Physics Formulas For Class 10 - Physics Formulas List

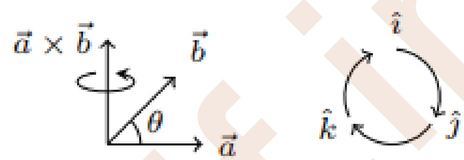
Vectors

Notation: $\vec{a} = a_x\,\hat{\imath} + a_y\,\hat{\jmath} + a_z\,\hat{k}$

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:



$$\vec{a}\times\vec{b} = (a_y b_z - a_z b_y)\hat{\imath} + (a_z b_x - a_x b_z)\hat{\jmath} + (a_x b_y - a_y b_x)\hat{k}$$

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

Kinematics

Average and Instantaneous Vel. and Accel.:

$$\vec{v}_{\rm av} = \Delta\vec{r}/\Delta t, \qquad \vec{v}_{\rm inst} = d\vec{r}/dt$$
$$\vec{a}_{\rm av} = \Delta\vec{v}/\Delta t \qquad \vec{a}_{\rm inst} = d\vec{v}/dt$$

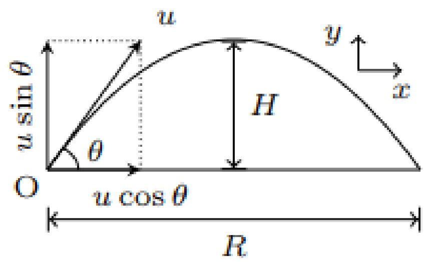
Motion in a straight line with constant a:

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

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

Projectile Motion

Projectile Motion:



$$x = ut\cos\theta, \quad y = ut\sin\theta - \tfrac{1}{2}gt^2$$

$$y = x\tan\theta - \frac{g}{2u^2\cos^2\theta}x^2$$

$$T = \frac{2u\sin\theta}{g}, \quad R = \frac{u^2\sin 2\theta}{g}, \quad H = \frac{u^2\sin^2\theta}{2g}$$

Work, Power and Energy

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

Kinetic energy: $K = \frac{1}{2}mv^2 = \frac{p^2}{2m}$

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

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

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

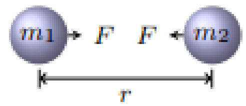
Work-energy theorem: $W = \Delta K$

Mechanical energy: $E = U + K$. Conserved if forces are conservative in nature.

Power $P_{\text{av}} = \frac{\Delta W}{\Delta t}, \quad P_{\text{inst}} = \vec{F}\cdot\vec{v}$

Gravitation

Gravitational force: $F = G\frac{m_1 m_2}{r^2}$



Potential energy: $U = -\frac{GMm}{r}$

Gravitational acceleration: $g = \frac{GM}{R^2}$

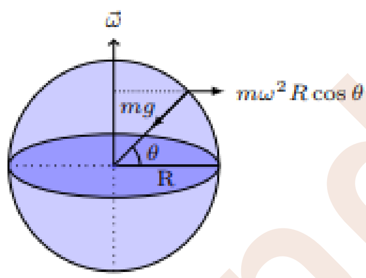
Variation of g with depth: $g_{\text{inside}} \approx g\left(1 - \frac{2h}{R}\right)$

Variation of g with height: $g_{\text{outside}} \approx g\left(1 - \frac{h}{R}\right)$

Effect of non-spherical earth shape on g:
$g_{\text{at pole}} > g_{\text{at equator}}$ $(\because R_{\text{e}} - R_{\text{p}} \approx 21\text{ km})$

Effect of earth rotation on apparent weight:

$$mg'_\theta = mg - m\omega^2 R\cos^2\theta$$



Orbital velocity of satellite: $v_o = \sqrt{\frac{GM}{R}}$

Waves Motion

General equation of wave: $\frac{\partial^2 y}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 y}{\partial t^2}$.

