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Physics Equations & Answers (Quick Study Academic)

Quick Study

PHYSICS EQUATIONS & ANSWERS

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PHYSICS

EQUATIONS & ANSWERS

Essential Tool for Physics Laws, Concepts, Variables and Equations including - Sample Problems, Common Pitfalls and Helpful Hints

BASICS

A. Units for Physical Quantities

Base Units	Symbol	Unit
Length	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 ²
Ang. Accel.	α	rad/s ²
Ang. Momentum	L	kg m ² /s
Ang. Velocity	ω	rad/s
Angle	θ, φ	radian
Capacitance	C	Farad (F, C/V)
Charge	Q, q	Coulomb (C, A·s)
Density	ρ	kg/m ³
Displacement	s, Δx	meter (m)
Electric Field	E	V/m
Electric Flux	Φ _E	V·m
Electromotive Force (EMF)	ε	Volts (V)
Energy	E, U, Q	Joule (J, kg m ² /s ²)
Entropy	S	J/K
Force	F	Newton (N, kg m/s ²)
Frequency	f, ν	Hertz (Hz, 1/s)
Heat	Q	Joule (J)
Magnetic Field	B	Tesla (T, Wb/m ²)
Magnetic Flux	Φ _B	Weber (Wb, kg m ² /s ² A)
Momentum	p	kg m/s
Power	P	Watt (W, J/s)
Pressure	P	Pascal (Pa, N/m ²)
Resistance	R	Ohm (Ω, V/A)
Temperature	T	Kelvin (K)
Velocity	v	m/s
Volume	V	m ³
Wavelength	λ	meter (m)
Work	W	Joule (J, N·m)

B. Fundamental Physical Constants

Base Units	Symbol	Unit
Mass of electron	m _e	9.11 × 10 ⁻³¹ kg
Mass of proton	m _p	1.67 × 10 ⁻²⁷ kg
Avogadro Constant	N _A	6.02 × 10 ²³ mol ⁻¹
Elementary charge	e	1.60 × 10 ⁻¹⁹ C
Faraday constant	F	96,485 C/mol
Speed of light	c	3.00 × 10 ⁸ m/s
Molar Gas Constant	R	8.314 J mol ⁻¹ K ⁻¹
Boltzmann Constant	k	1.38 × 10 ⁻²³ J/K
Gravitational Constant	G	6.67 × 10 ⁻¹¹ m ³ kg ⁻¹ s ⁻²
Permeability of Space	μ ₀	4π × 10 ⁻⁷ N/A ²
Permittivity of Space	ε ₀	8.85 × 10 ⁻¹² C ² /N·m ²

C. Conversion Factors and Alternative Units

Unit	Description
Angle	1 degree = π/180 rad
Energy	1 eV = 1.60 × 10 ⁻¹⁹ J
Energy	1 Cal = 4.184 J
Force	1 dyne = 10 ⁻⁵ N
Volume	1 L = 1 dm ³
Pressure	1 bar = 10 ⁵ Pa
Length	1 Å = 10 ⁻¹⁰ m

MATHEMATICAL CONCEPTS

1. Vector Algebra

- Vector: Directed line segment having magnitude and direction.
- Unit vector: A vector of unit length in the direction of a vector A.
- Length of A: $|A| = \sqrt{A_x^2 + A_y^2 + A_z^2}$
- Addition of vectors A and B: add components.
- Sample Addition and Length Calculations:
 $A = 3i + 4j$, $B = 4i + 3j$
 $A + B = 7i + 7j$
 $|A + B| = \sqrt{7^2 + 7^2} = 9.9$
- Subtraction of vectors A and B: subtract components.
 $A - B = -i + j$
 $|A - B| = \sqrt{1^2 + 1^2} = 1.41$
- Dot product: $A \cdot B = |A||B|\cos\theta$
- Cross product: $A \times B = |A||B|\sin\theta \hat{n}$
- Sample Dot Product:
 $A = 3i + 4j$, $B = 4i + 3j$
 $A \cdot B = 12 + 12 = 24$
 $|A||B|\cos\theta = 5 \times 5 \cos\theta = 24$
 $\cos\theta = 24/25$
 $\theta = 23.1^\circ$
- Sample Cross Product:
 $A = 3i + 4j$, $B = 4i + 3j$
 $A \times B = (3 \times 3 - 4 \times 4)k = -k$
 $|A \times B| = 1$
 $|A||B|\sin\theta = 5 \times 5 \sin\theta = 1$
 $\sin\theta = 1/25$
 $\theta = 2.3^\circ$

2. Trigonometry

- Right triangle: $\sin\theta = \frac{\text{opposite}}{\text{hypotenuse}}$, $\cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}}$, $\tan\theta = \frac{\text{opposite}}{\text{adjacent}}$
- Sample calculations:
 $\theta = \sin^{-1}(0.5) = 30^\circ$
 $\theta = \cos^{-1}(0.5) = 60^\circ$
 $\theta = \tan^{-1}(0.5) = 26.6^\circ$
- Law of Sines: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
- Law of Cosines: $a^2 = b^2 + c^2 - 2bc\cos A$
- Area of triangle: $A = \frac{1}{2}bc\sin A$
- Sample calculations:
 $a = \sqrt{b^2 + c^2 - 2bc\cos A} = \sqrt{5^2 + 6^2 - 2(5)(6)\cos 60^\circ} = 4$
 $A = \sin^{-1}(\frac{a}{b}\sin B) = \sin^{-1}(\frac{4}{6}\sin 60^\circ) = 41.8^\circ$
 $\text{Area} = \frac{1}{2}(5)(6)\sin 60^\circ = 12.99$

3. Vector Product

- Angle between A and B: vector A is perpendicular to A × B.
- Sample Vector Product:
 $A = 3i + 4j$, $B = 4i + 3j$
 $A \times B = (3 \times 3 - 4 \times 4)k = -k$
 $|A \times B| = 1$
 $|A||B|\sin\theta = 5 \times 5 \sin\theta = 1$
 $\sin\theta = 1/25$
 $\theta = 2.3^\circ$
- Angle between A and B: vector A is perpendicular to A × B.
- Sample Vector Product:
 $A = 3i + 4j$, $B = 4i + 3j$
 $A \times B = (3 \times 3 - 4 \times 4)k = -k$
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Synopsis

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

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