

Useful Formulae in Advanced Level Physics

- A1. $a = \frac{v^2}{r} = \omega^2 r$ centripetal acceleration
- A2. $a = \omega^2 \chi$ simple harmonic motion
- A3. $L = I\omega$ angular momentum of a rigid body
- A4. $T = \frac{dL}{dt}$ torque on a rotating body
- A5. $E = \frac{1}{2} I\omega^2$ energy stored in a rotating body
- B1. $v = \sqrt{\frac{T}{m}}$ velocity of transverse wave motion in a stretched string
- B2. $v = \sqrt{\frac{E}{\rho}}$ velocity of longitudinal wave motion in a solid
- B3. $n = \tan \theta_p$ refractive index and polarizing angle
- B4. $d = \frac{\lambda D}{a}$ fringe width in double-slit interference
- B5. $d \sin \theta = n\lambda$ diffraction grating equation
- B6. $f' = f \left(\frac{v - u_o}{v - u_s} \right)$ Doppler frequency
- B7. $10 \log_{10} \left(\frac{I_2}{I_1} \right)$ definition of the decibel
- C1. $F = \frac{Gm_1 m_2}{r^2}$ Newton's law of gravitation
- C2. $V = \frac{GM}{r}$ gravitational potential
- C3. $r^3 / T^2 = \text{constant}$ Kepler's third law
- C4. $E = \frac{Q}{4\pi\epsilon_0 r^2}$ electric field due to a point charge
- C5. $V = \frac{Q}{4\pi\epsilon_0 r}$ electric potential due a point charge

- C6. $E = \frac{V}{d}$ electric field between parallel plates (numerically)
- C7. $C = \frac{Q}{V} = \frac{\epsilon_0 A}{d}$ capacitance of a parallel-plate capacitor
- C8. $Q = Q_0 e^{-t/RC}$ decay of charge with time when a capacitor discharges
- C9. $Q = Q_0 (1 - e^{-t/RC})$ rise of charge with time when charging a capacitor
- C10. $E = \frac{1}{2} CV^2$ energy stored in a capacitor
- C11. $I = nA v Q$ general current flow equation
- C12. $R = \frac{\rho l}{A}$ resistance and resistivity
- C13. $F = BQv \sin \theta$ force on a moving charge in a magnetic field
- C14. $F = BIl \sin \theta$ force on a current carrying a conductor in a magnetic field
- C15. $V = \frac{BI}{nQt}$ Hall voltage
- C16. $B = \frac{\mu_0 I}{2\pi r}$ magnetic field inside a long straight wire
- C17. $B = \frac{\mu_0 NI}{l}$ magnetic field inside long solenoid
- C18. $F = \frac{\mu_0 I_1 I_2}{2\pi r}$ force per unit length between long parallel straight current carrying conductors
- C19. $T = BAN \sin \phi$ torque on a rectangular current carrying coil in a uniform magnetic field
- C20. $E = BAN \omega \sin \omega t$ simple generator e.m.f.
- C21. $\frac{V_s}{V_p} \approx \frac{N_s}{N_p}$ ratio of secondary voltage to primary voltage in a transformer
- C22. $E = -L di / dt$ e.m.f. induced in an inductor
- C23. $E = \frac{1}{2} LI^2$ energy stored in an inductor
- C24. $X_L = \omega L$ reactance of an inductor

- C25. $X_C = \frac{1}{\omega C}$ reactance of a capacitor
- C26. $P = IV \cos \theta$ power in an a.c. circuit
- C27. $\Delta V_{out} / \Delta V_{in} = -\beta \frac{R_L}{R_B}$ voltage gain of transistor amplifier in the common emitter configuration
- C28. $V_o = A_o (V_+ - V_-)$ output voltage of op amp (open-loop)
- C29. $A = -\frac{R_f}{R_i}$ gain of inverting amplifier
- C30. $A = 1 + \frac{R_f}{R_i}$ gain of non-inverting amplifier
- D1. $pV = nRT = NkT$ equation of state for an ideal gas
- D2. $pV = \frac{1}{3} Nmc^2$ kinetic theory equation
- D3. $E_k = \frac{3RT}{2N_A} = \frac{3}{2} kT$ molecular kinetic energy
- D4. $E = \frac{F}{A} \cdot \frac{x}{L}$ macroscopic definition of Young modulus
- D5. $E = \frac{1}{2} Fx$ energy stored in stretching
- D6. $F = -\frac{dU}{dr}$ relationship between force and potential energy
- D7. $E = k/r$ microscopic interpretation of Young modulus
- D8. $P + \frac{1}{2} \rho v^2 + \rho gh = \text{constant}$ Bernoulli's equation
- D9. $\Delta U = Q + W$ first law of thermodynamics
- D10. $E_n = -\frac{13.6}{n^2} eV$ energy level equation for hydrogen atom
- D11. $N = N_o e^{-kt}$ law of radioactive decay
- D12. $t_{\frac{1}{2}} = \frac{\ln 2}{k}$ half-life and decay constant

D13. $\frac{1}{2}m v_m^2 = h\nu - \phi$ Einstein's photoelectric equation

D14. $E = mc^2$ mass-energy relationship



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