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LOGARITHM (Algebra)

Defination: If $y = a^x$, $a > 0$, $a \neq$, $a \in R$, then x is called logarithm of y to the base a and it is written as $x = \log_a y$

For example,

1) If $8 = 2^3$ then $3 = \log_2 8$
2) If $3^4 = 81$ then $4 = \log_3 81$

Note: i) $a^x = y$ is called Index form and $x = \log a y$ is called logarithmic form.

ii) Logarithm of negative number and zero are not defined.

LAWS OF LOGARITHMS.

1) $\log a (m+n) = \log a m + \log a n$
2) $\log a \left(\frac{m}{n}\right) = \log a^m - \log a^n$
3) $\log a (m)^n = n \log a^m$
4) $\log n^m = \frac{\log a^m}{\log a^n}$

REMARK:

1) $a^0 = 1 = \log a^1 = 0$
2) $a^1 = a = \log a^a = 1$
3) $a^{\log a^y} = a^{\log a^y} = y$

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Solved Examples.

1) $\log_2 16$

$\therefore 16 = 2^x$

$\therefore \cancel{4}^{7} = 2^x$

$\therefore 2^4 = 2^x$

$\therefore x = 4$

2) $\log_2 14 - \log_2 7$

$\therefore \log_2 \left[\frac{14}{7}\right]$

$\therefore \log_2 2$

$\therefore 2 = 2^x$

$\therefore x = 1.$

3) Find x if

$\log_3 27 = x$

$\therefore 27 = 3^x$

$\therefore 3^3 = 3^x$

$\therefore x = 3.$

4) $\log_5 125$

$\therefore 125 = 5^x$

$\therefore 5^3 = 5^x$

$\therefore x = 3.$

5) $(\log_3 4) \times (\log_4 81)$

$\therefore \frac{\log 4}{\log 3} \times \frac{\log 81}{\log 4}$

$\therefore \frac{\log 81}{\log 3} = \frac{\log 3^4}{\log 3}$

$\therefore 4 \times \frac{\log \cancel{3}}{\log \cancel{3}}$

$\therefore 4$

6) $\log_3 (x+6) = 2$

$\therefore x+6 = 3^2$

$\therefore x+6 = 9$

$\therefore x = 9-6$

$\therefore x = 3$

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DETERMINANT (Algebra)

Definition: The arrangement of numbers in equal number of rows and column enclosed between two bar is called determinant.

Determinant of order 3:

$$|A| = \begin{vmatrix} a_1 & b_1 & c_1 \\ b_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$= a_1 \begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - a_2 \begin{vmatrix} b_1 & c_1 \\ b_3 & c_3 \end{vmatrix} + a_3 \begin{vmatrix} b_1 & c_1 \\ b_2 & c_2 \end{vmatrix}$$

$$= a_1(b_2c_3 - c_2b_3) - a_2(b_1c_3 - c_1b_3) + a_3(b_1c_2 - c_1b_2)$$

AREA OF A TRIANGLE

Area of a triangle whose vertices are (x_1, y_1), $(x_2 y_2)$ and (x_3, y_3) is given

$$\text{Area of } \Delta(ABC) = \frac{1}{2} \begin{vmatrix} x_1 & y_1 & 1 \\ x_2 & y_2 & 1 \\ x_3 & y_3 & 1 \end{vmatrix}$$

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CRAMER'S RULE

It is called determinant method

$$D = \begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}$$

$$D_x = \begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix}$$ Replacing a_1, a_2, a_3 by d_1, d_2, d_3

$$D_y = \begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}$$ Replacing b_1, b_2, b_3 by d_1, d_2, d_3

$$D_z = \begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$$ Replacing c_1, c_2, c_3 by d_1, d_2, d_3

Then the solution is:

$$x = \frac{D_x}{D}, \quad y = \frac{D_y}{D}, \quad z = \frac{D_z}{D}$$

MATRICES (Algebra)

Defination: A set of $m \times n$ numbers are arranged in a rectangular form form of m rows $\times$ n columns enclosed in form of square bracket is called matrix of order $m \times n$.

