Chapter 1: Linear Equation in Two Variables

(1) The standard form of linear equation in two variables is $ax + by + c = 0$ where a, b, c, are real numbers and a, b are not equal to Zero at the same time. But if $c = 0$, the equation $ax + by + c = 0$ where a, b, c are real numbers and a, b are not equal to zero at the same time. But if $c = 0$, the equation $ax + by + c = 0$ will remain linear equation in two variables.

(2) We can obtain solution of simultaneous equation by using determinants. For this equations are to be expressed in the form of $a_1x + b_1y = c_1$ & $a_2x + b_2y = c_2$.

Then $D = \begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = (a_1b_2) - (b_1a_2)$

$D_x = \begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix} = (c_1b_2) - (b_1c_2)$

$D_y = \begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix} = (a_1c_2) - (c_1a_2)$

$x = \dfrac{D_x}{D}$ and $y = \dfrac{D_y}{D}$.

(3) The simultaneous equations are said to be consistent, if they have solution and are said to be inconsistent if they do not have solution.

The nature of solution and graphical interpretation depend on following conditions.

(i) If $\dfrac{a_1}{a_2} \neq \dfrac{b_1}{b_2}$	unique solution	Intersecting lines
(ii) If $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} \neq \dfrac{c_1}{c_2}$	No solution	Parallel lines
(iii) If $\dfrac{a_1}{a_2} = \dfrac{b_1}{b_2} = \dfrac{c_1}{c_2}$	Infinitely many solution.	Coincident lines

Chapter 2: Quadratic Equations

1. $ax^2 + bx + c = 0$ is the general form of quadratic equation where a, b, c are real numbers and $a \neq 0$.

2. The roots of the quadratic equation $ax^2 + bx + c = 0, a \neq 0$ are

$$\alpha = \frac{-b + \sqrt{b^2 - 4ac}}{2a}, \ \beta = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

3. The nature of the roots of the quadratic equation is determined by the value of $b^2 - 4ac$, which is called as discriminant of the quadratic equation and is denoted by Δ(Delta).

So for the quadratic equation $ax^2 + bx + c = 0$

(i) If $b^2 - 4ac > 0$, then $\sqrt{b^2 - 4ac}$ is real and therefore roots of equation are real and unequal.

(ii) If $b^2 - 4ac = 0$, then $\sqrt{b^2 - 4ac} = 0$ and therefore roots of equation are real and equal.

So $\alpha = \frac{-b}{2a}$ and $\beta = \frac{-b}{2a}$ as we say that equation has repeated roots.

(iii) If $b^2 - 4ac > 0$, then $\sqrt{b^2 - 4ac}$ is not real number and therefore equation does not have real roots.

(iv) If $b^2 - 4ac > 0$, and $b^2 - 4ac$ is not a perfect square then the roots of the quadratic equation are irrational and occur in pair. They are conjugate of each other.

4. If α and β are the roots of the quadratic equation $ax^2 + bx + c = 0$, then $\alpha + \beta = -\frac{b}{a}$ and $\alpha\beta = \frac{c}{a}$.

5. If α and β are the roots of the quadratic equation in variable 'x', then the equation is $x^2 - (\alpha + \beta)x + \alpha\beta = 0$

6. Some identities

(i) $x^2 + \frac{1}{x^2} = \left(x + \frac{1}{x}\right)^2 - 2$

(ii) $x^2 + \frac{1}{x^2} = \left(x - \frac{1}{x}\right)^2 + 2$

(iii) $\alpha^2 + \beta^2 = (\alpha + \beta)^2 - 2\alpha\beta$

(iv) $\alpha^3 + \beta^3 = (\alpha + \beta)^3 - 3\alpha\beta(\alpha + \beta)$

(v) $\alpha^3 - \beta^3 = (\alpha - \beta)^3 + 3\alpha\beta(\alpha - \beta)$

(vi) $(\alpha - \beta)^2 = (\alpha + \beta)^2 - 4\alpha\beta$

(vii) $\alpha^2 + \beta^2 = (\alpha - \beta)^2 + 2\alpha\beta$

Chapter 3: Arithmetic Progression

1. If $\{t_n\}$ is a sequence, then we denote the sum of the first 'n' terms of this sequence by $S_n = t_1 + t_2 + t_3 + \dots + t_n$.
2. If S_n is given then we can find any term of the sequence by $t_n = S_n - S_{n-1}$.
3. The n^{th} term of an A.P. with the first term 'a' and common difference 'd' is given by $t_n = [a + (n - 1) d]$
4. The sum of the first 'n' terms of an A.P. is given by

