Formulae

Optional Mathematics

Algebra

Functions: Types of functions:

a. Constant function b. Identity function c. Linear function

d. Quadratic function e. Cubic function f. Polynomial function

g. Trigonometric function h. Inverse function

Polynomials: Dividend = Divisor x Quotient + Remainder

Remainder and factor theorem:

Remainder theorem: If the polynomial f(x) is divided by x-a, the remainder is f(a).

Factor theorem: If the polynomial f(x) is divided by x-a and R = f(a) = 0, then x-a is the factor of f(x).

Arithmetic sequence and series:

The general term or nth term, $t_n = a + (n-1)d$

Arithmetic means between two numbers a and b, $M = \frac{a+b}{2}$

For n number of means, $d = \frac{b-a}{n+1}$ where, d = common difference

Sum of n terms, $S_n = \frac{n}{2}(a + l)$, where l = last term

Or $S_n = \frac{n}{2}[2a + (n-1)d]$

Sum of first n natural numbers, $S_n = \frac{n(n+1)}{2}$

Sum of first n odd numbers, $S_n = n^2$

Sum of first n even numbers, $S_n = n(n+1)$

Sum of squares of first n natural numbers, $S_n = \frac{n(n+1)(2n+1)}{6}$

Sum of cubes of first n natural numbers, $S_n = \left[\frac{n(n+1)}{2}\right]^2$

Geometric sequence and series:

The general term or nth term, $t_n = ar^{n-1}$

Geometric means between two numbers a and b, $G = \sqrt{ab}$

For n number of means, $r = \left(\frac{b}{a}\right)^{\frac{1}{n+1}}$ where, r = common ratio

Sum of n terms, $S_n = \frac{lr-a}{r-1}$, where l = last term, $[l = ar^{n-1}]$

Or $S_n = \frac{a(r^n-1)}{r-1}$ [NB: AM ≥ GM]

Matrices

1. $\begin{bmatrix} a & b \\ c & d \end{bmatrix} + \begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} a+p & b+q \\ c+r & d+s \end{bmatrix}$ 2. $\begin{bmatrix} a & b \\ c & d \end{bmatrix} - \begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} a-p & b-q \\ c-r & d-s \end{bmatrix}$

3. $\begin{bmatrix} a & b \\ c & d \end{bmatrix}\begin{bmatrix} p & q \\ r & s \end{bmatrix} = \begin{bmatrix} ap+br & aq+bs \\ cp+dr & cq+ds \end{bmatrix}$ 4. $If\ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, then\ A' = \begin{bmatrix} a & c \\ b & d \end{bmatrix}$

5 $If\ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, then\ |A| = \begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc.$

6. $If\ A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}, then\ Adj\ of\ A = \begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ 7. $A^{-1} = \frac{Adj\ of\ A}{|A|}$

8. $If\ a_1x + b_1y = c_1\ and\ a_2x + b_2y = c_2\ be\ two\ equations,$

$then\ matrix\ form\ is \begin{bmatrix} a_1 & b_1 \\ a_2 & b_2 \end{bmatrix}\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} c_1 \\ c_2 \end{bmatrix}$

Co-ordinate Geometry

1. The distance between two points $A(x_1, y_1)$ and $B(x_2, y_2)$ is $AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$
2. The co-ordinate of the point which bisects the line joining two points $A(x_1, y_1)$ and $B(x_2, y_2)$ is

$$(x , y) = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

3. The co-ordinate of the point which divides the line joining two points $A(x_1, y_1)$ and $B(x_2, y_2)$ internally in the ratio $m_1 : m_2$ is $(x , y) = \left(\frac{m_1x_2+m_2x_1}{m_1+m_2}, \frac{m_1y_2+m_2y_1}{m_1+m_2}\right)$
4. The co-ordinate of the point which divides the line joining two points $A(x_1, y_1)$ and $B(x_2, y_2)$ externally in the ratio $m_1 : m_2$ is $(x , y) = \left(\frac{m_1x_2-m_2x_1}{m_1-m_2}, \frac{m_1y_2-m_2y_1}{m_1-m_2}\right)$
5. The co-ordinate of the centroid of a ΔABC whose vertices are $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ is $(x , y) = \left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$
6. The area of ΔABC whose vertices are $A(x_1, y_1)$, $B(x_2, y_2)$ and $C(x_3, y_3)$ is

$$\Delta ABC = \frac{1}{2}[(x_1y_2 - x_2y_1) + (x_2y_3 - x_3y_2) + (x_3y_1 - x_1y_3)]$$

