy}{dx}\right)$ at $(2, 2)$ = ______,

θ = ____, $\tan\theta$ = ______.

NOTE

The activity may be repeated by taking point (4, 3) on first sheet, (0, 4) on second sheet and (1, 4) on the third sheet.

APPLICATION

Same activity can be used to verify the result that the slope of the tangent at a point is equal to the value of the derivative at that point for other curves.

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Activity 30

Objective

To obtain truth values of compound statements of the type $p \vee q$ by using switch connections in parallel.

Material Required

Switches, electric wires, battery and lamp/bulb.

Method of Construction

1. Connect switches S_1 and S_2 in parallel (See Fig. 30).
2. Connect battery and lamp so as to complete the circuit as shown in the figure.

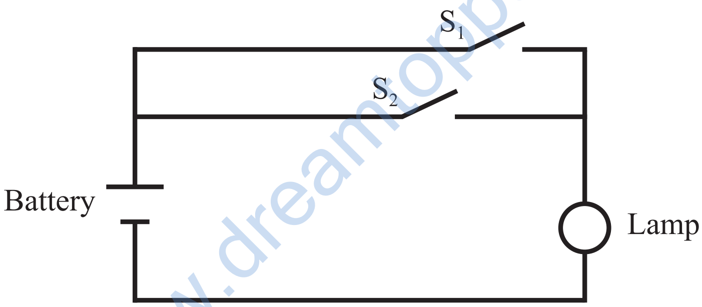

Fig. 30

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Demonstration

1. The lamp will glow if atleast one of switches S_1, S_2 is on. This gives the following results:

Switch S_1	Switch S_2	Status of lamp
on	off	glow
off	on	glow
off	off	not glow
on	on	glow

Let p and q represent the statements as follows:

p : S_1 is on, truth value of p is T.

$\sim p$: S_1 is off, truth value of p is F.

q : S_2 is on, truth value of q is T.

$\sim q$: S_2 is off, truth value of q is F.

When the lamp glows, truth value of $p \vee q$ is T. When the lamp does not glow, truth value of $p \vee q$ is F. Thus, from the circuit, the following table gives the truth value of $p \vee q$:

p	q	$p \vee q$
T	F	T
F	T	T
F	F	F
T	T	T

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Observation

1. If S_1 is on, truth value of p is ________________.

   If S_1 is off, truth value of p is ________________.

   If S_2 is on, truth value of q is ________________.

   If S_2 is off, truth value of q is ________________.

2. If S_1 is on, S_2 is off, truth value of $p \vee q$ is _________.

   If S_1 is on, S_2 is on, truth value of $p \vee q$ is _________.

   If S_1 is off, S_2 is off, truth value of $p \vee q$ is _________.

   If S_1 is off, S_2 is on, truth value of $p \vee q$ is _________.

   If S_1 is ______, S_2 is _____, truth value of $p \vee q$ is T.

Application

This activity helps in understanding truth values of the statements $p \vee q$ in different cases of the statements p and q.

Activity 31

Objective

To obtain truth values of compound statements of the type $p \wedge q$ by using switch connections in series.

Material Required

Switches, electric wires, battery and lamp/bulb.

Method of Construction

1. Connect switches S_1 and S_2 in series (See Fig. 31)
2. Connect battery and lamp so as to complete the circuit as shown in the figure.

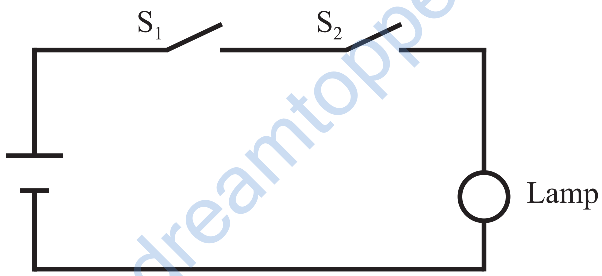

Fig. 31

Demonstration

1. The lamp will glow if both the switches S_1 and S_2 together are on. This gives the following results :

Switch S_1	Switch S_2	Status of lamp
on	off	not glow
on	on	glow
off	on	not glow
off	off	not glow

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Let p and q represent the statements as follows :

p : S_1 is on, truth value of p is T.

$\sim p$: S_1 is off, truth value of p is F.

q : S_2 is on, truth value of q is T.

$\sim q$: S_2 is off, truth value of q is F.