TYPES OF MATRICES.

1) Row matrix: matrix having only one row is called Row Matrix

$A = [2 \; 3 \; -1]$

2) Column matrix: matrix having only 1 column is called column matrix

$D = \begin{bmatrix} 8 \\ 4 \end{bmatrix}$

3) Square matrix: Matrix having equal no. of rows and columns is called square matrix.

$A = \begin{bmatrix} 2 & -1 & 0 \\ 1 & 3 & -4 \\ 5 & -3 & 4 \end{bmatrix}$

4) Diagonal matrix: A square matrix where all non diagonal elements are zero is called a Diagonal m

$D = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 3 & 0 \\ 0 & 0 & 4 \end{bmatrix}$

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5) Scalar Matrix: A diagonal matrix where all diagonal elements are equal is called a scalar matrix.

$$K = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 2 \end{bmatrix}$$

6) Unit Matrix: A scalar matrix where all diagonal elements are 1 (unit) is called identity matrix.

$$I = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

7) Zero Matrix: A matrix having all diagonal elements as zero is called zero matrix.

$$B = \begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$$

$$A = \begin{bmatrix} 0, & 0 & 0 \end{bmatrix}$$

TRANSPOSE OF A MATRIX

The transpose of matrix A is obtained by interchanging rows and columns. It is denoted by A' or A^t or A^T

For eg. $A = \begin{bmatrix} a & b & c \\ p & q & r \end{bmatrix}$ then $A' = \begin{bmatrix} a & p \\ b & q \\ c & r \end{bmatrix}$

SINGULAR MATRIX :

A square matrix A is called singular matrix if det(A) or $|A| = 0$

NON-SINGULAR MATRIX :

A square matrix A is called non-singular matrix if det(A) or $|A| \neq 0$

ADJOINT OF A MATRIX :

Adjoint of a matrix is the transpose of co-factor matrix.

INVERSE OF A MATRIX :

If matrix A is non-singular matrix and if there exists a matrix B such that $A \times B = B \times A = I$ then matrix B is inverse of A.

Notation: Inverse of A = A^{-1}

Formula: $A^{-1} = \frac{1}{\det A} \times \text{Adj } A$.

PARTIAL FRACTION (Algebra)

PROPER FRACTION:- If the fraction $\frac{P(x)}{Q(x)}$, if the degree of polynomial $P(x)$ is smaller than the degree of the polynom $Q(x)$ then it is said to be proper fr.

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CASE 1 - $\frac{ax+b}{(x-\alpha)(x-\beta)(x-\gamma)} = \frac{A}{(x-\alpha)} + \frac{B}{(x-\beta)} + \frac{C}{(x-}$

CASE 2 - $\frac{ax+b}{(x-\alpha)(x-\beta)^2} = \frac{A}{(x-\alpha)} + \frac{B}{(\alpha-\beta)} + \frac{C}{(\alpha-\beta)}$

CASE 3 - $\frac{ax+b}{(x-\alpha)(x^2+\beta)} = \frac{A}{(x-\alpha)} + \frac{Bx+C}{(\alpha^2+\beta)}$

IMPROPER FRACTION:- If the fraction $P(x)$, if the degree of polynomial $P(x)$, $Q(x)$ is greater than or equal to the degree of polynomial $Q(x)$ then the fraction is impro

Improper fraction to proper fraction:
Any improper fraction can be expressed as sum of polynomial and a proper fraction by division method.