7. The area of □ABCD whose vertices are $A(x_1, y_1)$, $B(x_2, y_2)$, $C(x_3, y_3)$ and $D(x_4, y_4)$ is

$$\square ABCD = \frac{1}{2}[(x_1y_2 - x_2y_1) + (x_2y_3 - x_3y_2) + (x_3y_4 - x_4y_3) + (x_4y_1 - x_1y_4)]$$

8. The slope of the line joining the points $A(x_1, y_1)$ and $B(x_2, y_2)$ is $m = \frac{y_2-y_1}{x_2-x_1}$
9. The slope of the line $ax + by + c = 0$ is $m = -\frac{coeffcient\ of\ x}{coefficient\ of\ y}$
10. Equation of the line in slope intercept form is $y = mx + c$
11. Equation of the line in double intercept form is $\frac{x}{a} + \frac{y}{b} = 1$
12. Equation of straight line in normal/ perpendicular form is $x\ cos\alpha + y\ sin\alpha = p$
13. Equation of the straight line passing through the points $A(x_1, y_1)$ and $B(x_2, y_2)$ is

$$\frac{y-y_1}{x-x_1} = \frac{y_2-y_1}{x_2-x_1} \quad \text{or} \quad m = \frac{y-y_1}{x-x_1}$$

14. The angle between the lines $y = m_1x + c_1$ and $y = m_2x + c_2$ is $tan\theta = \pm\frac{m_1-m_2}{1+m_1m_2}$
15. The lines $a_1x + b_1y = c_1$ *and* $a_2x + b_2y = c_2$ are a) Perpendicular if $m_1m_2 = -1$

    b) Parallel if $m_1 = m_2$
16. The length of the perpendicular from the point $P(x_1 , y_1)$ to the line $ax + by + c = 0$ is

$$P = \pm\frac{ax_1 + by_1 + c}{\sqrt{a^2 + b^2}}$$

17. The angle between the straight lines $ax^2 + 2hxy + by^2 = 0$ is $tan\theta = \pm\frac{2\sqrt{h^2-ab}}{a+b}$
18. The straight lines $ax^2 + 2hxy + by^2 = 0$ are a) Perpendicular if $a + b = 0$

    b) Parallel if $h^2 = ab$
19. Equation of a circle with centre O(0, 0) and radius r is $x^2 + y^2 = r^2$
20. Equation of a circle with centre C(h, k) and radius r is $(x - h)^2 + (y - k)^2 = r^2$
21. Equation of circle whose end points of diameter are $P(x_1, y_1)$ and $Q(x_2, y_2)$ is

$$(x - x_1)(x - x_2) + (y - y_1)(y - y_2) = 0$$

Trigonometry

Basic trigonometry formulae

1 $sinA = \frac{p}{h}$. 2. $cosA = \frac{b}{h}$ 3. $tanA = \frac{p}{b}$ 4. $cosecA = \frac{h}{p}$ 5. $secA = \frac{h}{b}$

6. $cotA = \frac{b}{p}$ 7. $sinA.cosecA = 1$ 8. $cosA.secA = 1$ 9. $tanA.cotA = 1$

10. $tanA = \frac{sinA}{cosA}$ 11. $cotA = \frac{cosA}{sinA}$ 12. $sin^2A + cos^2A = 1$

13. $cosec^2A - cot^2A = 1$ 14. $sec^2A - tan^2A = 1$

Compound angles

1. $\sin(A+B) = sinAcosB + cosAsinB$ 2. $\sin(A-B) = sinAcosB - cosAsinB$
3. $\cos(A+B) = cosAcosB - sinAsinB$ 4. $\cos(A-B) = cosAcosB + sinAsinB$
6. $\tan(A+B) = \frac{tanA+tanB}{1-tanA\,tanB}$ 7. $\tan(A-B) = \frac{tanA-tanB}{1+tanA\,tanB}$
8. $\cot(A+B) = \frac{cotAcotB-1}{cotA+cotB}$ 9. $\cot(A-B) = \frac{cotAcotB+1}{cotB-cotA}$
10. $\sin(A+B)\sin(A-B) = sin^2A - sin^2B = cos^2B - cos^2A$
11. $\cos(A+B)\cos(A-B) = cos^2A - sin^2B = cos^2B - sin^2A$

Multiple angles

1. $sin2A = 2sinAcosA$ 2. $cos2A = cos^2A - sin^2A = 2cos^2A - 1 = 1 - 2sin^2A$
3. $tan2A = \frac{2tanA}{1-tan^2A}$ 4. $cot2A = \frac{cot^2A-1}{2cotA}$ 5. $sin2A = \frac{2tanA}{1+tan^2A}$ 6. $sin2A = \frac{2cotA}{1+cot^2A}$
7. $cos2A = \frac{1-tan^2A}{1+tan^2A}$ 8. $cos2A = \frac{cot^2A-1}{cot^2A+1}$ 9. $\frac{1-cos2A}{1+cos2A} = tan^2A$ 10. $\frac{1+cos2A}{1-cos2A} = cot^2A$
11. $sin3A = 3sinA - 4sin^3A$ 12. $cos3A = 4cos^3A - 3cosA$
13. $tan3A = \frac{3tanA-tan^3A}{1-3tan^2A}$ 14. $cot3A = \frac{3cotA-cot^3A}{1-3cot^2A}$