When the lamp glows, truth value of $p \wedge q$ is T. When the lamp does not glow, truth value of $p \wedge q$ is F. Thus, from the circuit, the following table gives the truth values of $p \wedge q$.

p	q	$p \wedge q$
T	T	T
F	T	F
T	F	F
F	F	F

Observation

1. If S_1 is on, truth value of p is _______________.

   If S_1 is off, truth value of p is _______________.

   If S_2 is on, truth value of q is _______________.

   If S_2 is off, truth value of q is _______________.

2. If S_1 is on, S_2 is off, truth value of $p \wedge q$ is ________.

   If S_1 is on, S_2 is on, truth value of $p \wedge q$ is ________.

   If S_1 is off, S_2 is off, truth value of $p \wedge q$ is ________.

   If S_1 is off, S_2 is on, truth value of $p \wedge q$ is ________.

   If S_1 is _____, S_2 is ____, truth value of $p \wedge q$ is T.

Application

This activity may help the students in understandig truth values of the statements $p \wedge q$ in different cases of the statements p and q.

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Activity 32

Objective

To write the sample space, when a die is rolled once, twice --------

Material Required

A die, paper, pencil/pen, plastic discs, marked with 1, 2, 3, 4, 5 or 6.

Method of Construction

1. Throw a die once. The number on its top will be 1, 2, 3, 4, 5 or 6.
2. Make a tree diagram showing its six branches with number 1,2, 3, 4, 5 or 6 (See Fig. 32.1)
3. Write the sample space of these outcomes.
4. Throw a die twice. It can fall in any of the 36 ways as shown in Fig. 32.2 by the tree diagram. Write the sample space of these outcomes.