Improper Fraction $= Q + \frac{R}{D}$

TRIGNOMETRY

Some Important Formula:

1) Fundamental Identities

i) $\sin^2\theta + \cos^2\theta = 1$

ii) $1 + \tan^2\theta = \sec^2\theta$

iii) $1 + \cot^2\theta = \operatorname{cosec}^2\theta$

2) For a right angle triangle.

i) $\sin\theta = \dfrac{\text{opposite side}}{\text{Hypotenuse}}$

ii) $\cos\theta = \dfrac{\text{adjacent side}}{\text{Hypotenuse}}$

iii) $\tan\theta = \dfrac{\text{opposite side}}{\text{adjacent side}}$

iv) $\sec\theta = \dfrac{\text{Hypotenuse}}{\text{Adjacent side}}$

v) $\operatorname{cosec}\theta = \dfrac{\text{Hypotenuse}}{\text{Opposite side}}$

vi) $\cot\theta = \dfrac{\text{Adjacent side}}{\text{Opposite side}}$.

3) Measures of an angle.

θ°	30°	45°	60°	90°	180°	270°	360°	
θ^c	$\pi/6$	$\pi/4$	$\pi/3$	$\pi/2$	π	$3\pi/2$	2π	

4) Sign Convention.

Quadrant II	Quadrant I.
S	A
T	C
Quadrant III	Quadrant IV

A – All ratios are P^+

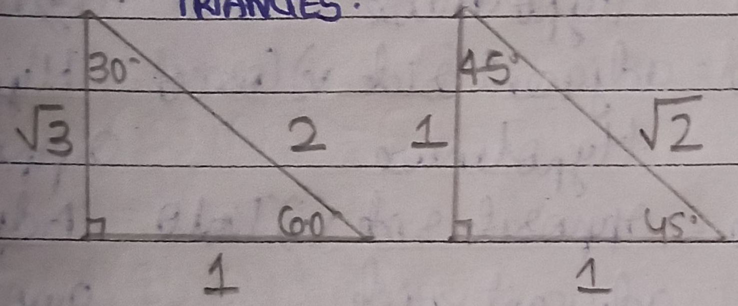
S – Sine ratio is P^+

T – Tan ratio is P^+

C – Cosine ratio is P^+

θ / Ratios	30°	45°	60°
$\sin\theta$	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$
$\cos\theta$	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$
$\tan\theta$	$\frac{1}{\sqrt{3}}$	1	$\frac{\sqrt{3}}{1}$

TRIANGES.



Quadrant II
$\pi-\theta$ $\sin\theta = +ve$
$2\pi-\theta$ $\cos\theta = -ve$
$5\pi-\theta$ $\tan\theta = -ve$

Quadrant I
$2\pi+\theta$ $\sin\theta = +ve$
$4\pi+\theta$ $\cos\theta = +ve$
$6\pi+\theta$ $\tan\theta = +ve$

Quadrant III
$\pi+\theta$ $\sin\theta = -ve$
$3\pi+\theta$ $\cos\theta = -ve$
$5\pi+\theta$ $\tan\theta = +ve$

Quadrant IV.
$2\pi-\theta$ $\sin\theta = -ve$
$4\pi-\theta$ $\cos\theta = +ve$
$6\pi-\theta$ $\tan\theta = -ve$

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COMPOUND ANGLES.

The angle obtained by addition or substraction of given angles is called Compound Angle.

1) $\sin(A+B) = \sin A \cdot \cos B + \cos B \sin A$

2) $\sin(A-B) = \sin A \cdot \cos B - \cos B \cdot \sin A$

3) $\cos(A+B) = \cos A \cdot \cos B - \sin A \cdot \sin B$

4) $\cos(A-B) = \cos A \cdot \cos B + \sin A \cdot \sin B$

5) $\tan(A+B) = \dfrac{\tan A + \tan B}{1 - \tan A \cdot \tan B}$

6) $\tan(A-B) = \dfrac{\tan A - \tan B}{1 + \tan A \cdot \tan B}$

measure of two angles is either zero or is an integral multiple of $90°$, that is $n \cdot \frac{\pi}{2}$. These are called Allied $\angle$'s

1) $\sin(90+\theta) = \cos\theta$.