Sub-multiple angles

1. $sinA = 2sin\frac{A}{2}cos\frac{A}{2}$ 2. $cosA = cos^2\frac{A}{2} - sin^2\frac{A}{2} = 2cos^2\frac{A}{2} - 1 = 1 - 2sin^2\frac{A}{2}$
3. $tanA = \frac{2tan\frac{A}{2}}{1-tan^2\frac{A}{2}}$ 4. $cotA = \frac{cot^2\frac{A}{2}-1}{2cot\frac{A}{2}}$ 5. $sinA = \frac{2tan\frac{A}{2}}{1+tan^2\frac{A}{2}}$ 6. $sinA = \frac{2cot\frac{A}{2}}{1+cot^2\frac{A}{2}}$
7. $cosA = \frac{1-tan^2\frac{A}{2}}{1+tan^2\frac{A}{2}}$ 8. $cosA = \frac{cot^2\frac{A}{2}-1}{cot^2\frac{A}{2}+1}$ 9. $\frac{1-cosA}{1+cosA} = tan^2\frac{A}{2}$ 10. $\frac{1+cosA}{1-cosA} = cot^2\frac{A}{2}$
11. $sinA = 3sin\frac{A}{3} - 4sin^3\frac{A}{3}$ 12. $cosA = 4cos^3\frac{A}{3} - 3cos\frac{A}{3}$
13. $tanA = \frac{3tan\frac{A}{3}-tan^3\frac{A}{3}}{1-3tan^2\frac{A}{3}}$ 14. $cotA = \frac{3cot\frac{A}{3}-cot^3\frac{A}{3}}{1-3cot^2\frac{A}{3}}$

Transformation of trigonometric formulas

$$If\ A+B = C\ and\ A-B = D\ then\ A = \frac{C+D}{2}\ and\ B = \frac{C-D}{2}$$

1. $sinC + sinD = 2sin\frac{C+D}{2}cos\frac{C-D}{2}$ 2. $sinC - sinD = 2cos\frac{C+D}{2}sin\frac{C-D}{2}$
3. $cosC + cosD = 2cos\frac{C+D}{2}cos\frac{C-D}{2}$ 4. $cosC - cosD = -2sin\frac{C+D}{2}sin\frac{C-D}{2}$
5. $\sin(A+B) + \sin(A-B) = 2sinAcosB$ 6. $\sin(A+B) - \sin(A-B) = 2cosAsinB$
7. $\cos(A+B) + \cos(A-B) = 2cosAcosB$ 8. $\cos(A-B) - \cos(A+B) = 2sinAsinB$

Formulae

θ	0°	30°	45°	60°	90°	120°	135°	150°	180°	210°	225°	240°	270°	300°	315°	330°	360°
Sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{\sqrt{3}}{2}$	-1	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{1}{2}$	0
Cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0	$-\frac{1}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{\sqrt{3}}{2}$	-1	$-\frac{\sqrt{3}}{2}$	$-\frac{1}{\sqrt{2}}$	$-\frac{1}{2}$	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
Tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	$\propto$	$-\sqrt{3}$	-1	$-\frac{1}{\sqrt{3}}$	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	$\propto$	$-\sqrt{3}$	-1	$-\frac{1}{\sqrt{3}}$	0
Cot	$\propto$	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0	$-\frac{1}{\sqrt{3}}$	-1	$-\sqrt{3}$	$\propto$	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0	$-\frac{1}{\sqrt{3}}$	-1	$-\sqrt{3}$	$\propto$
Sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	$\propto$	-2	$-\sqrt{2}$	$-\frac{2}{\sqrt{3}}$	-1	$-\frac{2}{\sqrt{3}}$	$-\sqrt{2}$	-2	$\propto$	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
Cosec	$\propto$	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	$\propto$	-2	$-\sqrt{2}$	$-\frac{2}{\sqrt{3}}$	-1	$-\frac{2}{\sqrt{3}}$	$-\sqrt{2}$	-2	$\propto$

