

JEE Main Physics: 20 Most Important Formulas

Chapter-wise formula sheet for quick revision

1. Projectile Motion

$$T = 2u \sin\theta / g$$

$$H = u^2 \sin^2\theta / 2g$$

$$R = u^2 \sin 2\theta / g$$

$$R(\max) = u^2 / g \text{ (at } \theta = 45^\circ \text{)}$$

$$H / R = \tan\theta / 4$$

2. Newton's Laws of Motion (Bodies in Contact, Pulleys)

$$a = F(\text{net}) / m(\text{total})$$

$$F = ma \text{ (apply on each body's free body diagram)}$$

3. Work-Energy Theorem

$$W = \Delta KE = \frac{1}{2}m(v^2 - u^2)$$

4. Young's Modulus

$$Y = \text{Stress} / \text{Strain} = (F/A) / (\Delta L/L) = FL / (A\Delta L)$$

$$\Delta L = FL / (AY)$$

5. Continuity and Bernoulli's Equation

$$A_1 v_1 = A_2 v_2$$

$$P + \frac{1}{2}\rho v^2 + \rho gh = \text{constant}$$

$$v = \sqrt{2gh} \text{ (Torricelli, } h = \text{depth of hole)}$$

6. First Law of Thermodynamics

$$\Delta Q = \Delta U + W$$

$$\text{Adiabatic: } \Delta Q = 0, \Delta U = -W$$

$$PV^\gamma = \text{constant}$$

$$W = nR\Delta T / (1 - \gamma) = (P_2 V_2 - P_1 V_1) / (1 - \gamma)$$

7. Degrees of Freedom

$$U = (f/2) nRT$$

$$C_v = fR/2, C_p = (f/2 + 1)R, \gamma = C_p/C_v$$

Gas	f	C _v	C _p	γ
Monatomic	3	3R/2	5R/2	5/3
Diatomic	5	5R/2	7R/2	7/5
Triatomic (non-linear)	6	3R	4R	4/3

8. Electric Field for Different Shapes

Infinite wire: $E = 2k\lambda / r$

Finite wire (perpendicular): $E = (k\lambda/r)(\sin\theta_1 + \sin\theta_2)$

Arc: $E = (2k\lambda/r) \sin(\theta/2)$

Ring axis: $E = kQx / (R^2 + x^2)^{3/2}$; centre: $E = 0$

Hollow sphere: inside 0; outside kQ/r^2

Solid non-conducting sphere: inside kQr / R^3 ; outside kQ/r^2

9. Electric Potential and Potential Energy

$U = kq_1q_2 / r$

$V = kq / r$

$E = -dV/dr$, $\Delta V = -\int E \cdot dr$

$W = q \Delta V$

10. Combination of Resistors

Series: $R = R_1 + R_2 + \dots$

Parallel: $1/R = 1/R_1 + 1/R_2 + \dots$

Balanced Wheatstone bridge: $P/Q = R/S$

11. Magnetic Field

Ring centre: $B = \mu_0 i / 2R$

Ring axis: $B = \mu_0 i R^2 / [2(R^2 + x^2)^{3/2}]$

Straight wire: $B = (\mu_0 i / 4\pi r)(\sin\theta_1 + \sin\theta_2)$

Infinite wire: $B = \mu_0 i / 2\pi r$

12. Charged Particle in a Magnetic Field

$F = qvB \sin\theta$ ($F = q \mathbf{v} \times \mathbf{B}$)

$r = mv / qB = \sqrt{2mK} / qB$

$F \perp B$, so $\mathbf{a} \cdot \mathbf{B} = 0$

13. Magnetic Flux and Faraday's Law

$\phi = BA \cos\theta$

$\epsilon = -d\phi/dt$

14. LCR Series Circuit

$Z = \sqrt{R^2 + (X_L - X_C)^2}$

$X_L = \omega L$, $X_C = 1/\omega C$

Resonance: $\omega = 1/\sqrt{LC}$, $f = 1 / (2\pi\sqrt{LC})$

15. Refraction and Lens Maker's Formula

$$\mu_2/v - \mu_1/u = (\mu_2 - \mu_1)/R$$

$$1/f = (\mu - 1)(1/R_1 - 1/R_2)$$

$$f(\text{medium}) / f(\text{air}) = (\mu_L - 1) / (\mu_L/\mu_m - 1)$$

16. Einstein's Photoelectric Equation

$$h\nu = \phi + K(\text{max}) = h\nu_0 + K(\text{max})$$

$$K(\text{max}) = eV_0$$

$$E = hc/\lambda$$

17. Bohr's Atomic Model

$$r = 0.529 n^2/Z \text{ \AA} \quad (r \propto n^2/Z)$$

$$v = 2.2 \times 10^6 \times Z/n \text{ m/s} \quad (v \propto Z/n)$$

$$T \propto n^3/Z^2$$

$$mvr = nh / 2\pi$$

18. De Broglie Wavelength

$$\lambda = h/p = h / \sqrt{2mK} = h / \sqrt{2mqV}$$

$$\text{Electron: } \lambda = 12.27 / \sqrt{V} \text{ \AA}$$

$$\text{Proton: } 0.286 / \sqrt{V} \text{ \AA}$$

$$\text{Deuteron: } 0.202 / \sqrt{V} \text{ \AA}$$

$$\text{Alpha particle: } 0.101 / \sqrt{V} \text{ \AA}$$

19. Hydrogen Spectrum

$$1/\lambda = RZ^2 (1/n_1^2 - 1/n_2^2), R \approx 1.09 \times 10^7 \text{ m}^{-1}$$

$$\text{Lyman } n_1 = 1, \text{ Balmer } n_1 = 2, \text{ Paschen } n_1 = 3, \text{ Brackett } n_1 = 4, \text{ Pfund } n_1 = 5$$

$$\lambda(\text{max}): n_2 = n_1 + 1$$

$$\lambda(\text{min}): n_2 = \infty$$

20. Mass Defect and Binding Energy

$$\Delta m = Z \cdot m_p + (A - Z) \cdot m_n - M(\text{nucleus})$$

$$BE = \Delta m c^2 \quad (1 \text{ u} = 931.5 \text{ MeV})$$