2) $\sin(90-\theta) = \cos\theta$

3) $\cos(90+\theta) = -\sin\theta$

4) $\cos(90-\theta) = \sin\theta$

1) $\sin C + \sin D = 2\sin\left(\frac{(C+D)}{2}\right) \cdot \cos\left(\frac{(C\mp D)}{2}\right)$

2) $\sin C - \sin D = 2\cos\left(\frac{(C+D)}{2}\right) \cdot \sin\left(\frac{(C-D)}{2}\right)$

3) $\cos C + \cos D = 2\cos\left(\frac{(C+D)}{2}\right) \cdot \cos\left(\frac{(C\mp D)}{2}\right)$

4) $\cos C - \cos D = -2\sin\left(\frac{(C+D)}{2}\right) \cdot \overset{\sin}{\cancel{\cos}}\left(\frac{(C-D)}{2}\right)$

1) S+S	=	2SC
2) S−S	=	2CS
3) C+C	=	2CC
4) C−C	=	−2SS

INVERSE TRIGNOMETRY.

Property I.

1) $\sin(\sin^{-1}x) = x$

2) $\cos(\cos^{-1}x) = x$

3) $\tan(\tan^{-1}x) = x$

4) $\cot(\cot^{-1}x) = x$

5) $\sec(\sec^{-1}x) = x$

6) $\operatorname{cosec}(\operatorname{cosec}^{-1}x) = x$

Property II.

1) $\sin^{-1}(-x) = -\sin^{-1}x$

2) $\cos^{-1}(-x) = \pi - \cos^{-1}x$

3) $\tan^{-1}(-x) = -\tan^{-1}x$

4) $\cot^{-1}(-x) = \pi - \cot^{-1}x$

5) $\sec^{-1}(-x) = \pi - \sec^{-1}x$

6) $\operatorname{cosec}^{-1}(-x) = -\operatorname{cosec}^{-1}x$

Property III.

1) $\sin^{-1}x + \cos^{-1}x = \frac{\pi}{2}$

2) $\tan^{-1}x + \cot^{-1}x = \frac{\pi}{2}$

3) $\sec^{-1}x + \operatorname{cosec}^{-1}x = \frac{\pi}{2}$

Property IV.

1) If $x>0$, $y>0$ and $xy<1$ then

$$\tan^{-1}x + \tan^{-1}y = \tan\left(\frac{x+y}{1-xy}\right)$$

2) If $x>0$, $y>0$ and $xy>1$ then

$$\tan^{-1}x + \tan^{-1}y = \tan\left(\frac{x+y}{1-xy}\right) + \pi$$

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COORDINATE GEOMETRY.

Straight line

1) Slope of a line = $m = \tan\theta$

2) Slope of a line = $m = \frac{y_2 - y_1}{x_2 - x_1}$

3) Slope of line = $m = -\frac{A}{B}$

4) Angle between two straight line is $\theta = \tan^{-1}\left|\frac{m_1 - m_2}{1 + m_1 \cdot m_2}\right|$

5) Two lines are parallel if their slopes are equal $\therefore m_1 = m_2$

6) Condition for two lines are perpendicular:
$\therefore m_1 \times m_2 = -1$

7) Slope point form:
Equation of line having slope 'm' and passing through point $A(x_1, y_1)$ is
$y - y_1 = m(x - x_1)$

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8) Two point form:

Equation of line having passing through poin $A(x_1, y_1)$ and $B(x_2, y_2)$ is given

$$\frac{y-y_1}{y_1-y_2} = \frac{x-x_1}{x_1-x_2}$$

9) Two intercept form:

The equation of line making intercepts a and b on x-axis and y-axis respectively $= \frac{x}{a} + \frac{y}{b} = 1$.