Vector

1. Magnitude of a vector is $\sqrt{x^2 + y^2}$
2. Dot product of two vectors is $\vec{a}.\vec{b} = |\vec{a}||\vec{b}|cos\theta$ or $\vec{a}.\vec{b} = x_1x_2 + y_1y_2$
3. Angle between two vectors is $cos\theta = \frac{x_1x_2+y_1y_2}{\sqrt{x_1{}^2+x_2{}^2}\ \sqrt{y_1{}^2+y_2{}^2}}$
4. $If\ \theta = 90^\circ\ then\ \vec{a}.\vec{b} = 0$, $If\ \theta = 0^\circ\ then\ \vec{a}.\vec{b} = |\vec{a}||\vec{b}|$, $If\ \theta = 180^\circ\ then\ \vec{a}.\vec{b} = -|\vec{a}||\vec{b}|$
5. Internal division $\vec{p} = \frac{m\vec{b}+n\vec{a}}{m+n}$, External division $\vec{q} = \frac{m\vec{b}-n\vec{a}}{m-n}$, Centroid $\vec{g} = \frac{1}{3}(\vec{a} + \vec{b} + \vec{c})$

Transformation

1. Translation with vector $T = \begin{pmatrix} a \\ b \end{pmatrix}$ $\quad p(x,y) \to p'(x + a, y + b)$
2. Translation with matrix $M = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$ $\quad p(x,y) \to p'(ax + by, cx + dy)$
3. Reflection in X-axis $p(x,y) \to p'(x, -y)$ 4. Reflection in Y-axis $p(x,y) \to p'(-x, y)$
5. Reflection in line y = x $\quad p(x,y) \to p'(y,x)$
6. Reflection in line y = - x $\quad p(x,y) \to p'(-y,-x)$
7. Reflection in line x = h $\quad p(x,y) \to p'(2h - x, y)$
8. Reflection in line y = k $\quad p(x,y) \to p'(x, 2k - y)$
9. Rotation of 90^0/-270^0 about O(0,0) $\quad p(x,y) \to p'(-y, x)$
10. Rotation of 180^0/-180^0 about O(0,0) $\quad p(x,y) \to p'(-x,-y)$
11. Rotation of 270^0/-90^0 about O(0,0) $\quad p(x,y) \to p'(y, -x)$
12. Rotation of 90^0/-270^0 about M(a,b) $\quad p(x,y) \to p'(-y + a + b, x - a + b)$
13. Rotation of 180^0/-180^0 about M(a,b) $\quad p(x,y) \to p'(2a - x, 2b - y)$
14. Rotation of 270^0/-90^0 about M(a,b) $\quad p(x,y) \to p'(y + a - b, -x + a + b)$
15. Enlargement with centre O(0,0) and scale factor k $\quad p(x,y) \to p'(kx, ky)$
16. Enlargement, centre M(a,b), scale factor k $\quad p(x,y) \to p'[k(x - a) + a, k(y - b) + b]$

Transformation using matrix

1. Reflection in X-axis $\begin{pmatrix} 1 & 0 \\ 0 & -1 \end{pmatrix}$ 2. Reflection in Y-axis $\begin{pmatrix} -1 & 0 \\ 0 & 1 \end{pmatrix}$
3. Reflection in line y = x $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$ 4. Reflection in line y = -x $\begin{pmatrix} 0 & -1 \\ -1 & 0 \end{pmatrix}$
5. Rotation of 90^0 about O(0,0) $\begin{pmatrix} 0 & -1 \\ 1 & 0 \end{pmatrix}$ 6. Rotation of 180^0 about O(0,0) $\begin{pmatrix} -1 & 0 \\ 0 & -1 \end{pmatrix}$
7. Rotation of 270^0 about O(0,0) $\begin{pmatrix} 0 & 1 \\ -1 & 0 \end{pmatrix}$ 8. Enlargement at O(0,0), scale factor k $\begin{pmatrix} k & 0 \\ 0 & k \end{pmatrix}$

Formulae

Statistics

1. Range, R = L − S   2. Coefficient of range = $\frac{L-S}{L+S}$ 3. Quartile deviation, $Q.D. = \frac{Q_3-Q_1}{2}$

4. Coefficient of quartile deviation = $\frac{Q_3-Q_1}{Q_3+Q_1}$

Mean Deviation		Individual Series	Discrete Series	Continuous Series
	From Mean	$M.D. = \frac{\sum\lvert X-\bar{X}\rvert}{N}$	$M.D. = \frac{\sum f\lvert X-\bar{X}\rvert}{N}$	$M.D. = \frac{\sum f\lvert m-\bar{X}\rvert}{N}$
	From Median	$M.D. = \frac{\sum\lvert X-M_d\rvert}{N}$	$M.D. = \frac{\sum f\lvert X-M_d\rvert}{N}$	$M.D. = \frac{\sum f\lvert m-M_d\rvert}{N}$ Where, m = mid value

