NAVNEET'S

LOGARITHMIC AND MATHEMATICAL TABLES

(WITH USEFUL DATA)

FOR SCHOOLS AND COLLEGES

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INDEX

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NAVNEET EDUCATION LIMITED

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1. SOME CONVERSION FACTORS

1. Mass and Density :

1 kg = 1000 g

1 u = 1.661×10^{-27} kg

1 kg/m^3 = 10^{-3} g/cm^3

2. Length, Area and Volume :

1 m = 100 cm = 39.37 in
= 3.281 ft

1 mi = 1.609 km = 5280 ft

1 in = 2.54 cm

1 nm = 10^{-9} m = 10 Å

1 pm = 10^{-12} m = 1000 fm

1 Å = 10^{-8} cm = 10^{-10}m = 0.1 nm
= 100 pm

1 light year = 9.46×10^{15} m

1 m^2 = 10^4 cm^2

1 mL = 1 cm^3 = 10^{-3} L = 10^{-3} dm^3
= 10^{-6} m^3

1 m^3 = 10^3 dm^3 = 10^3 L = 10^6 mL
= 10^6 cm^3

1 L = 10^3 mL = 10^3 cm^3 = 1 dm^3
= 10^{-3} m^3

3. Time :

1 d = 86 400 s

1 y = $365\frac{1}{4}$ d = 3.16×10^7 s

4. Angular Measure :

1 rad = $\frac{180^\circ}{\pi} = 57.3^\circ$ (plane angle)

π rad = 180° = $\frac{1}{2}$ rev (plane angle)

5. Speed :

1 m/s = 3.28 ft/s = 2.24 mi/h

1 km/h = 0.621 mi/h = 0.278 m/s

6. Force and Pressure :

1 N = 10^5 dynes = 0.225 lb

1 ton = 1000 kg

1 Pa = 1 N/m^2 = 10 dyn/cm^2

1 atm = 1.013×10^5 Pa
= 1.013×10^5 N/m^2
= 76 cm Hg

7. Energy and Power :

1 J = 10^7 ergs = 0.2389 cal

1 kW·h = 3.6×10^6 J

1 cal = 4.186 J

1 eV = 1.602×10^{-19} J

8. Magnetism :

1 T = 1 Wb/m^2 = 10^4 gauss

MISCELLANEOUS

$\pi = 3.1416$, $\pi^2 = 9.87$, $\frac{1}{\pi} = 0.3183$

$e = 2.718$, $\log_{10} e = 0.4343$, $\log_e 10 = 2.303$, $\log_e x = 2.303 \log_{10} x$

Gravitational constant, $G = 6.673 \times 10^{-11}$ N·m^2/kg^2

Universal gas constant, $R = 8.315$ J/mol·K

Avogadro constant, $N_A = 6.022 \times 10^{23}$ mol^{-1}

Boltzmann constant, $k = 1.381 \times 10^{-23}$ J/K

Stefan-Boltzmann constant, $\sigma = 5.670 \times 10^{-8}$ W/m^2·K^4

Speed of light in free space, $c = 2.998 \times 10^8$ m/s

Elementary charge, $e = 1.602 \times 10^{-19}$ C

Permittivity constant, $\varepsilon_0 = 8.854 \times 10^{-12}$ F/m

Permeability constant, $\mu_0 = 1.257 \times 10^{-6}$ H/m

Planck constant, $h = 6.626 \times 10^{-34}$ J·s

Rydberg constant, $R = 1.097 \times 10^7$ m^{-1}

Electron mass, $m_e = 9.109 \times 10^{-31}$ kg

Proton mass, $m_p = 1.673 \times 10^{-27}$ kg

Neutron mass, $m_n = 1.675 \times 10^{-27}$ kg

2. ALGEBRA

* $\log_a x = y \iff x = a^y$, $a > 0$, $a \neq 1$, $x > 0$.

  $\log_q p = \log_q r \cdot \log_r p$

* Sum of first n terms of an A.P. with first term a and common difference d is $\frac{1}{2}n[2a + (n-1)d] = n \times$ (average of first and last terms).

* Sum of first n terms of a G.P. with first term a and common ratio r is $\frac{a(1-r^n)}{1-r} = \frac{a(r^n-1)}{r-1}$, $(r \neq 1)$

* $\sum_{r=1}^{n} r = \frac{n}{2}(n+1)$; $\sum_{r=1}^{n} r^2 = \frac{n}{6}(n+1)(2n+1)$;

  $\sum_{r=1}^{n} r^3 = \frac{n^2}{4}(n+1)^2$

* If $f(x) \equiv ax^2 + bx + c$ where $a \neq 0$, $a, b, c \in \mathrm{R}$, then roots α, β of $f(x) = 0$ are given by $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. Also $\alpha + \beta = \frac{-b}{a}$, $\alpha\beta = \frac{c}{a}$.