$$S_n = \frac{n}{2}\left[2a+(n-1)d\right] \text{ i.e.}$$

$$= na+\frac{n(n-1)}{2}d$$

5. If we know the 1^{st} term and the n^{th} term of the A.P. i.e. t_1 and t_n then the sum of 'n' term is given by

$$S_n = \frac{n}{2}\times[t_1+t_n]$$

$$= \frac{n}{2}\times[a+\ell]$$ where 'a' is the first term and

'ℓ' is the last term

6. Whenever we wish to consider three, four or five consecutive terms of an A.P., then consider as follows.
   - **(i)** Three consecutive terms as $a - d, a, a + d$.
   - **(ii)** Four consecutive terms as $a - 3d, a - d, a + d, a + 3d$. (here common difference is $2d$)
   - **(iii)** Five consecutive terms as $a - 2d, a - d, a, a + d, a + 2d$

Chapter 4: Financial Planning

1. CGST and SGST are two components of GST, which is to be paid to the government.
2. Output tax is tax collected at the time of sale.
3. Input tax is tax paid at the time of purchase.
   $\therefore$ GST payable = Output tax – ITC
4. MV is the Market Value.
5. FV is the Face Value
6. Dividend is always reckoned on the face value of share.
7. If MV > FV, then share is at premium.
8. If MV = FV, then share is at par.
9. If MV < FV, then share is at discount.

10. MV = FV + Premium
11. Buying price of share (cost price) = MV + Brokerage
12. Selling price of share = MV – Brokerage.

Chapter 5 : Probability

1. The probability of an event 'A' of a finite sample space 'S' is written as P(A) and is measured as

$$P(A) = \frac{\text{Number of sample points in event A}}{\text{Number of sample points in S}}$$

$$P(A) = \frac{n(A)}{n(S)}$$

2. Probability of any event lies between 0 and 1; both inclusive therefore always in fraction.

   i.e. $0 \leq P(A) \leq 1$

Chapter 6 : Statistics

1. **Mean of grouped frequency distribution:** To find mean of grouped frequency distribution, it is assumed that the frequency of each class interval is concentrated at its class marks.

   (i) Direct method:

   $$\text{Mean} = \bar{x} = \frac{\sum f_i x_i}{\sum f_i}$$

   Where x_i : Class mark of i^{th} class interval
   f_i : frequency of i^{th} class interval

   (ii) Assumed mean method or shift of origin method:

   $$\text{Mean} = \bar{x} = A + \bar{d}$$

   Where $\bar{d} = \dfrac{\sum f_i d_i}{\sum f_i}$ A: assumed mean

   $d_i = x_i - A$ for each i

   (iii) Step deviation method or shift of origin and scale method:

   $$\text{Mean} = \bar{x} = A + h\bar{u}$$

   Where $\bar{u} = \dfrac{\sum f_i u_i}{\sum f_i}$, $u_i = \dfrac{x_i - A}{h} = \dfrac{d_i}{h}$ for each i.

   A: assumed mean, h = width of class interval.

2. **Median of grouped frequency distribution:**

(i) Cumulative frequency distribution (less than type) table should be prepared.

(ii) If N is the total frequency, locate the class whose cumulative frequency less than type is just greater than or equal to $\frac{N}{2}$. This is a median class.

(iii) Median of grouped frequency distribution is calculated by-

$$\text{Median} = L + \left(\frac{N}{2} - c.f.\right)\frac{h}{f}$$

Where L : Lower limit of median class

N : Total frequency

$c.f.$: Cumulative frequency (less than type) of the class preceding median class.

h : width of median class.

f : frequency of median class.

3. **Mode of grouped frequency distribution.**

(i) Locate, the class having maximum frequency. This class is called modal class.

(ii) Mode is calculated by

$$\text{Mode} = L + \left[\frac{f_m - f_1}{2f_m - f_1 - f_2}\right]h$$

Where L : Lower limit of modal class

f_m : maximum frequency

f_1 : frequency of pre modal class

f_2 : frequency of post modal class

h : width of modal class.