Standard Deviation			
	Individual Series	Discrete Series	Continuous Series
Direct	$S.D.(\sigma) = \sqrt{\frac{\sum x^2}{N}}$ where $x = X - \bar{X}$	$S.D.(\sigma) = \sqrt{\frac{\sum fx^2}{N}}$ where $x = X - \bar{X}$	$S.D.(\sigma) = \sqrt{\frac{\sum fx^2}{N}}$ where $x = m - \bar{X}$ and m is mid value
Short-cut	$S.D.(\sigma) = \sqrt{\frac{\sum d^2}{N} - \left(\frac{\sum d}{N}\right)^2}$ where $d = X - A$ and A is assumed mean	$S.D.(\sigma) = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2}$ where $d = X - A$ and A is assumed mean	$S.D.(\sigma) = \sqrt{\frac{\sum fd^2}{N} - \left(\frac{\sum fd}{N}\right)^2}$ where $d = m - A$ and A is assumed mean
Step-deviation	$S.D. = \left(\sqrt{\frac{\sum d'^2}{N} - \left(\frac{\sum d'}{N}\right)^2}\right) \times h$ where $d' = \frac{X-A}{h}$ A is assumed mean and h is the common factor	$S.D. = \left(\sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2}\right) \times h$ where $d' = \frac{X-A}{h}$ A is assumed mean and h is the common factor	$S.D. = \left(\sqrt{\frac{\sum fd'^2}{N} - \left(\frac{\sum fd'}{N}\right)^2}\right) \times h$ where $d' = \frac{m-A}{h}$ A is assumed mean and h is the common factor

(i) Coefficient of S.D. = $\frac{S.D.(\sigma)}{\bar{X}}$ (ii) Coefficient of Variance = $\frac{S.D.(\sigma)}{\bar{X}} \times 100\%$

Compulsory Mathematics

1. Set

a) $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

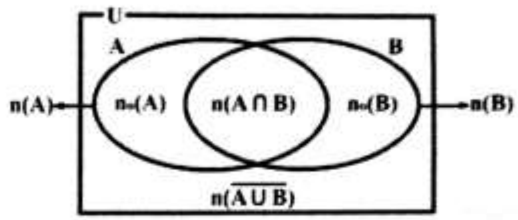
b) $n(A \cap B) = n(A) + n(B) - n(A \cup B)$

c) $n(\overline{A \cup B}) = n(U) - n(A \cup B)$

d) $n(\overline{A \cap B}) = n(U) - n(A \cap B)$

e) $n_0(A) = n(A) - n(A \cap B) = n(A - B)$

f) $n_0(B) = n(B) - n(A \cap B) = n(B - A)$



g) $n(A \cup B \cup C) = n(A) + n(B) + n(C) - n(A \cap B) - n(B \cap C) - n(C \cap A) + n(A \cap B \cap C)$

h) $n(\overline{A \cup B \cup C}) = n(U) - n(A \cup B \cup C)$

i) $n(\overline{A \cap B \cap C}) = n(U) - n(A \cap B \cap C)$

2. Laws of Indices

a) $a^m \times a^n = a^{(m+n)}$ b) $a^m \div a^n = a^{(m-n)}$ c) $(a^m)^n = a^{mn}$ d) $a^0 = 1$

e) $a^{-m} = \frac{1}{a^m}$ f) $a^{\frac{m}{n}} = \sqrt[n]{a^m}$ g) If $a^x = a^y$, then x = y h) If $a^x = b^x$, then a = b

3. Profit and Loss

a) Profit = SP – CP b) Loss = CP – SP c) Profit amount = Profit % of CP

d) Loss amount = Loss % of CP e) Profit percent = $\frac{Profit\ amount}{CP} \times 100\%$

f) Loss percent = $\frac{Loss\ amount}{CP} \times 100\%$ g) CP = $\frac{100}{100 + Profit\ \%} \times SP$

h) CP = $\frac{100}{100 - Loss\ \%} \times SP$ i) SP = $\frac{100 + Profit\ \%}{100} \times CP$ j) SP = $\frac{100 - Loss\ \%}{100} \times CP$

4. Discount and VAT

a) SP = MP – Discount amount

b) MP = SP + Discount amount

c) Discount amount = MP – SP

d) Discount amount = Discount % of MP

CP = Cost Price

SP = Selling Price

MP = Marked Price

VAT = Value Added Tax

e) VAT amount = SP with VAT – SP with discount

f) SP with VAT = VAT amount + SP with discount

g) VAT amount = VAT % of SP

h) If the price of an article is Rs x and a discount of d% and VAT of V% is applied on it, then the price after VAT = $\frac{x \times (100 - d\%)(100 + V\%)}{100 \times 100}$

i) If two articles are bought for Rs p and one is sold for x% profit and other for x% loss so that the selling price of both are equal then there will be always loss and percentage of loss = $\left(\frac{x}{10}\right)^2 \%$

