FORMULAS

Nature of Science

$C = 2\pi r$

$A = \pi r^2$

$SA = 4\pi r^2$

$V = \frac{4}{3}\pi r^3$

$\frac{d}{dx} x^n = nx^{n-1}$

$\frac{d}{dx} Ce^{ax} = aCe^{ax}$

$\frac{d}{dx} A \sin bx = Ab \cos bx$

$\frac{d}{dx} A \cos bx = -Ab \sin bx$

$\int x^n \, dx = \frac{1}{n+1} x^{n+1} + C, \; n \neq -1$

$\int \frac{dx}{x} = \ln x + C$

Force and Motion

$v_f = v_i + at$

$x_f = x_i + v_i t + \frac{1}{2} a t^2$

$v_f^2 - v_i^2 = 2a(x_f - x_i)$

$a_c = \frac{v^2}{r}$

$F = -kx$

$F \leq \mu N$

$F = \frac{G m_1 m_2}{r^2}$

$\theta_f = \theta_i + \omega_i t + \frac{1}{2} \alpha t^2$

$\omega_f = \omega_i + \alpha t$

$v = r\omega$

$a = r\alpha$

$r = \frac{\sum mr}{\sum m}$

$I = \int r^2 \, dm$

$I = \sum mr^2$

$\boldsymbol{\tau} = \mathbf{r} \times \mathbf{F}$

$\sum \boldsymbol{\tau} = I\boldsymbol{\alpha}$

$KE = \frac{1}{2} I\omega^2$

$\mathbf{L} = \mathbf{r} \times \mathbf{p}$

$L = I\omega$

$P = \rho g h$

$F = \rho V g$

$A_1 v_1 = A_2 v_2$

$P + \frac{1}{2}\rho v^2 + \rho g y = \text{constant}$

FORMULAS (continued)

Energy, Momentum, and Heat Transfer

$$W = \int F\,dx$$

$$KE = \frac{1}{2}mv^2$$

$$PE = mgh$$

$$PE = \frac{1}{2}kx^2$$

$$\int F\,dt = \Delta p$$

$$\Delta \ell = \alpha \ell_0 \Delta T$$

$$\Delta Q = mc\Delta T$$

$$\Delta Q = mL$$

$$\frac{\Delta Q}{\Delta t} = \frac{kA\Delta T}{d}$$

$$PV = nRT$$

$$\frac{1}{2}m\overline{v^2} = \frac{3}{2}k_bT$$

$$\Delta E = Q - P\Delta V$$

$$e = \frac{T_h - T_c}{T_h}$$

Electricity and Magnetism

$$F = \frac{k_e q_1 q_2}{r^2}$$

$$\mathbf{E} = \frac{\mathbf{F}}{q_0}$$

$$\oint \mathbf{E} \bullet d\mathbf{A} = 4\pi k_e q$$

$$V = -\int \mathbf{E} \bullet d\mathbf{r}$$

$$V = \frac{k_e q}{r}$$

$$R = \frac{\rho \ell}{A}$$

$$V = IR$$

$$R_s = \Sigma R_i$$

$$\frac{1}{R_p} = \sum \frac{1}{R_i}$$

$$P = IV$$

$$C = \frac{Q}{V}$$

$$C_p = \Sigma C_i$$

$$\frac{1}{C_s} = \sum \frac{1}{C_i}$$

$$\mathbf{F} = q\mathbf{v} \times \mathbf{B}$$

$$\mathbf{F} = I\boldsymbol{\ell} \times \mathbf{B}$$

$$\oint \mathbf{B} \bullet d\boldsymbol{\ell} = \mu_0 I$$

$$\varepsilon_{avg} = -\frac{\Delta \Phi}{\Delta t}$$

$$\Phi = B_\perp A$$

FORMULAS (continued)

Waves, Sound, and Light	Modern Physics
$a = -\omega^2 x$	$E = hf$
$x = A \sin \omega t$	$E = mc^2$
$T = 2\pi\sqrt{\frac{m}{k}}$	$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$
$T = 2\pi\sqrt{\frac{L}{g}}$	$hf = \phi + eV$
$v = f\lambda$	$\Delta x \Delta p \geq h$
$v = \sqrt{\frac{T}{\mu}}$	$\Delta E \Delta t \geq h$
$v = \sqrt{\frac{\gamma RT}{M}}$	$p = \frac{h}{\lambda}$
$2L = n\lambda$, n is an integer	
$4L = n\lambda$, n is odd	
$n_1 \sin \theta_1 = n_2 \sin \theta_2$	
$n = \frac{c}{v}$	
$\frac{1}{f} = \frac{1}{s_i} + \frac{1}{s_0}$	
$M = \frac{h_i}{h_0} = -\frac{s_i}{s_0}$	
$d \sin \theta = m\lambda$	
$I = I_0 \cos^2 \theta$	

CONSTANTS

Description	Value
Acceleration of gravity on Earth (g)	$9.80\ \text{m/s}^2$
Speed of light in a vacuum (c)	$3.00 \times 10^8\ \text{m/s}$
Planck's constant (h)	$6.63 \times 10^{-34}\ \text{J•s} = 4.14 \times 10^{-15}\ \text{eV•s}$
Electron rest mass	$9.11 \times 10^{-31}\ \text{kg}$
Proton rest mass	$1.67 \times 10^{-27}\ \text{kg}$
Charge of electron	$-1.60 \times 10^{-19}\ \text{C}$
Coulomb's constant (k_e)	$9.0 \times 10^9\ \text{N•m}^2/\text{C}^2$
Boltzmann constant (k_b)	$1.38 \times 10^{-23}\ \text{J/K}$
Gas constant (R)	$8.31\ \text{J/(mol•K)}$
Gravitational constant (G)	$6.67 \times 10^{-11}\ \text{N•m}^2/\text{kg}^2$
Permeability of free space (μ_0)	$4\pi \times 10^{-7}\ \text{T•m/A}$
Avogadro's number	6.02×10^{23}