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# Physics Equations & Answers (Quick Study Academic)

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# PHYSICS EQUATIONS & ANSWERS

Essential Text for Physics Learners, Concepts, Equations and Answers Including Sample Problems, Common Pitfalls and Helpful Hints

## BASICS

### A. Units for Physical Quantities

Base Units	Symbol	Unit
Length	L, l	Meter (m)
Mass	m, M	Kilogram (kg)
Temperature	T	Kelvin (K)
Time	t	Second (s)
Electric Current	I	Ampere (A, C/s)
Derived Units	Symbol	Unit
Acceleration	a	m/s <sup>2</sup>
Ang. Accel.	$\alpha$	rad/s <sup>2</sup>
Ang. Momentum	L	kg m <sup>2</sup> /s
Ang. Velocity	$\omega$	rad/s
Angle	$\theta, \phi$	radian
Capacitance	C	Farad (F, C/V)
Charge	Q, q	Coulomb (C, A.s)
Density	$\rho$	kg/m <sup>3</sup>
Displacement	s, d	meter (m)
Electric Field	E	V/m
Electric Flux	$\Phi_E$	V.m
Electromotive Force (EMF)	$\mathcal{E}$	Volt (V)
Energy	E, U, K	Joule (J, kg m <sup>2</sup> /s <sup>2</sup> )
Entropy	S	J/K
Force	F	Newton (N, kg m/s <sup>2</sup> )
Frequency	f, $\nu$	Hertz (Hz, 1/s)
Heat	Q	Joule (J)
Magnetic Field	B	Tesla (T, Wb/m <sup>2</sup> )
Magnetic Flux	$\Phi_B$	Weber (Wb, kg m <sup>2</sup> /s <sup>2</sup> A)
Momentum	p	kg m/s
Power	P	Watt (W, J/s)
Pressure	P	Pascal (Pa, N/m <sup>2</sup> )
Resistance	R	Ohm ( $\Omega$ , V/A)
Torque	$\tau$	N.m
Velocity	v	m/s
Volume	V	m <sup>3</sup>
Wavelength	$\lambda$	meter (m)
Work	W	Joule (J, N.m)

### B. Fundamental Physical Constants

Base Units	Symbol	Unit
Mass of electron	$m_e$	$9.11 \times 10^{-31}$ kg
Mass of proton	$m_p$	$1.67 \times 10^{-27}$ kg
Avogadro Constant	$N_A$	$6.02 \times 10^{23}$ mol <sup>-1</sup>
Elementary charge	e	$1.60 \times 10^{-19}$ C
Faraday constant	F	96,485 C/mol
Speed of light	c	$3 \times 10^8$ m/s
Molar Gas Constant	R	$8.314$ J mol <sup>-1</sup> K <sup>-1</sup>
Boltzmann Constant	k	$1.38 \times 10^{-23}$ J/K
Gravitational Constant	G	$6.67 \times 10^{-11}$ m <sup>3</sup> kg <sup>-1</sup> s <sup>-2</sup>
Permeability of Space	$\mu_0$	$4\pi \times 10^{-7}$ N/A <sup>2</sup>
Permittivity of Space	$\epsilon_0$	$8.85 \times 10^{-12}$ F/m

### C. Conversion Factors and Alternative Units

Unit	Description
Angle	1 radian = 57.3°
Energy	1 eV = 1.60 × 10 <sup>-19</sup> J
Energy	1 J = 0.239 cal
Force	1 dyne = 10 <sup>-5</sup> N
Volume	1 L = 1 dm <sup>3</sup>
Pressure	1 bar = 10 <sup>5</sup> Pa
Length	1 Å = 10 <sup>-10</sup> m

## MATHEMATICAL CONCEPTS

### 1. Vector Algebra

- Vector: Directed line segment having (x, y, z) components by 1.
- Unit vector: (along x, y, z) along x, y, z
- Vector:  $\vec{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}$
- Length of  $\vec{A} = (A_x^2 + A_y^2 + A_z^2)^{1/2}$
- Addition of vectors  $\vec{A}$  &  $\vec{B}$ , add components
- Sample Addition and Length Calculations

$$\vec{A} = 3\hat{i} + 4\hat{j}, \quad \vec{B} = 2\hat{i} + 3\hat{j}$$

$$\vec{A} + \vec{B} = 5\hat{i} + 7\hat{j}$$

$$|\vec{A} + \vec{B}| = \sqrt{5^2 + 7^2} = \sqrt{74} \approx 8.60$$

$$\vec{A} \cdot \vec{B} = 3 \times 2 + 4 \times 3 = 6 + 12 = 18$$

$$|\vec{A}| = \sqrt{3^2 + 4^2} = 5, \quad |\vec{B}| = \sqrt{2^2 + 3^2} = \sqrt{13} \approx 3.61$$

$$\cos \theta = \frac{\vec{A} \cdot \vec{B}}{|\vec{A}| |\vec{B}|} = \frac{18}{5 \times 3.61} \approx 0.99$$

$$\theta = \cos^{-1}(0.99) \approx 8.1^\circ$$

$$\vec{C} = \vec{A} \times \vec{B} = (3 \times 3 - 4 \times 2)\hat{k} = 1\hat{k}$$

$$\vec{A} \times \vec{B} = |\vec{A}| |\vec{B}| \sin \theta \hat{n}$$

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$$

### 2. Cross or Vector Product

- Angle between  $\vec{A}$  and  $\vec{B}$ , vector  $\vec{C}$  is perpendicular to  $\vec{A}$  and  $\vec{B}$
- Sample: Vector Product

$$\vec{A} = 3\hat{i} + 4\hat{j}, \quad \vec{B} = 2\hat{i} + 3\hat{j}$$

$$\vec{A} \times \vec{B} = (3 \times 3 - 4 \times 2)\hat{k} = 1\hat{k}$$

$$\vec{A} \times \vec{B} = |\vec{A}| |\vec{B}| \sin \theta \hat{n}$$

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$$

$$\vec{A} \times \vec{B} = |\vec{A}| |\vec{B}| \sin \theta \hat{n}$$

$$\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$$

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## Synopsis

Essential tool for physics laws, concepts, variables and equations, including sample problems, common pitfalls and helpful hints.

## Book Information

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