10) Perpendicular distance between 2 ∥ lines:

The distance between two parallel lines $ax + by + c_1$ and $ax + by + c_2$ is given

$$d = \left| \frac{c_2 - c_1}{\sqrt{a^2+b^2}} \right|$$

11) Perpendicular distance between point & line

If $P(x_1, y_1)$ is any point and $Ax + By + C = 0$ is line, the perpendicular distance of point P from the line is given by $\left| \frac{Ax_1 + By_1 + C}{\sqrt{A^2+B^2}} \right|$

2

3) Area of Triangle = $\sqrt{s(s-a)(s-b)(s-c)}$

4) Area of Equilateral triangle = $\frac{\sqrt{3}}{4} \times \text{Side}^2$

5) Area of Rectangle = length × breadth.

6) Area of Square = Side × Side

7) Area of Parallelogram = Base × Height

8) Area of Rhombus = $\frac{1}{2} \times \text{diagonal}_1 \times \text{diagonal}_2$

9) Area of Trapezium = $\frac{1}{2} \times$ Sum of ∥ sides × heigh

10) Area of Circle = πr^2

11) Area of Annulus = $\pi (R^2 - r^2)$

Volume and Surface Area

1) Cuboid

1.1 Surface Area of Cuboid = $2(lb + bh + hl)$

1.2 Volume of Cuboid = $l \times b \times h$

2) Cube

2.1 Surface Area of Cuboid = $2(l)^2$

2.2 Volume of Cuboid = $l \times l \times l$

3) Cylinder

3.1 Volume of Cylinder = $\pi r^2 h$

3.2 T.S.A. of Cylinder = $2\pi r(r+h)$

3.3 C.S.A. of Cylinder = $2\pi r h$

4) Cone

4.1 Volume of Cone = $1/3 \pi r^2 h$

4.2 T.S.A. of Cone = $\pi r(r+l)$

4.3 C.S.A. of Cone = $\pi r l$

5) Sphere

5.1 Volume of Sphere = $4/3 \pi r^3 h$

5.2 Surface Area of Sphere = $4\pi r^2$

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⑥ Hemisphere

6.1 Volume of Hemisphere $= 2/3 \pi r^3$

6.2 Surface Area of Hemisphere $= 2\pi r^2$

STATISTICS

1) RANGE $= L - S$ — L = largest observation, S = smallest observation

2) COEFFICIENT OF RANGE $= \frac{L-S}{L+S}$

3) MEAN DEVIATION

Mean Deviation for raw data:

i) mean Deviation about mean $= \frac{\sum |x_i - \bar{x}|}{N} = \frac{\sum |d_i|}{N}$

where $\bar{x}$ = mean of N observation

4) Mean Deviation for Ungrouped data:

M.D. about mean $= \frac{\sum f_i |x_i - \bar{x}|}{N} = \frac{\sum f_i |d_i|}{N}$

where $N = \sum f_i$ and

$|d_i| = |x_i - \bar{x}|$

5) STANDARD DEVIATION

Standard Deviation for raw data

i) Standard Deviation $= \sqrt{\frac{\sum (x_i - \bar{x})^2}{N}} = \sqrt{\frac{\sum d_i^2}{N}}$

$\bar{x}$ = mean

$d_i = |x_i - \bar{x}|$

N = Total number of observation.

6) Standard Deviation for ungrouped data

$$S.D. = \sigma = \sqrt{\frac{\sum f_i d_i^2}{N}}$$

$N = \sum f_i$

$\bar{x}$ = mean = $\sum f_i x_i$

$d_i = (x_i - \bar{x})$

7) VARIANCE

The square of standard deviation is called the variance.

Raw Data

Variance = $(S.D)^2$

$$\text{Coefficient of Variance} = \frac{S.D}{\text{Mean}} \times 100$$

8) COMPARISON OF TWO SETS OF OBS.

Less the coefficient of variance the set is more consistent. If a set has greater coefficient of variance then it is not so reliable because it has less consistency, more variants.

All The Best For Finals.