5. Simple Interest

a) $I = \frac{PTR}{100}$ b) $P = \frac{I \times 100}{TR}$ c) $T = \frac{I \times 100}{PR}$ d) $R = \frac{I \times 100}{PT}$

e) $A = P + I$ f) $A = P\left(\frac{100+TR}{100}\right)$ g) $P = \frac{A \times 100}{100 + TR}$

I = Interest (in Rs)P = Principal (in Rs) T = Time (in years)

R = Rate (in % per annum) A = Amount (in Rs)

6. Compound Interest

a) Compound Amount = $P\left(1 + \frac{R}{100}\right)^T$

For different rates: eg. R_1 in 1st year, R_2 in 2nd year, R_3 in 3rd year

Compound Amount = $P\left(1 + \frac{R_1}{100}\right)\left(1 + \frac{R_2}{100}\right)\left(1 + \frac{R_3}{100}\right)$

For time given in T years and M months

Compound Amount = $P\left(1 + \frac{R}{100}\right)^T\left(1 + \frac{MR}{1200}\right)$

b) Compound Interest = $P\left[\left(1 + \frac{R}{100}\right)^T - 1\right]$

For different rates: eg. R_1 in 1st year, R_2 in 2nd year, R_3 in 3rd year

Compound Interest = $P\left[\left(1 + \frac{R_1}{100}\right)\left(1 + \frac{R_2}{100}\right)\left(1 + \frac{R_3}{100}\right) - 1\right]$

For time given in T years and M months

Compound Interest = $P\left[\left(1 + \frac{R}{100}\right)^T\left(1 + \frac{MR}{1200}\right) - 1\right]$

c) Compound Amount Half Yearly = $P\left(1 + \frac{R}{200}\right)^{2T}$

d) Compound Interest Half Yearly = $P\left[\left(1 + \frac{R}{200}\right)^{2T} - 1\right]$

7. Population Growth: $P_t = P\left(1 + \frac{R}{100}\right)^T$

where, P = Population of a country or a place at a certain time.

R = Rate of growth of population. T = Time (in years).

P_t = Population of a country or a place after t years.

The actual population in T years = P_t – Number of deaths + M_{in} - M_{out}

where, M_{in} = Number of in migrants. M_{out} = Number of out migrants.

8. Depreciation: $P_t = P\left(1 - \frac{R}{100}\right)^T$

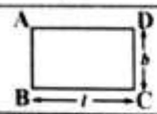
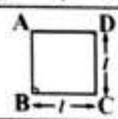
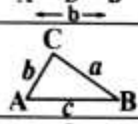
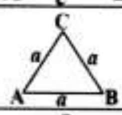
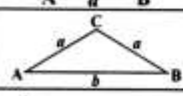
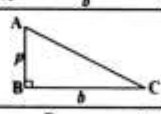
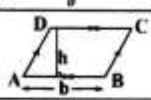
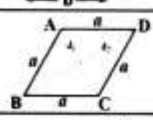
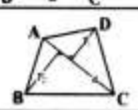
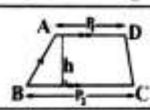
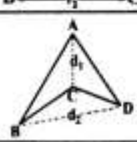
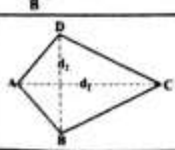
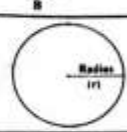
where, P = Original price. R = Rate of depreciation.

T = Time period for depreciation (in years).

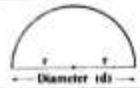
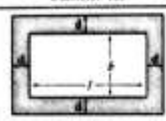
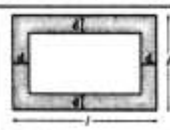
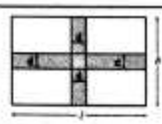
P_t = Depreciated price after T years.

9. Mensuration

A. Plane Figures

Sl. No.	Name	Figure	Area	Perimeter
1	Rectangle		$A = l \times b$	$P = 2(l + b)$
2	Square		$A = l^2$	$P = 4l$
3	Triangle		$A = \frac{1}{2} b \times h$	$P = AB + BC + CA$
4	Triangle		$A = \sqrt{s(s-a)(s-b)(s-c)}$	$P = 2s = (a + b + c)$
5	Equilateral Triangle		$A = \frac{\sqrt{3}a^2}{4}$	$P = 3a$
6	Isosceles Triangle		$A = \frac{b}{4}\sqrt{a^2 - b^2}$	$P = b + 2a$
7	Right Angled Triangle		$A = \frac{1}{2} b \times p$	$P = p + b + \sqrt{p^2 + b^2}$
8	Parallelogram		$A = b \times h$	$P = 2(AD + AB)$
9	Rhombus		$A = \frac{1}{2} d_1 \times d_2$	$P = 4a$
10	Quadrilateral		$A = \frac{1}{2} d(p_1 + p_2)$	$P = AB + BC + CD + DA$
11	Trapezium		$A = \frac{1}{2} h(p_1 + p_2)$	$P = p_1 + p_2 + AB + CD$
12	Arrow-Head		$A = \frac{1}{2} d_1 \times d_2$	$P = AB + BC + CD + DA$
13	Kite		$A = \frac{1}{2} d_1 \times d_2$	$P = AB + BC + CD + DA$
14	Circle		$A = \pi r^2 = \frac{\pi d^2}{4} = \frac{C^2}{4\pi}$	$C = 2\pi r = \pi d$