4. **Relationship between Mean, Mode and Median**

Mean - Mode = 3 (Mean - Median)

5. In pie diagram central angle (θ) due to item is

$$\theta = \frac{\text{Value of the specific item}}{\text{Total value of all the item}} \times 360^\circ$$

6. In histogram the classes should be continuous.
7. Area bounded by histogram and by frequency polygon is same.

Chapter 1 : Similarity

(1) If A, b, h represent area, base and height of a triangle respectively, then

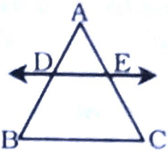
(i) $\dfrac{A_1}{A_2} = \dfrac{b_1 \times h_1}{b_2 \times h_2}$ (ii) $\dfrac{A_1}{A_2} = \dfrac{b_1}{b_2}$ if $h_1 = h_2$

(iii) $\dfrac{A_1}{A_2} = \dfrac{h_1}{h_2}$ if $b_1 = b_2$ (iv) $A_1 = A_2$ if $b_1 = b_2$ & $h_1 = h_2$

(2) **Basic proportionality theorem:**

In ABC, if line DE || side BC

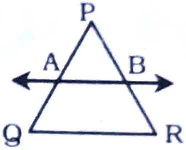
then $\dfrac{AD}{DB} = \dfrac{AE}{EC}$



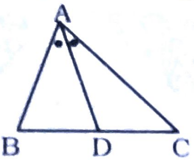
(3) **Converse of basic proportionality theorem:**

If $\dfrac{PA}{AQ} = \dfrac{PB}{BR}$

Then line AB || side QR



(4) **Property of an angle bisector of a triangle:**



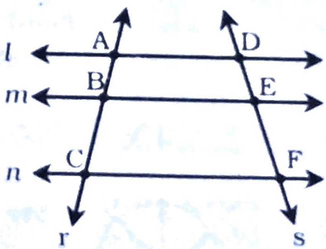
In ΔABC, if AD is bisector of $\angle BAC$

Then $\dfrac{BD}{DC} = \dfrac{AB}{AC}$

(5) **Property of three parallel lines:**

If line l || line m || line n

Then $\dfrac{AB}{BC} = \dfrac{DE}{EF}$



(6) **Tests of similarity of triangles:**

(i) A – A – A test (i.e. A – A test)

(ii) S – A – S test (iii) S – S – S test

(7) **Theorem of areas of similar triangles:**

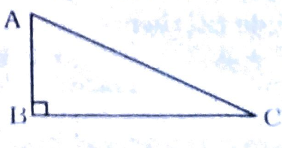
If $\Delta ABC \sim \Delta PQR$ then, $\dfrac{A(\Delta ABC)}{A(\Delta PQR)} = \dfrac{AB^2}{PQ^2} = \dfrac{BC^2}{QR^2} = \dfrac{AC^2}{PR^2}$

Chapter 2 : Pythagoras Theorem

(1) **Pythagoras theorem:**

In ΔABC, if $\angle ABC = 90^\circ$

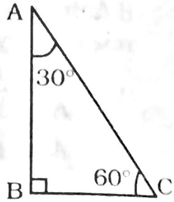
then $AC^2 = AB^2 + BC^2$.



(2) If a, b, c are natural numbers and a > b, then $[(a^2 + b^2), (a^2 - b^2), (2ab)]$ is Pythagorean triplet.

(3) **Property of 30° - 60° - 90° triangle:**

In ΔABC, if $\angle B = 90°$, $\angle A = 30°$ and $\angle C = 60°$ then



side opposite to 30° $= \frac{1}{2} \times$ hypotenuse

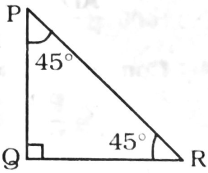
i.e. $BC = \frac{1}{2} AC$

and side opposite to 60° $= \frac{\sqrt{3}}{2} \times$ hypotenuse

i.e. $AB = \frac{\sqrt{3}}{2} \times AC$

(4) **Property of 45° - 45° - 90° triangle:**

In ΔPQR, if $\angle Q = 90°$, $\angle P = \angle R = 45°$ then

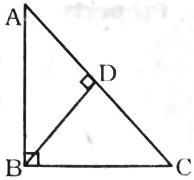


side opposite to 45° $= \frac{1}{\sqrt{2}} \times$ hypotenuse

i.e. $PQ = QR = \frac{1}{\sqrt{2}} \times PR$

(5) **Similarity and right angled triangle:**

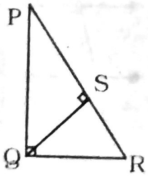
In ΔABC, if $\angle ABC = 90°$ and $BD \perp$ hypotenuse AC then



$\Delta ADB \sim \Delta ABC$

$\Delta BDC \sim \Delta ABC$ and $\Delta ADB \sim \Delta BDC$

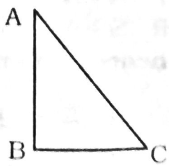
(6) **Theorem of Geometric mean:**



In ΔPQR, if $\angle PQR = 90°$ and $QS \perp$ hypotenuse PR then $QS^2 = PS \times SR$

