Physics formulas from Mechanics, Waves, Optics, Heat and Thermodynamics, Electricity and Magnetism and Modern Physics. Also includes the value of Physical Constants. Helps in quick revision for CBSE, NEET, JEE Mains, and Advanced.

0.1: Physical Constants

	1000000	
Speed of light	·C	$3 \times 10^8 \text{ m/s}$
Planck constant	3%	$6.63 \times 10^{-34} \text{ J s}$
	Perc	1242 eV-mm
Gravitation constant	402	$6.67 \times 10^{-11} \text{ m}^3 \text{ kg}^{-1} \text{ s}^{-1}$
Boltzmann constant	. Ag	$1.38 \times 10^{-23} \text{ J/K}$
Molar gas constant	372	8.314 J/(mol K)
Avogadro's number	NA	$6.023 \times 10^{23} \text{ mol}^{-1}$
Charge of electron	400	$1.602 \times 10^{-19} \text{ C}$
Permeability of vac-	APPOI	$4\pi \times 10^{-7} \text{ N/A}^2$
Permittivity of vacuum	45.00	$8.85 \times 10^{-12} \text{ F/m}$
Coulomb constant	No.	$9 \times 10^9 \text{ N m}^2/\text{C}^2$
Faraday constant	F	96485 C/mol
Mass of electron	3794	$9.1 \times 10^{-31} \text{ kg}$
Mass of proton	XIV.	$1.6726 \times 10^{-27} \text{ kg}$
Mass of neutron	700 m	$1.6749 \times 10^{-27} \text{ kg}$
Atomic mass unit	3.0	$1.66 \times 10^{-27} \text{ kg}$
Atomic mass unit	1.0	931.49 MeV/e ²
Stefan-Boltzmann constant	e#	$5.67 \times 10^{-8} \text{ W/(m}^2 \text{ K}^4)$
Rydberg constant	R_{∞}	$1.097 \times 10^7 \text{ m}^{-1}$
Bohr magneton	10.00	$9.27 \times 10^{-24} \text{ J/T}$
Bohr radius	400	$0.529 \times 10^{-10} \text{ m}$
Standard atmosphere	45.500	$1.01325 \times 10^{5} \text{ Pa}$
Wien displacement constant	ь	$2.9\times10^{-3}~\mathrm{m~K}$

1 MECHANICS

1.1: Vectors

Notation:
$$\vec{a} = a_x i + a_y j + a_z \hat{k}$$

Magnitude:
$$a = |\vec{a}| = \sqrt{a_x^2 + a_y^2 + a_z^2}$$

Dot product:
$$\vec{a} \cdot \vec{b} = a_x b_x + a_y b_y + a_z b_z = ab \cos \theta$$

Cross product:

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$$\vec{a} \times \vec{b} = (a_y b_x - a_x b_y) \hat{i} + (a_x b_x - a_x b_x) \hat{j} + (a_x b_y - a_y b_x) \hat{k}$$

 $|\vec{a} \times \vec{b}| = ab \sin \theta$

1.2: Kinematics

Average and Instantaneous Vel. and Accel.:

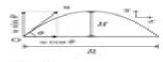
$$\vec{v}_{tor} = \Delta \vec{r} / \Delta t$$
, $\vec{v}_{inst} = d\vec{r} / dt$
 $\vec{\sigma}_{tor} = \Delta \vec{v} / \Delta t$ $\vec{\sigma}_{inst} = d\vec{v} / dt$

Motion in a straight line with constant a:

$$v = u + at$$
, $s = ut + \frac{1}{2}at^2$, $v^2 - u^2 = 2as$

Relative Velocity:
$$\vec{v}_{A/B} = \vec{v}_A - \vec{v}_B$$

Projectile Motion:



$$x = ut \cos \theta$$
, $y = ut \sin \theta - \frac{1}{2}gt^2$
 $y = x \tan \theta - \frac{g}{2u^2 \cos^2 \theta}x^2$
 $T = \frac{2u \sin \theta}{g}$, $R = \frac{u^2 \sin 2\theta}{g}$, $H = \frac{u^2 \sin^2 \theta}{2g}$

1.3: Newton's Laws and Friction

Linear momentum:
$$\vec{p} = m\vec{v}$$

Newton's second law:
$$\vec{F} = \frac{d\vec{x}}{dt}$$
, $\vec{F} = m\vec{a}$

Newton's third law:
$$\vec{F}_{AB} = -\vec{F}_{BA}$$

Frictional force:
$$f_{\text{static, max}} = \mu_s N$$
, $f_{\text{kinetic}} = \mu_k N$

Banking angle:
$$\frac{v^2}{rg} = \tan \theta$$
, $\frac{v^2}{rg} = \frac{\mu + \tan \theta}{1 - \mu \tan \theta}$

Centripetal force:
$$F_c = \frac{m_F^2}{r}$$
, $a_c = \frac{v^2}{r}$

Pseudo force:
$$\vec{F}_{pseudo}^{z} = -m\vec{a}_{0}$$
, $F_{centrifugal} = -\frac{mr^{2}}{\sigma}$

Minimum speed to complete vertical circle:

$$v_{\text{min. bottom}} = \sqrt{5al}$$
, $v_{\text{min. top}} = \sqrt{gl}$

Conical pendulum: $T = 2\pi \sqrt{\frac{t\cos\theta}{g}}$



1.4: Work, Power and Energy

Work:
$$W = \vec{F} \cdot \vec{S} = FS \cos \theta$$
, $W = \int \vec{F} \cdot d\vec{S}$

Kinetic energy:
$$K = \frac{1}{3}mv^2 = \frac{e^2}{4m}$$

Potential energy:
$$F = -\partial U/\partial x$$
 for conservative forces.

$$U_{\text{gravitational}} = mgh$$
, $U_{\text{spring}} = \frac{1}{2}kx^2$

Work done by conservative forces is path independent and depends only on initial and final points: $\oint \vec{F}_{conservative} \cdot d\vec{r} = 0$.

Work-energy theorem:
$$W = \Delta K$$

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