Formulae

Sl. No.	Name	Figure	Area	Perimeter
15	Semicircle		$A = \frac{\pi r^2}{2} = \frac{\pi d^2}{8}$	$P = \pi r + d = \pi r + 2r$
16	Outer Path		$A = 2d(l + b + 2d)$	---
17	Inner Path		$A = 2d(l + b - 2d)$	---
18	Cross Path		$A = d(l + b - d)$	---

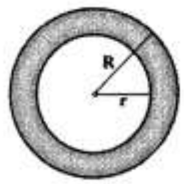
19 Diagonal of rectangle = $\sqrt{l^2 + b^2}$

20 Diagonal of square = $l\sqrt{2}$

21 Area of circular ring = $\pi(R^2 - r^2)$

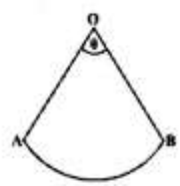
where, R = Radius of great circle

r = Radius of small circle



22 Area of sector of circle, $A = \frac{\pi r^2}{360^0} \times \theta$

Perimeter of sector of circle, $P = \frac{\pi r \theta}{180^0} + 2r$



B. Solid Figures

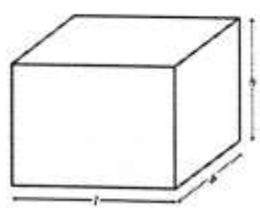
a) Cuboid

i. Area of four walls, $A = 2h(l + b)$

ii. Volume, $V = l \times b \times h$

iii. Total surface area = $2(lb + bh + lh)$

iv. Diagonal = $\sqrt{l^2 + b^2 + h^2}$



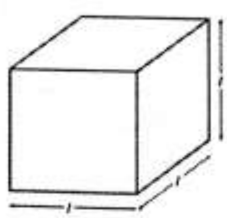
b) Cube

i. Area of each wall, $A = l^2$

ii. Volume, $V = l^3$

iii. Total surface area = $6l^2$

iv. Diagonal = $l\sqrt{3}$



c) Prism

i. Volume, $V = ah$

ii. The area of rectangular faces = Ph

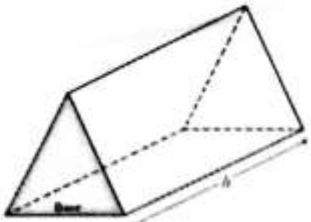
iii. Total surface area = $Ph + 2a$

P = Perimeter of base

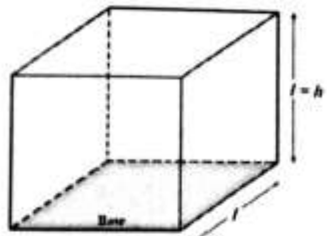
a = Area of base

h = Height of prism

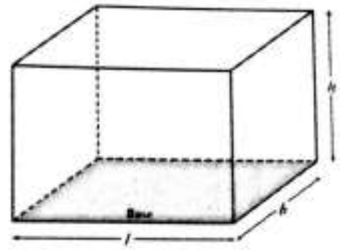
Formulae



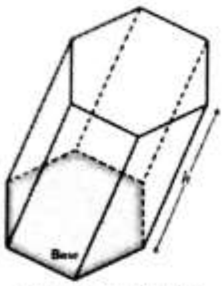
Triangular Base Prism



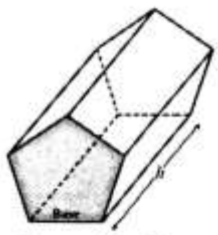
Squared Base Prism



Rectangular Base Prism



Hexagonal Base Prism



Pentagonal Base Prism

Circular Base Prism

d) Cylinder

i. Circumference of base, $C = 2\pi r$

ii. Area of Base, $a = \pi r^2$

iii. Curved surface area, $S = 2\pi rh$

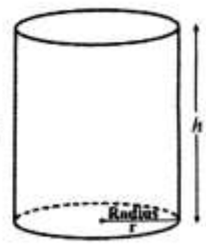
iv. Total surface area, $A = 2\pi r(r + h)$