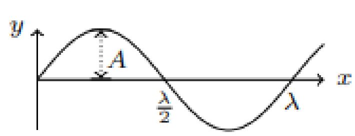
Notation: Amplitude A, Frequency ν, Wavelength λ, Period T, Angular Frequency ω, Wave Number k,

$$T = \frac{1}{\nu} = \frac{2\pi}{\omega}, \quad v = \nu\lambda, \quad k = \frac{2\pi}{\lambda}$$

Progressive wave travelling with speed v:

$$y = f(t - x/v), \rightsquigarrow +x; \quad y = f(t + x/v), \rightsquigarrow -x$$

Progressive sine wave:



$$y = A\sin(kx - \omega t) = A\sin(2\pi\,(x/\lambda - t/T))$$

Sound Wave

Displacement wave: $s = s_0 \sin \omega(t - x/v)$

Pressure wave: $p = p_0 \cos \omega(t - x/v)$, $p_0 = (B\omega/v)s_0$

Speed of sound waves:

$$v_{\text{liquid}} = \sqrt{\frac{B}{\rho}}, \quad v_{\text{solid}} = \sqrt{\frac{Y}{\rho}}, \quad v_{\text{gas}} = \sqrt{\frac{\gamma P}{\rho}}$$

Intensity: $I = \frac{2\pi^2 B}{v} {s_0}^2 \nu^2 = \frac{{p_0}^2 v}{2B} = \frac{{p_0}^2}{2\rho v}$

Standing longitudinal waves:

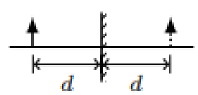
$$p_1 = p_0 \sin \omega(t - x/v), \quad p_2 = p_0 \sin \omega(t + x/v)$$
$$p = p_1 + p_2 = 2p_0 \cos kx \sin \omega t$$

Reflection of Light

Laws of reflection:

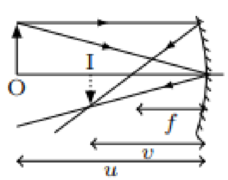
(i) Incident ray, reflected ray, and normal lie in the same plane (ii) $\angle i = \angle r$

Plane mirror:



(i) the image and the object are equidistant from mirror (ii) virtual image of real object

Spherical Mirror:



1. Focal length $f = R/2$
2. Mirror equation: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$
3. Magnification: $m = -\frac{v}{u}$

Heat and Temperature

Temp. scales: $F = 32 + \frac{9}{5}C, \quad K = C + 273.16$

Ideal gas equation: $pV = nRT, \quad n$: number of moles

van der Waals equation: $\left(p + \frac{a}{V^2}\right)(V - b) = nRT$

Thermal expansion: $L = L_0(1 + \alpha\Delta T)$,
$A = A_0(1 + \beta\Delta T)$, $V = V_0(1 + \gamma\Delta T)$, $\gamma = 2\beta = 3\alpha$

Thermal stress of a material: $\frac{F}{A} = Y\frac{\Delta l}{l}$

Specific Heat

Specific heat: $s = \frac{Q}{m\Delta T}$

Latent heat: $L = Q/m$

Specific heat at constant volume: $C_v = \left.\frac{\Delta Q}{n\Delta T}\right|_V$

Specific heat at constant pressure: $C_p = \left.\frac{\Delta Q}{n\Delta T}\right|_p$

Relation between C_p and C_v: $C_p - C_v = R$

Ratio of specific heats: $\gamma = C_p/C_v$

Relation between U and C_v: $\Delta U = nC_v\Delta T$

Specific heat of gas mixture:

$$C_v = \frac{n_1C_{v1} + n_2C_{v2}}{n_1 + n_2}, \quad \gamma = \frac{n_1C_{p1} + n_2C_{p2}}{n_1C_{v1} + n_2C_{v2}}$$

Molar internal energy of an ideal gas: $U = \frac{f}{2}RT$,
$f = 3$ for monatomic and $f = 5$ for diatomic gas.

Photoelectric Effect

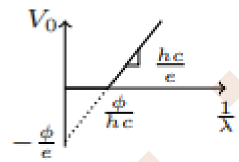
Photon's energy: $E = h\nu = hc/\lambda$

Photon's momentum: $p = h/\lambda = E/c$

Max. KE of ejected photo-electron: $K_{\max} = h\nu - \phi$

Threshold freq. in photo-electric effect: $\nu_0 = \phi/h$

Stopping potential: $V_o = \frac{hc}{e}\left(\frac{1}{\lambda}\right) - \frac{\phi}{e}$



de Broglie wavelength: $\lambda = h/p$