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Physics Equations & Answers (Quick Study Academic)

Quick Study Academic **PHYSICS EQUATIONS & ANSWERS**

Essential Tool for Physics Learners, 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
Theory Constant	c	Angstrom - Å (10 ⁻¹⁰ m)

Derived Units

Symbol	Unit	
Acceleration	a	m/s ²
Ang. Area	A	radian ²
Ang. Momentum	L	kg m ² /s
Ang. Velocity	ω	radian/s
Angle	θ, φ	radian
Capacitance	C	Farad F (C ² /V)
Charge	Q, q, e	Coulomb C (A·s)
Density	ρ	kg/m ³
Displacement	s, Δs	meter - m
Electric Field	E	V/m
Electric Flux	Φ _E	V·m
Electromotive Force (EMF)	ε	Volt - V
Energy	E, U, K, Δ	Joule (kg m ² /s ²)
Energy	U	Joule
Force	F	Newton - N (kg m/s ²)
Frequency	f, ν	Hertz - Hz (cycles/s)
Heat	Q	Joule - J
Magnetic Field	B	Tesla (N/A·m)
Magnetic Flux	Φ _B	Weber (kg m ² /s ² ·A)
Momentum	p	kg m/s
Power	P	Wattage W (J/s)
Power	P, 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	6.022 × 10 ²³ mol ⁻¹
Elementary charge	e	1.602 × 10 ⁻¹⁹ C
Faraday constant	F	96,485 C/mol
Speed of light	c	3 × 10 ⁸ m/s
Molar Gas Constant	R	8.314 J mol ⁻¹ K ⁻¹
Boltzmann Constant	k	1.38 × 10 ⁻²³ J K ⁻¹
Gravitation Constant	G	6.67 × 10 ⁻¹¹ m ³ kg ⁻¹ s ⁻²
Permittivity of Space	ε ₀	8.85 × 10 ⁻¹² N/A ²
Permeability of Space	μ ₀	4π × 10 ⁻⁷ T·m/A

C. Conversion Factors and alternate units

Unit	Description
Angle	1 radian = 57.3°
Energy	1 eV = 1.602 × 10 ⁻¹⁹ 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

1. Vector: Directed distance (characterized using (x, y, z) components)

a. 3-D vector: $\vec{A} = A_x \hat{i} + A_y \hat{j} + A_z \hat{k}$

b. Vector: $\vec{A} = A_x \hat{i} + A_y \hat{j}$

c. Length of $\vec{A} = \sqrt{A_x^2 + A_y^2 + A_z^2}$

2. Addition of vectors: $\vec{A} + \vec{B} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{j} + (A_z + B_z)\hat{k}$

3. Sample Addition and Length Calculations

$\vec{A} = 3\hat{i} + 4\hat{j}$ $\vec{B} = -2\hat{i} + 3\hat{j} + 5\hat{k}$

$\vec{A} + \vec{B} = 1\hat{i} + 7\hat{j} + 5\hat{k}$ $|\vec{A} + \vec{B}| = \sqrt{1^2 + 7^2 + 5^2} = \sqrt{75} = 8.66$

$\vec{A} + \vec{B} = 1\hat{i} + 7\hat{j} + 5\hat{k}$ $|\vec{A} + \vec{B}| = \sqrt{1^2 + 7^2 + 5^2} = \sqrt{75} = 8.66$

Note: $|\vec{A} + \vec{B}| \neq |\vec{A}| + |\vec{B}|$

a. This is scalar product: $\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$

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

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

$\vec{A} \cdot \vec{B} = 3(-2) + 4(3) = -6 + 12 = 6$

$|\vec{A}| = \sqrt{3^2 + 4^2} = 5$ $|\vec{B}| = \sqrt{(-2)^2 + 3^2} = \sqrt{13} = 3.61$

$6 = 5(3.61) \cos \theta$ $\cos \theta = \frac{6}{18.05} = 0.332$ $\theta = 70.5^\circ$

2. Multiply \vec{A} & \vec{B}

a. This is scalar product: $\vec{A} \cdot \vec{B} = |\vec{A}| |\vec{B}| \cos \theta$

b. $\vec{A} = 3\hat{i} + 4\hat{j}$ $\vec{B} = -2\hat{i} + 3\hat{j}$

$\vec{A} \cdot \vec{B} = 3(-2) + 4(3) = -6 + 12 = 6$

$|\vec{A}| = \sqrt{3^2 + 4^2} = 5$ $|\vec{B}| = \sqrt{(-2)^2 + 3^2} = \sqrt{13} = 3.61$

$6 = 5(3.61) \cos \theta$ $\cos \theta = \frac{6}{18.05} = 0.332$ $\theta = 70.5^\circ$

3. Imparting

1. Basic relations for a triangle: $\vec{A} + \vec{B} = \vec{C}$

2. Values of sin, cos and tan

3. Unit and sine waves



Synopsis

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

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