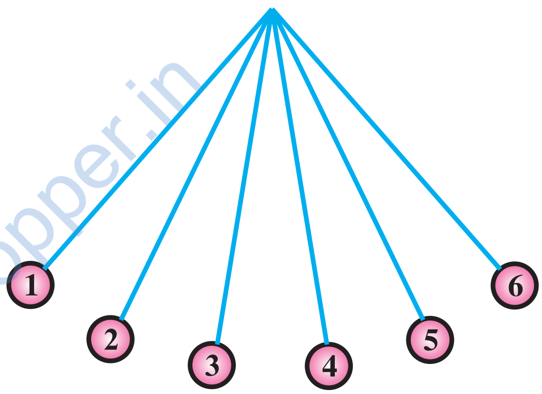

Fig 32.1

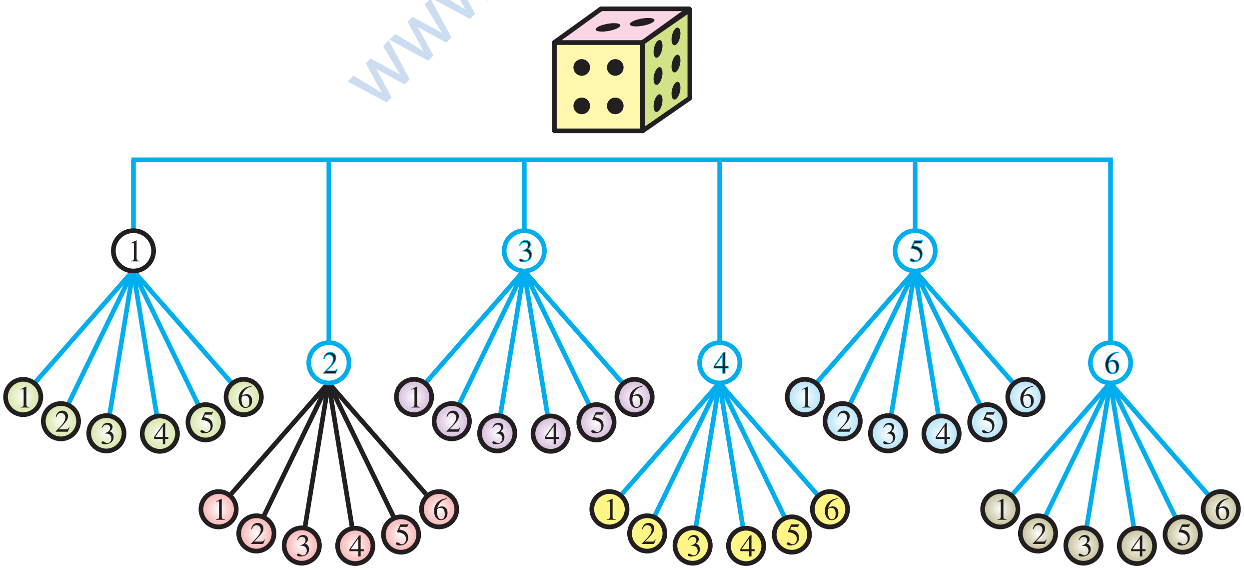

Fig 32.2

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

DEMONSTRATION

1. If a die is thrown once, the sample space is

$$S = \{1, 2, 3, 4, 5, 6\}. \text{ Number of elements in } S = 6 = 6^1$$

2. If a die is thrown twice, the sample space is

$$\text{Sample space } S = \begin{Bmatrix} (1,1),(1,2),(1,3),(1,4),(1,5),(1,6),(2,1),(2,2),(2,3),(2,4),(2,5),(2,6) \\ (3,1),(3,2),(3,3),(3,4),(3,5),(3,6),(4,1),(4,2),(4,3),(4,4),(4,5),(4,6) \\ (5,1),(5,2),(5,3),(5,4),(5,5),(5,6),(6,1),(6,2),(6,3),(6,4),(6,5),(6,6) \end{Bmatrix}$$

The number of elements in S = 36 = 6^2 and so on.

OBSERVATION

Number of elements in sample space when a die is thrown

Once = __________, Thrice = ________, Four times = __________

APPLICATION

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

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Activity 33

Objective

To write the sample space, when a coin is tossed once, two times, three times, four times.

Material Required

One rupee coin, paper pencil/pen, plastic circular discs, marked with Head (H) and Tail (T).

Method of Construction

1. Toss a coin once. It can have two outcomes – Head or Tail.
2. Make a tree diagram showing the two branches of a tree - with H (Head) on one branch and T (Tail) on the other (see Fig. 33.1).
3. Write its sample space.
4. Toss a coin twice. It can have four outcomes (see Fig. 33.2)
5. Repeat the experiment with tossing the coin three times, four times, ..., *n* and write their sample spaces, if possible. (see Fig. 33.3 and 33.4).