v. Volume, $V = \pi r^2 h$

a = Area of base

r = Radius of base

h = Height of cylinder



e) Sphere

i. Area of great circle, $A_1 = \pi r^2 = \frac{\pi}{4} d^2$

ii. Circumference of a great circle, $C = 2\pi r = \pi d$

iii. Surface Area, $A = 4\pi r^2 = \pi d^2$

iv. Volume, $V = \frac{4}{3}\pi r^3 = \frac{1}{6}\pi d^3$

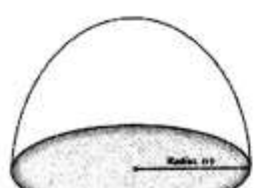
f) Hemisphere

i. Area of great circle = $\pi r^2 = \pi \frac{d^2}{4}$

ii. Circumference of great circle = $2\pi r = \pi d$

iii. Area of curved surface, $S = 2\pi r^2 = \frac{1}{2}\pi d^2$

iv. Total surface area, $A = 3\pi r^2 = \frac{3}{4}\pi d^2$



g) Squared Base Pyramid

i. Area of base = l^2

ii. Area of triangular faces = $lS_1 + bS_2$

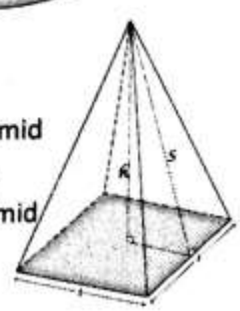
iii. Total surface area, $A = 2sl + l^2$

iv. Volume, $V = \frac{1}{3} l^2 h$

S = Slant height of the pyramid

l = Length of base

h = Height of pyramid



h) Rectangular Base Pyramid

i. Area of base = l^2

ii. Area of triangular faces = $lS_1 + bS_2$

iii. Total surface area, $A = lS_1 + bS_2 + l \times b$

iv. Volume, $V = \frac{1}{3} l \times b \times h$

v. Slant height along length, $S_1 = \sqrt{\left(\frac{b}{2}\right)^2 + h^2}$

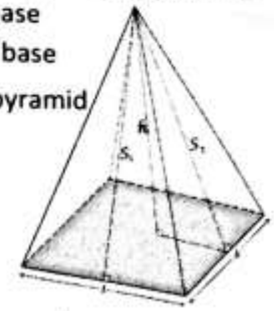
vi. Slant height along breadth, $S_2 = \sqrt{\left(\frac{l}{2}\right)^2 + h^2}$

S_1 & S_2 = Slant height of the pyramid

l = Length of base

b = Breadth of base

h = Height of pyramid



i) Cone

i. Slant height, $l = \sqrt{h^2 + r^2}$

ii. Area of base, $A = \pi r^2 = \pi \frac{d^2}{4}$

iii. Circumference of base, $C = 2\pi r = \pi d$

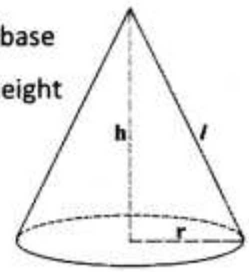
iv. Area of curved surface, $A = \pi r l = \frac{1}{2} \pi d l$

v. Total surface area, $A = \pi r(r + l)$

vi. Volume, $V = \frac{1}{3} \pi r^2 h$

r = Radius of base

h = Vertical height



j) Rectangular Room

i. Area of floor, $A = l \times b$

ii. Area of ceiling, $A_c = l \times b$

iii. Area of four walls, $A_{4w} = 2h(l + b)$

iv. Perimeter, $P = 2(l + b)$

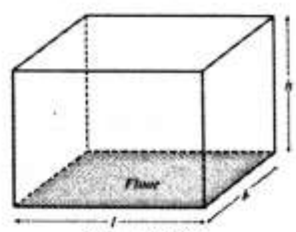
v. Total surface area = $2(lb + bh + lh)$

vi. Capacity or Volume, $V = l \times b \times h$

vii. Area of floor = Area of ceiling = Area of carpet = $l \times b$

viii. Area of floor = $N \times A$

where, A = Area of a piece of carpet and N = Number of carpets



Rectangular Room

ix. Total cost = A × R , where, R = Cost per square meter

x. Total cost = l × R , where, l = Length of carpet

xi. Volume of wood in box = External Volume – Internal Volume

xii. Volume of wall = NV_1 , where, N = Number of bricks, V_1 = Volume of a brick

xiii. Cost of constructing a wall = × R , where, R = Cost of a brick

xiv. Area of four walls excluding door and window = $2h(l + b) - x - y$

where, x = Area of a window and y = Area of door