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Physics Equations & Answers (Quick Study Academic)

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PHYSICS: A DISCRETE APPROACH

PHYSICS

EQUATIONS & ANSWERS

Essential Tools for Physics: Laws, Concepts, Variables and Equations including Sample Problems, Common Pitfalls and Physical Models

BASICS

A. Units for Physical Quantities

Base Units	Symbol	Unit
Length	L	Meter - m
Mass	M	Kilogram - kg
Temperature	T	Kelvin - K
Time	t	Second - s
Theory: Current	I	Ampere - A (SI Unit)
Derived Units	Symbol	Unit
Acceleration	a	m/s^2
Ang. Accel.	α	rad/s^2
Ang. Momentum	L	$kg \cdot m^2/s$
Ang. Velocity	ω	rad/s
Angle	θ	radian
Capacitance	C	Farad F (SI Unit)
Charge	q	Coulomb C (SI Unit)
Density	ρ	kg/m^3
Displacement	$s, \Delta x$	meter - m
Electric Field	E	Volt/m
Electric Flux	Φ_E	$N \cdot m^2/C$
Electromotive Force (EMF)	$\mathcal{E}$	Volt - V
Energy	E, U, K	Joule (J) = $kg \cdot m^2/s^2$
Entropy	S	J/K
Force	F	Newton (N) = $kg \cdot m/s^2$
Frequency	f, ν	Hertz (Hz) = $1/s$
Heat	Q	Joule - J
Magnetic Field	B	Tesla (T) = $N/(A \cdot m)$
Magnetic Flux	Φ_B	Weber (Wb) = $T \cdot m^2$
Momentum	p	$kg \cdot m/s$
Power	P	Wattage W (J/s)
Power	P	Watt - W (J/s)
Pressure	P	Pascal (Pa) = N/m^2
Resistance	R	Ohm (Ω) = V/A
Energy	E	Joule - J
Velocity	v	m/s
Volume	V	m^3
Wavelength	λ	meter - m
Work	W	Joule - J (SI Unit)

B. Fundamental Physical Constants

Base Units	Symbol	Unit
Mass of electron	m_e	$9.11 \times 10^{-31} \text{ kg}$
Mass of proton	m_p	$1.67 \times 10^{-27} \text{ kg}$
Average Atomic Mass	N_A	$6.022 \times 10^{23} \text{ mol}^{-1}$
Elementary charge	e	$1.602 \times 10^{-19} \text{ C}$
Gravitational constant	G	$6.674 \times 10^{-11} \text{ N} \cdot m^2/\text{kg}^2$
Speed of light	c	$3 \times 10^8 \text{ m/s}$
Molar Gas Constant	R	$8.314 \text{ J/mol} \cdot K$
Boltzmann Constant	k_B	$1.38 \times 10^{-23} \text{ J/K}$
Gravitational Constant	G	$6.674 \times 10^{-11} \text{ N} \cdot m^2/\text{kg}^2$
Permeability of Space	μ_0	$4\pi \times 10^{-7} \text{ T} \cdot m/A$
Permittivity of Space	ϵ_0	$8.85 \times 10^{-12} \text{ C}^2/\text{N} \cdot m^2$

C. Conversion Factors and SI Prefixes

Unit	Description
Angle	$1 \text{ radian} = 180^\circ/\pi$
Energy	$1 \text{ J} = 1 \text{ N} \cdot m$
Energy	$1 \text{ eV} = 1.602 \times 10^{-19} \text{ J}$
Force	$1 \text{ N} = 1 \text{ kg} \cdot m/s^2$
Volume	$1 \text{ L} = 1 \text{ dm}^3$
Pressure	$1 \text{ Pa} = 1 \text{ N/m}^2$
Length	$1 \text{ Å} = 10^{-10} \text{ m}$

MATHEMATICAL CONCEPTS

A. Vector Algebra

1. **Vector** - Directional characteristic (along x, y, z) components $\hat{i}, \hat{j}, \hat{k}$
2. **Scalar** - Directionless (along x, y, z) along x, y, z along x, y, z
3. **Vector** $\vec{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}$
4. **Length of $\vec{A}$** $|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$
5. **Addition of vectors $\vec{A}$ and $\vec{B}$** add components $\vec{A} + \vec{B} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{j} + (A_z + B_z)\hat{k}$
6. **Sample Addition and Length Calculations:**
 $\vec{A} = 3\hat{i} + 4\hat{j}$
 $|\vec{A}| = \sqrt{3^2 + 4^2} = 5$
 $\vec{B} = 2\hat{i} + 3\hat{j}$
 $|\vec{B}| = \sqrt{2^2 + 3^2} = \sqrt{13}$
 $\vec{A} + \vec{B} = 5\hat{i} + 7\hat{j}$
 $|\vec{A} + \vec{B}| = \sqrt{5^2 + 7^2} = \sqrt{74}$

Note: $|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$

3. Multiply $\vec{A}$ and $\vec{B}$

- a. **Dot or scalar product:** $\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$
- b. **Cross product:** $\vec{A} \times \vec{B} = |\vec{A}| |\vec{B}| \sin \theta \hat{n}$

Note: θ is the angle between $\vec{A}$ and $\vec{B}$

a. $\vec{A} \cdot \vec{A} = |\vec{A}|^2 = A^2$

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

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

d. $\vec{A} \times \vec{A} = 0$

e. $\vec{A} \times \vec{B} = -\vec{B} \times \vec{A}$

f. $\vec{A} \cdot (\vec{B} \times \vec{C}) = (\vec{A} \times \vec{B}) \cdot \vec{C}$



Synopsis

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

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Very helpful product. Bought "used", came in "new" shape. Very direct and to-the-point equations and insight. Great help for taking those physics finals and mid-terms or your all-around nerve-killing quiz!

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Exactly what my son needed. The pricing could not be beat and the shipping was FAST. It provided the insight and details the teacher was not "TEACHING" the kids.

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