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Demonstration

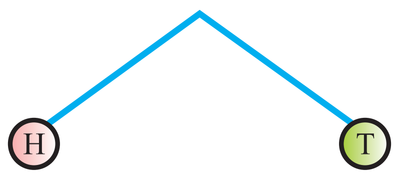

Fig. 33.1

1. If a coin is tossed once, the sample space is

$$S = \{H, T\}$$

Number of elements in $S = 2 = 2^1$

2. When a coin is tossed twice, the sample space is

$$S = \{HH, HT, TH, TT\}$$

Number of elements in $S = 4 = 2^2$

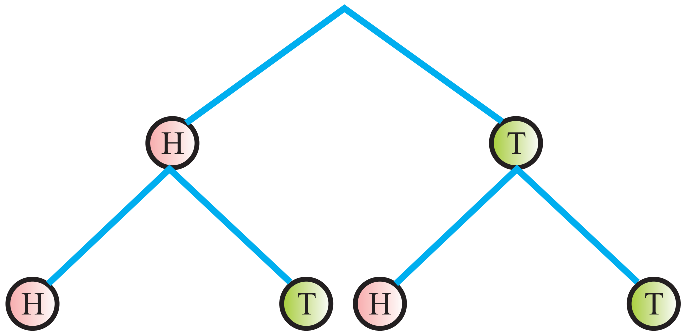

Fig. 33.2

3. When a coin is tossed three times, the sample space is

$$S = \{HHH, HHT, HTH, HTT, THH, THT, TTH, TTT\}$$

Number of elements in S = 8 = 2^3

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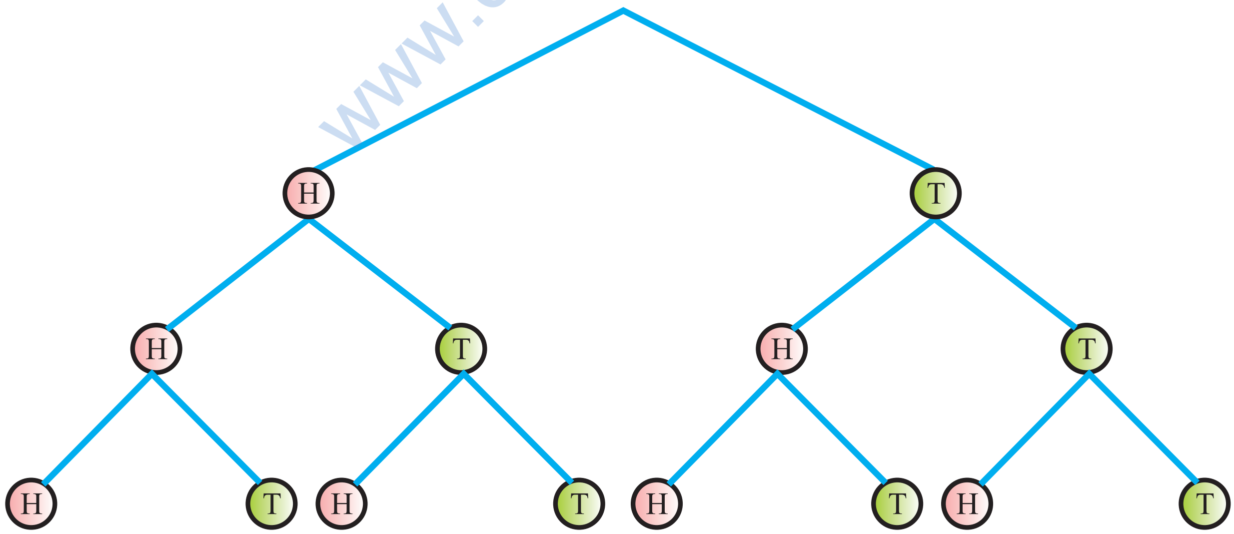

Fig. 33.3

4. When a coin is tossed four times, the S = Sample space is

$$\left\{\begin{matrix} \text{HHHH, HHHT, HHTH, HHTT, HTHH, HTHT, HTTH, HTTT,} \\ \text{THHH, THHT, THTH, THTT, TTHH, TTHT, TTTH, TTTT} \end{matrix}\right\}$$

Number of elements in S = 16 = 2^4 and so on.

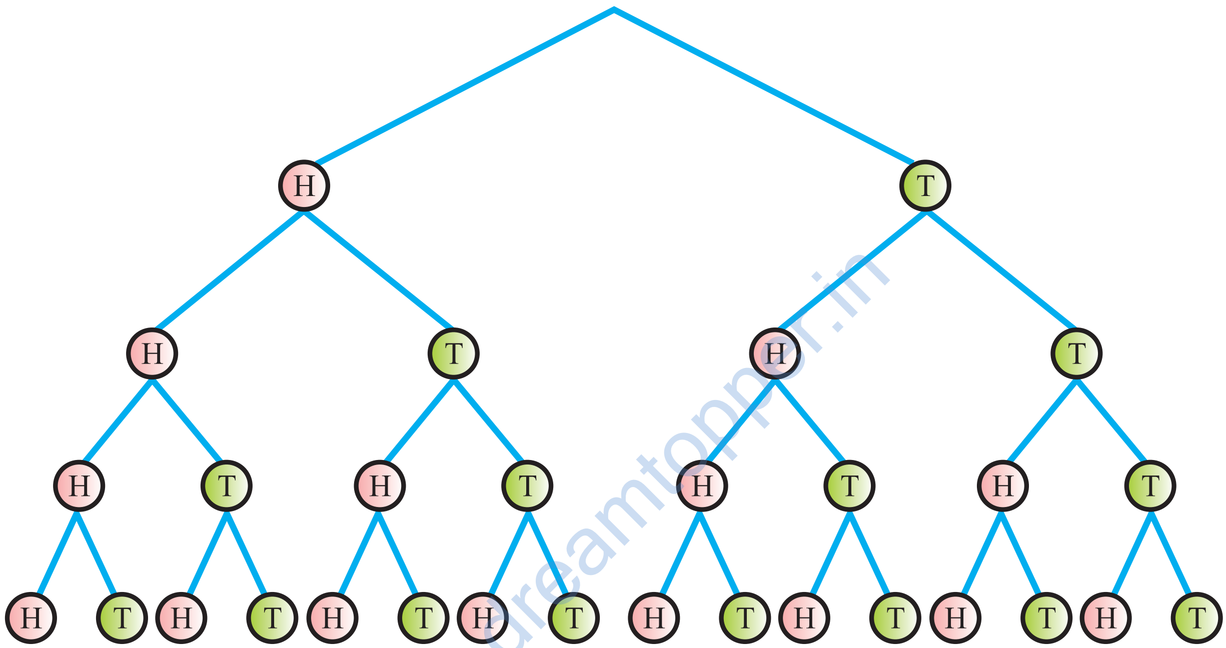

Fig. 33.4

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Observation

Number of elements in sample space, when a

1. coin is tossed once = __________.
2. coin is tossed twice = __________.
3. coin is tossed three times = __________.
4. coin is tossed four times = __________.

Application

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