(7) **Converse of Pythagoras theorem:**

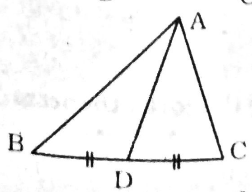
In ΔABC, if $AC^2 = AB^2 + BC^2$ then $\angle ABC = 90°$



(8) **Apollonius theorem:**

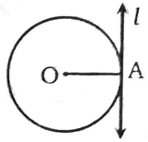
In ΔABC, if D is a midpoint of side BC then

$AB^2 + AC^2 = 2AD^2 + 2BD^2$

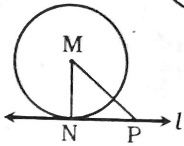


Chapter 3 : Circle

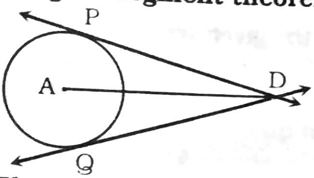
(1) Tangent theorem:
Line l is a tangent to the circle with centre O at a point of contact A then line $l \perp$ radius OA.



(2) Converse of tangent theorem:
If M is the centre of a circle & MN is a radius then line $l \perp$ seg MN at N.



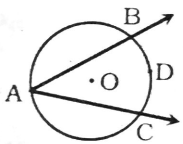
(3) Tangent segment theorem:



If DP & DQ are tangent segments drawn from external point D to a circle with centre A then seg DP $\cong$ seg DQ .

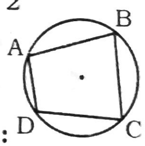
(4) Theorem of touching circles: If two circles touch each other, their point of contact lies on the line joining their centres.

(5) Inscribed angle theorem:



In a circle with centre O, $\angle$BAC is inscribed in arc BAC & arc BDC is intercepted by the angle then $\angle BAC = \frac{1}{2}$ m(arc BDC)

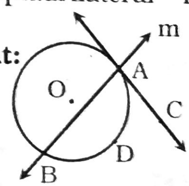
(6) Theorem of cyclic quadrilateral:
$\square$ABCD is cyclic
then $\angle B + \angle D = \angle A + \angle C = 180°$



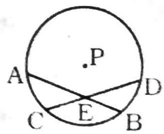
(7) Converse of cyclic quadrilateral theorem:
If a pair of opposite angles of a quadrilateral is supplementary, the quadrilateral is cyclic.

(8) Theorem of angle between tangent & secant:
If line AC & line AB are tangent & secant respectively of a circle with centre O then

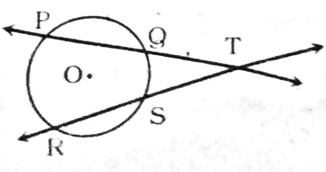
$\angle$ BAC $= \frac{1}{2}$ m(arc BDC)



(9) Theorem of Internal division of chords:
If chords AB & CD of a circle with centre P intersect at point E, then AE $\times$ EB = CE $\times$ ED

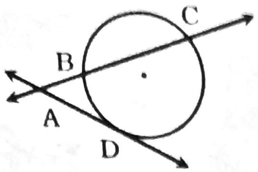


(10) Theorem of External division of chords:



If secants containing chords PQ and RS of a circle intersect outside the circle in point T, then PT $\times$ QT = RT $\times$ ST

(11) **Tangent secant segments theorem:**



Point A is in exterior of a circle. A secant through A intersects the circle at points B & C and a tangent through A touches the circle at point D then $AB \times AC = AD^2$

Chapter 4 : Geometric Constructions

(1) To construct a triangle, similar to the given triangle, bearing the given ratio with the sides of the given triangle,
  (i) when vertices are distinct
  (ii) when one vertex is common.

(2) To construct a tangent at a point on the circle
  (i) using centre of the circle.
  (ii) without using the centre of the circle.

(3) To construct tangents to the given circle from a point outside the circle.

Chapter 5 : Co-ordinate Geometry

(1) Co-ordinates of origin are (0, 0). If co-ordinates of point P are (x, y) then $d(O, P) = \sqrt{x^2 + y^2}$

(2) If points $A(x_1, y_1)$ and $B(x_2, y_2)$ lie on the XY-plane then
$d(A, B) = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
This is known as distance formula.