  Roots will be real if $b^2 - 4ac \geqslant 0$ and imaginary if $b^2 - 4ac < 0$.

* Remainder when polynomial $P(x)$ is divided by $(x-a)$ is $P(a)$

* Number of combinations of n objects taken r at a time

  ${}^{n}C_r$ or $\binom{n}{r} = \frac{n!}{(n-r)!\,r!}$, where $n! = n(n-1)(n-2) \ldots 3.2.1$

  Binomial Theorem :

  $(1 \pm x)^n = {}^{n}C_0 \pm {}^{n}C_1 x + {}^{n}C_2 x^2 \pm \ldots\ldots + (-1)^r {}^{n}C_r x^r + \ldots\ldots + (-1)^n x^n$

  where ${}^{n}C_r = \frac{n!}{r!\,(n-r)!}$.

3. COORDINATE GEOMETRY

(1) **Distance formula :**

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$, where d is the distance between two points having coordinates (x_1, y_1) and (x_2, y_2).

(2) **Section formulae :**

The coordinates of the point which divides the join of (x_1, y_1) and (x_2, y_2)

(i) *internally* in the ratio $m : n$ are $\left(\frac{mx_2 + nx_1}{m+n}, \frac{my_2 + ny_1}{m+n}\right)$

(ii) *externally* in the ratio $m : n$ are $\left(\frac{mx_2 - nx_1}{m-n}, \frac{my_2 - ny_1}{m-n}\right)$

(iii) in two equal parts (i.e., midpoint) are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$

(3) Centroid of the $\triangle ABC$ where coordinates of A, B, C are $(x_1, y_1), (x_2, y_2), (x_3, y_3)$ has coordinates $\left(\frac{x_1+x_2+x_3}{3}, \frac{y_1+y_2+y_3}{3}\right)$

(4) Slope of the line containing the segment with end points $(x_1, y_1), (x_2, y_2)$ is given by :

$m = \frac{y_2-y_1}{x_2-x_1} = \frac{\text{Difference of ordinates}}{\text{Difference of abscissae}}$, where $(x_2-x_1) \neq 0$

(5) Acute angle α between two lines with slopes m_1 and m_2 is given by $\tan\alpha = \left|\frac{m_1-m_2}{1+m_1m_2}\right|$ where $m_1m_2 \neq -1$

Two lines with slopes m_1 and m_2 will be parallel if $m_1 = m_2$.

Two lines with slopes m_1 and m_2 will be perpendicular if $m_1m_2 = -1$.

4. MENSURATION

Geometrical Form	Perimeter	Area	Volume
Rectangle (sides a, b)	$2a+2b$	ab	.....
Square (side a)	$4a$	a^2	.....
Triangle (base a, altitude h)	.....	$\frac{1}{2}ah$	.....
Triangle (sides a, b, c)	$a+b+c=2s$	$\sqrt{s(s-a)\ (s-b)\ (s-c)}$ where $s=\frac{a+b+c}{2}$	.....
Circle (radius r)	$2\pi r$	πr^2	.....
Ellipse (axes $2a$, $2b$)	$2\pi\sqrt{\frac{a^2+b^2}{2}}$ app.	πab	.....
Cylinder (radius r, height h)	.....	$2\pi r(h+r)$	πr^2h
Cone (radius r, height h, slant height l)	.....	$\pi r(l+r)$	$\frac{1}{3}\pi r^2h$
Sphere (radius r)	.....	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Anchor ring (mean radius R, radius of circular section r)	.....	$4\pi^2 r\ R$	$2\pi^2 r^2\ R$

5. TRIGONOMETRY

(a) $\frac{\sin\theta}{\cos\theta} = \tan\theta$

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

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

$1 + \cot^2\theta = \text{cosec}^2\theta$

$\sin(90°-\theta) = \cos\theta$

$\cos(90°-\theta) = \sin\theta$

$\sin(180°-\theta) = \sin\theta$

$\cos(180°-\theta) = -\cos\theta$

$\sin^2\theta = \frac{1-\cos2\theta}{2}$

$\cos^2\theta = \frac{1+\cos2\theta}{2}$

$\tan^2\theta = \frac{1-\cos2\theta}{1+\cos2\theta}$

$\sin(\theta \pm \phi) = \sin\theta\cdot\cos\phi \pm \cos\theta\cdot\sin\phi$

$\cos(\theta \pm \phi) = \cos\theta\cdot\cos\phi \mp \sin\theta\cdot\sin\phi$

$\tan(\theta \pm \phi) = \frac{\tan\theta \pm \tan\phi}{1 \mp \tan\theta\cdot\tan\phi}$

