

Formulae Physics for Competitive Exams

No. Mechanics

1. Linear motion with constant acceleration

$$v = u + at$$

$$s = ut + \frac{1}{2}at^2$$

$$v^2 = u^2 + 2as$$

$$s = \left(\frac{u+v}{2}\right) \times t$$

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

2. Relative motion

$$S_{bc} = S_b - S_c$$

$$v_{bc} = v_b - v_c$$

$$a_{bc} = a_b - a_c$$

3. Momentum of a particle

$$mv$$

4. Newton's experimental law (NEL)

$$v_1 - v_2 = -e(u_1 - u_2)$$

5. Conservation of momentum

$$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$$

6. Impulse (change in momentum)

$$mv - mu$$

7. Angle in radians

$$\theta = \frac{s}{r}$$

8. Angular velocity

$$\omega = \frac{\theta}{t}$$

9. Linear velocity and angular velocity

$$v = r\omega$$

10. Centripetal acceleration

$$a = r\omega^2 = \frac{v^2}{r}$$

11. Centripetal force

$$F = mr\omega^2 = \frac{mv^2}{r}$$

12. Newton's law of gravitation

$$F = \frac{Gm_1m_2}{d^2}$$

13. Force and acceleration

$$F = ma$$

14. Weight and acceleration due to gravity

$$W = mg = v\rho g;$$
$$g = \frac{GM}{R^2}$$

15. Period of a satellite

$$T^2 = \frac{4\pi^2 R^2}{GM}$$

16. Moment of a force

$$M = Fd$$

17 Torque of a couple

$$T = Fd$$

Centres of gravity

1. Hemisphere, radius r

$$\frac{3}{8} \times r \text{ from centre}$$

2. Hemispherical shell, radius r

$$\frac{1}{2} \times r \text{ from centre}$$

3. Right circular cone

$$\frac{1}{4} \times h \text{ from the base}$$

4. Triangular lamina

$$\frac{1}{3} \text{ from base along median} = \left(\frac{x_1 + x_2 + x_3}{3}, \frac{y_1 + y_2 + y_3}{3} \right)$$

5. Arc, radius r , angle 2θ

$$\frac{r \sin \theta}{\theta}$$

6. Sector of disc, radius r , angle 2θ

$$\frac{2 r \sin \theta}{3 \theta}$$

Moment of Inertia

1. Uniform rod, length $2l$

$$\text{Centre} = \frac{1}{3}ml^2$$

$$\text{One end} = \frac{4}{3}ml^2$$

2. Uniform disc, radius r

$$\text{Centre} = \frac{1}{2}mr^2$$

$$\text{Diameter} = \frac{1}{4}mr^2$$

3. Uniform hoop, radius r

$$\text{Centre} = mr^2$$

$$\text{Diameter} = \frac{1}{2}mr^2$$

4. Uniform solid sphere, radius r

$$\text{Diameter} = \frac{2}{5}mr^2$$

5. Parallel axis theorem

$$I_b = I_c + m|bc|^2$$

6. Perpendicular axis theorem

$$I_z = I_x + I_y$$

7. Hooke's law

$$F = -ks$$

8. Simple harmonic motion

$$a = -\omega^2 s$$

$$T = \frac{1}{f} = \frac{2\pi}{\omega}$$

$$s = A \sin (\omega t + \alpha)$$

$$v^2 = \omega^2 (A^2 - s^2)$$

9. Simple pendulum

$$T = 2\pi \sqrt{\frac{l}{g}}$$

10. Compound pendulum

$$T = 2\pi\sqrt{\frac{I}{mgh}}$$

11. Work

$$W = Fs = \int F ds$$

12. Potential (gravitational) energy

$$E_p = mgh$$

13. Kinetic energy

$$E_k = \frac{1}{2}mv^2$$

14. Principle of conservation of mechanical energy

$$E_p + E_k = \text{constant}$$

15. Mass-energy equivalence

$$E = mc^2$$

16. Power

$$P = \frac{W}{t} = Fv$$

17. Percentage efficiency

$$\frac{\text{power output} \times 100}{\text{power input}}$$

18. Young's modulus

$$E = \frac{\sigma}{\epsilon}$$

19. Stress

$$\sigma = -\frac{F}{A}$$

20. Strain

$$\epsilon = \frac{\Delta l}{l}$$

21. Density

$$\rho = \frac{m}{v}$$

22. Pressure

$$p = \frac{F}{A}$$

23. Pressure in a fluid

$$p = \rho gh$$

24. Thrust on an immersed plane surface

$$T = AP_{\text{centroid}}$$

25. Boyle's law

$$pV = \text{constant}$$

Heat and temperature

1. Celsius temperature

$$\frac{t}{^{\circ}\text{C}} = \frac{T}{\text{K}} - 273.15$$

2. Energy needed to change temperature

$$\Delta E = mc \Delta \theta$$

$$\Delta E = C \Delta \theta$$

3. Energy needed to change state

$$\Delta E = ml$$

$$\Delta E = L$$

Waves

1. Velocity of a wave

$$c = f\lambda$$

2. Doppler effect

$$f' = \frac{fc}{c \pm u}$$

3. Fundamental frequency of a stretched string

$$f = \frac{1}{2l} \sqrt{\frac{T}{\mu}}$$

4. Mirror and lens formula

$$\frac{1}{f} = \frac{1}{u} + \frac{1}{v}$$

5. Magnification

$$m = \frac{v}{u}$$

6. Power of a lens

$$P = \frac{1}{f}$$

7. Two lenses in contact

$$P = P_1 + P_2$$

8. Refractive index

$$n = \frac{\sin i}{\sin r} = \frac{\text{real depth}}{\text{apparent depth}}$$

$$n = \frac{1}{\sin C} = \frac{c_1}{c_2}$$

9. Diffraction grating $n \lambda = d \sin \theta$

Electricity

1. Coulomb's law $F = \frac{1}{4 \pi \epsilon} \times \frac{q_1 q_2}{d^2}$

2. Electric field strength $E = \frac{F}{q}$

3. Potential difference $V = \frac{W}{q}$

4. Ohm's law $V = IR$

5. Resistivity $\rho = \frac{RA}{l}$

6. Resistors in series $R = R_1 + R_2$

7. Resistors in parallel $\frac{1}{R} = \frac{1}{R_1} + \frac{1}{R_2}$

8. Wheatstone bridge $\frac{R_1}{R_2} = \frac{R_3}{R_4}$

9. Joule's law $P = RI^2$

10. Force on a current-carrying conductor $F = IlB$

11. Force on a charged particle $F = qvB$

12. Induced emf $E = -\frac{d\phi}{dt}$

13. Alternating voltage and current $V_{rms} = \frac{v_0}{\sqrt{2}}$

$$I_{rms} = \frac{I_0}{\sqrt{2}}$$

14. Capacitance

$$C = \frac{q}{V}$$

15. Parallel-plate capacitor

$$C = \frac{A\epsilon_0}{d}$$

16. Energy stored in capacitor

$$W = \frac{1}{2}CV^2$$

17. Power

$$P = VI$$

18. Magnetic flux

$$\phi = BA$$

19. Transformer

$$\frac{V_i}{V_0} = \frac{N_p}{N_s}$$

Modern physics

1. Energy of a photon

$$E = hf$$

2. Einstein's photoelectric equation

$$hf = \phi + \frac{1}{2}mv_{max}^2$$

3. Law of radioactive decay

$$A = \lambda N$$

4. Half-life

$$T_{\frac{1}{2}} = \frac{\ln 2}{\lambda}$$

5. Mass-energy equivalence

$$E = mc^2$$