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Physics Equations & Answers (Quick Study Academic)

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Quick Study
ACADEMIC

PHYSICS

EQUATIONS & ANSWERS

Essential Tool for Physics Laws, Concepts, Variables and Equations including Sample Problems, Common Pitfalls and Physical Facts

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 Constant	ϵ	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	radian
Capacitance	C	Farad F (C/V)
Charge	Q	Coulomb (C/A/s)
Density	ρ	kg/m ³
Displacement	s	meter (m)
Electric Field	E	V/m
Electric Flux	Φ_E	V·m
Electromotive Force (EMF)	$\mathcal{E}$	Volt (V)
Energy	E, U, K	Joule (J/kg m ² s ⁻²)
Entropy	S	J/K
Force	F	Newton (N/kg m/s ²) = J/m
Frequency	f	Hertz (Hz) (cycles/s)
Heat	Q	Joule (J)
Magnetic Field	B	Tesla (T) (Wb/m ²)
Magnetic Flux	Φ_B	Weber (Wb/kg m ² s ⁻²)
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	1.602×10^{-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
Gravitational Constant	G	6.67×10^{-11} m ³ kg ⁻¹ s ⁻²
Permeability of Space	μ_0	$4\pi \times 10^{-7}$ N/A ²
Permittivity of Space	ϵ_0	8.85×10^{-12} F/m

C. Conversion Factors and Approximate Values

Unit	Description
Angle	1 radian = $180^\circ/\pi$
Energy	1 eV = 1.602×10^{-19} J
Force	1 dyne = 10^{-5} N
Volume	1 L = 10^{-3} m ³
Pressure	1 Pa = 10^5 N/m ²
Length	1 Å = 10^{-10} m

MATHEMATICAL CONCEPTS

A. Vector Algebra

1. Vector: Directed quantity (magnitude & direction) (e.g., $\vec{A}$)
2. Unit vector: (along $\vec{A}$) along $\hat{A}$, along $\hat{B}$
3. Length of $\vec{A}$: $|\vec{A}| = \sqrt{A_x^2 + A_y^2 + A_z^2}$
4. Addition of vectors $\vec{A}$ & $\vec{B}$: add components
 $\vec{A} + \vec{B} = (A_x + B_x)\hat{i} + (A_y + B_y)\hat{j} + (A_z + B_z)\hat{k}$
5. Sample Addition and Length Calculations:
 $\vec{A} = 3\hat{i} + 4\hat{j}$, $\vec{B} = 2\hat{i} + 3\hat{j} + 4\hat{k}$
 $\vec{A} + \vec{B} = 5\hat{i} + 7\hat{j} + 4\hat{k}$
 $|\vec{A} + \vec{B}| = \sqrt{5^2 + 7^2 + 4^2} = \sqrt{74} \approx 8.60$
6. Dot or scalar product: $\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}|\cos\theta$
7. Cross or vector product: $\vec{A} \times \vec{B} = |\vec{A}||\vec{B}|\sin\theta\hat{n}$
8. Right-hand rule gives the direction of vector $\vec{A} \times \vec{B}$

9. Note: $\vec{A} \cdot \vec{A} = |\vec{A}|^2$
10. Multiply $\vec{A}$ & $\vec{B}$:
 $\vec{A} \cdot \vec{B} = A_x B_x + A_y B_y + A_z B_z$
 $\vec{A} \times \vec{B} = (A_y B_z - A_z B_y)\hat{i} + (A_z B_x - A_x B_z)\hat{j} + (A_x B_y - A_y B_x)\hat{k}$
11. Sample: Vector product:
 $\vec{A} = 3\hat{i} + 4\hat{j}$, $\vec{B} = 2\hat{i} + 3\hat{j} + 4\hat{k}$
 $\vec{A} \times \vec{B} = (4 \cdot 4 - 3 \cdot 12)\hat{i} + (3 \cdot 2 - 3 \cdot 0)\hat{j} + (3 \cdot 3 - 4 \cdot 0)\hat{k}$
 $\vec{A} \times \vec{B} = (-4)\hat{i} + 6\hat{j} + 9\hat{k}$
 $|\vec{A} \times \vec{B}| = \sqrt{(-4)^2 + 6^2 + 9^2} = \sqrt{101} \approx 10.05$

B. Circle or Vector Product

1. Circle: $C = 2\pi r$
2. Area: $A = \pi r^2$
3. Volume: $V = \frac{4}{3}\pi r^3$
4. Surface area: $S = 4\pi r^2$
5. Sample: Vector Product:
 $\vec{A} = 3\hat{i} + 4\hat{j}$, $\vec{B} = 2\hat{i} + 3\hat{j} + 4\hat{k}$
 $\vec{A} \times \vec{B} = (-4)\hat{i} + 6\hat{j} + 9\hat{k}$
 $|\vec{A} \times \vec{B}| = \sqrt{(-4)^2 + 6^2 + 9^2} = \sqrt{101} \approx 10.05$
6. Note: $\vec{A} \cdot \vec{B} = |\vec{A}||\vec{B}|\cos\theta$
7. Note: $\vec{A} \times \vec{B} = |\vec{A}||\vec{B}|\sin\theta\hat{n}$
8. Right-hand rule gives the direction of vector $\vec{A} \times \vec{B}$

C. Trigonometry

1. Basic relations for a triangle: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$
2. Values of $\sin, \cos, \tan$
 $\sin 0^\circ = 0$, $\cos 0^\circ = 1$, $\tan 0^\circ = 0$
 $\sin 30^\circ = \frac{1}{2}$, $\cos 30^\circ = \frac{\sqrt{3}}{2}$, $\tan 30^\circ = \frac{1}{\sqrt{3}}$
 $\sin 45^\circ = \frac{1}{\sqrt{2}}$, $\cos 45^\circ = \frac{1}{\sqrt{2}}$, $\tan 45^\circ = 1$
 $\sin 60^\circ = \frac{\sqrt{3}}{2}$, $\cos 60^\circ = \frac{1}{2}$, $\tan 60^\circ = \sqrt{3}$
 $\sin 90^\circ = 1$, $\cos 90^\circ = 0$, $\tan 90^\circ = \infty$
3. Area of triangle: $\frac{1}{2}ab\sin C$
4. Area of circle: πr^2
5. Circumference of circle: $2\pi r$
6. Volume of sphere: $\frac{4}{3}\pi r^3$
7. Surface area of sphere: $4\pi r^2$
8. Area of rectangle: $l \times b$
9. Area of triangle: $\frac{1}{2} \times \text{base} \times \text{height}$
10. Area of circular ring: $\pi(R^2 - r^2)$
11. Area of annulus: $\pi(R^2 - r^2)$
12. Area of circular sector: $\frac{\theta}{360} \times \pi r^2$
13. Length of arc: $\frac{\theta}{360} \times 2\pi r$

Synopsis

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

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Many books will go out of date, from 2006, this pamphlet of Physics Equations & Answers (Quick Study Academic) Pamphlet â “ February 14, 2006 will not. It is a given. It's fact! When you don't have all this committed to memory, then this pamphlet will allow you to refresh and remember. It is really worth having. I like it a lot.

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