(3) **Section formula:** The co-ordinates of a point which divides the line segment joined by two distinct points (x_1, y_1) & (x_2, y_2) in the ratio $m : n$ are $\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$

(4) **Midpoint formula:** The co-ordinates of a midpoint of a line segment joining two distinct points (x_1, y_1) & (x_2, y_2) are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

(5) **Centroid formula:** If (x_1, y_1) & (x_2, y_2) are the vertices of a triangle then co-ordinates of the centroid are
$\left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3}\right)$

(6) **Slope of a line:** If (x_1, y_1) and (x_2, y_2) are any two points on line l, the slope of the line l is given by,

Slope of line $l = \dfrac{y_2 - y_1}{x_2 - x_1}$

Generally slope is shown by letter m

$\therefore \quad m = \dfrac{y_2 - y_1}{x_2 - x_1}$

(7) **(i)** The slope of X-axis and of any line parallel to X-axis is zero.

(ii) The slope of Y-axis and of any line parallel to Y-axis cannot be determined.

Chapter 6 : Trigonometry

(1) $\operatorname{cosec} \theta = \dfrac{\text{hypotenuse}}{\text{opposite side}}$, $\quad \sec \theta = \dfrac{\text{hypotenuse}}{\text{adjacent side}}$,

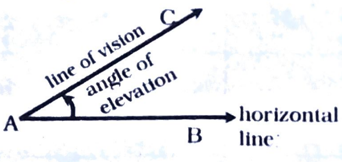
$\cot \theta = \dfrac{\text{adjacent side}}{\text{opposite side}}$

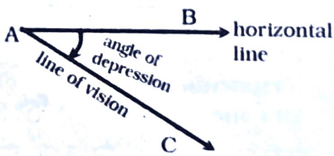
(2) $\sin \theta \times \operatorname{cosec} \theta = 1$, $\cos \theta \times \sec \theta = 1$, $\tan \theta \times \cot \theta = 1$

(3) **Trigonometric identities:**

$$\sin^2 \theta + \cos^2 \theta = 1$$
$$1 + \cot^2 \theta = \operatorname{cosec}^2 \theta$$
$$1 + \tan^2 \theta = \sec^2 \theta$$

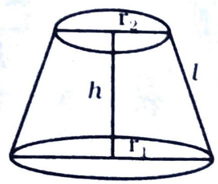
(4) **(i)** Angle of elevation **(ii)** Angle of depression





Chapter 7 : Mensuration

(1) Frustum of a cone:
h = height of frustum
l = slant height of frustum
r_1 & r_2 are radii of circular faces of a frustum ($r_1 > r_2$)



(i) Slant height of frustum $= l$

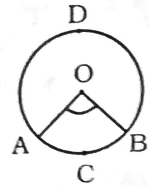
$$= \sqrt{h^2 + (r_1 - r_2)^2}$$

(ii) Curved surface area of a frustum $= \pi l(r_1 + r_2)$

(iii) Total surface area of a frustum

$$= \pi l(r_1 + r_2) + \pi r_1^2 + \pi r_2^2$$

(iv) Volume of a frustum $= \frac{1}{3}\pi h\left(r_1^2 + r_2^2 + r_1 r_2\right)$



(2) **(i)** Area of sector (A) $= \frac{\theta}{360} \times \pi r^2$

(ii) Length of an arc $(l) = \frac{\theta}{360} \times 2\pi r$

(iii) Area of a sector $= \frac{\text{length of the arc} \times \text{radius}}{2}$

(3) Area of segment PAQ $= r^2\left[\frac{\pi\theta}{360} - \frac{\sin\theta}{2}\right]$

(4) **Surface area and volume of solid figures:**

	Solid Figure	Surface Area			Volume
		Plane Surface	Curved Surface	Total Surface	
(i)	Cuboid	$2(lb+bh+lh)$	-	$2(lb+bh+lh)$	$l \times b \times h$
(ii)	Cube	$6l^2$	-	$6l^2$	l^3
(iii)	Cylinder	$2\pi r^2$	$2\pi rh$	$2\pi r(r + h)$	$\pi r^2 h$
(iv)	Cone	πr^3	πrl	$\pi r(r + l)$	$\frac{1}{3}\pi r^2 h$
(v)	Frustrum of cone	$\pi r_1^2 + \pi r_2^2$	$\pi(r_1+r_2)l$	$\pi(r_1+r_2)l + \pi r_1^2 + \pi r_2^2$	$\frac{\pi}{3}(r_1^2 + r_2^2 + r_1 r_2)h$
(vi)	Sphere	-	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
(vii)	Hemisphere (closed)	πr^2	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi^3$