$\sin 2\theta = 2 \sin \theta \cdot \cos \theta = \dfrac{2 \tan \theta}{1 + \tan^2 \theta}$

$\cos 2\theta = \cos^2 \theta - \sin^2 \theta = 2 \cos^2 \theta - 1 = 1 - 2 \sin^2 \theta = \dfrac{1 - \tan^2 \theta}{1 + \tan^2 \theta}$

$\sin 3\theta = 3 \sin \theta - 4 \sin^3 \theta; \quad \cos 3\theta = 4 \cos^3 \theta - 3 \cos \theta$

$\sin A + \sin B = 2 \sin \left(\dfrac{A+B}{2}\right) \cdot \cos \left(\dfrac{A-B}{2}\right)$

$\sin A - \sin B = 2 \cos \left(\dfrac{A+B}{2}\right) \cdot \sin \left(\dfrac{A-B}{2}\right)$

$\cos A + \cos B = 2 \cos \left(\dfrac{A+B}{2}\right) \cdot \cos \left(\dfrac{A-B}{2}\right)$

$\cos A - \cos B = -2 \sin \left(\dfrac{A+B}{2}\right) \cdot \sin \left(\dfrac{A-B}{2}\right)$

If $\tan \dfrac{x}{2} = t$, $\sin x = \dfrac{2t}{1+t^2}$, $\cos x = \dfrac{1-t^2}{1+t^2}$, $\tan x = \dfrac{2t}{1-t^2}$

(b) In any triangle :

(i) $\dfrac{a}{\sin A} = \dfrac{b}{\sin B} = \dfrac{c}{\sin C} = 2R$ **(sine rule),**

(ii) $a^2 = b^2 + c^2 - 2bc \cos A$ **(cosine rule),**

(iii) $\sin \dfrac{A}{2} = \sqrt{\dfrac{(s-b)(s-c)}{bc}}$, (iv) $\cos \dfrac{A}{2} = \sqrt{\dfrac{s(s-a)}{bc}}$,

(v) Radius of circumcircle, $R = \dfrac{abc}{4\triangle}$ (where $\triangle$ = area of triangle)

(vi) Radius of inscribed circle, $r = \dfrac{\triangle}{s}$ (where $\triangle$ = area of triangle)

Trigonometrical ratios of special angles

θ	0°	30°	45°	60°	90°
sin	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cos	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tan	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	∞
cot	∞	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0
sec	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	∞
cosec	∞	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1

CONVERSION FACTORS

Length

From \ To	milli-	centi-	deci-	metre	deca-	hecto-	kilo-
milli-	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}	10^{-6}
centi-	10	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}	10^{-5}
deci-	10^{2}	10	1	10^{-1}	10^{-2}	10^{-3}	10^{-4}
metre	10^{3}	10^{2}	10	1	10^{-1}	10^{-2}	10^{-3}
deca-	10^{4}	10^{3}	10^{2}	10	1	10^{-1}	10^{-2}
hecto-	10^{5}	10^{4}	10^{3}	10^{2}	10	1	10^{-1}
kilo-	10^{6}	10^{5}	10^{4}	10^{3}	10^{2}	10	1

USEFUL DATA

Coefcient of linear expansion ($°C^{-1}$)

Iron	12×10^{-6}
Copper	17×10^{-6}
Brass	18×10^{-6}
Aluminium	23×10^{-6}

Specic heat capacity (in J/kgK, at 25° C)

Brass	370
Copper	384
Iron	449
Aluminium	897

Mechanical equivalent of heat, $J = 4.186$ J/cal

ABOUT THE EARTH

Polar radius = 6356.8 km, Equatorial radius = 6378.1 km
Mean radius = 6371 km
Volume = $1.083 \times 10^{21} m^3$
Mass = 5.972×10^{24}kg
Mean density = 5.514 g/cm ^{3} = 5514 kg/m^3
Mean distance from the Moon = 3.84×10^{8}m
Mean distance from the Sun = 1.496×10^{11}m
Gravity at sea level = 9.806 65 m/s^2(standard)

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