Physics Formula Sheet

Matthew Williams • Physics • May 20, 2026

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Section A — Mechanics

Measurement

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

Density ρ (kg m^{3}), mass m (kg), volume V (m^3).

Vectors

$$R = \sqrt{(F_1)^2 + (F_2)^2} \qquad \theta = \tan^{-1}\left(\frac{F_2}{F_1}\right)$$

Resultant of two perpendicular forces; θ measured from F_1.

$$F_x = F\cos\theta \qquad F_y = F\sin\theta$$

Resolving a force F at angle θ to the horizontal into components.

Statics

$$T = Fd$$

Moment T (N m), force F (N), perpendicular distance d (m).

$$F = ke$$

F k e

Hooke's Law: force (N), spring constant (N m^{-1}), extension (m). Valid up to the elastic limit only.

$$W = mg$$

Weight W (N), mass m (kg), gravitational field strength $g = 10$ N kg^{-1}.

Motion

$$v = u + at \qquad s = ut + \tfrac{1}{2}at^2 \qquad v^2 = u^2 + 2as \qquad s = \tfrac{1}{2}(u + v)t$$

SUVAT equations for uniform acceleration. All four assume constant a.

$$F = ma$$

Newton's Second Law: net force F (N), mass m (kg), acceleration a (m s^{-2}).

$$p = mv$$

Momentum p (kg m s^{-1}), mass m (kg), velocity v (m s^{-1}). Momentum is conserved in a closed system.

$$F\Delta t = \Delta(mv)$$

Impulse equals change in momentum. Force F (N), time Δt (s).

Energy, Work and Power

$$W = Fd$$

Work done W (J), force F (N), displacement d (m) in the direction of the force.

$$E_p = mgh \qquad E_k = \tfrac{1}{2}mv^2$$

Gravitational potential energy and kinetic energy (J).

$$P = \frac{E}{t}$$

Power P (W), energy E (J), time t (s).

$$\text{efficiency} = \frac{\text{useful energy output}}{\text{total energy input}} \times 100\%$$

Hydrostatics

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

Pressure P (Pa), force F (N), area A (m^2).

$$\Delta P = \rho g \Delta h$$

Fluid pressure at depth Δh (m); fluid density ρ (kg m^{-3}), $g = 10$ N kg^{-1}.

$$U = \rho_{\text{fluid}}\, g\, V_{\text{displaced}}$$

Upthrust (Archimedes): buoyant force equals weight of fluid displaced.

Section B — Thermal Physics

$$T(\text{K}) = \theta(^\circ\text{C}) + 273$$

Kelvin to Celsius conversion. Absolute zero = 0 K = −273 °C.

$$P_1 V_1 = P_2 V_2$$

Boyle's Law (constant temperature).

$$\frac{V_1}{T_1} = \frac{V_2}{T_2}$$

Charles' Law (constant pressure). Temperature must be in kelvin.

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

Pressure Law (constant volume). Temperature must be in kelvin.

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2}$$

General gas law. Temperature must be in kelvin.

$$E_H = mc\Delta\theta$$

Specific heat capacity: thermal energy E_H (J), mass m (kg), specific heat capacity c (J kg^{-1} K^{-1}), temperature change $\Delta\theta$ (K or °C).

$$E_H = mL$$

Specific latent heat: thermal energy E_H (J), mass m (kg), specific latent heat L (J kg^{-1}).

Section C — Waves and Optics

$$v = f\lambda \qquad f = \frac{1}{T}$$

Wave equation: speed v (m s^{-1}), frequency f (Hz), wavelength λ (m), period T (s).

$$d = \frac{vt}{2}$$

Echo distance: total time t (s), speed of sound $v \approx 330$

m s{. Factor of 2 because sound travels to reflector and back.

$$n = \frac{\sin i}{\sin r}$$

Snell's Law: refractive index n, angle of incidence i, angle of refraction r
. Angles measured from the normal.

$$n = \frac{c}{v}$$

Refractive index in terms of wave speeds: speed of light in vacuum $c = 3 \times 10^8$
m s{, speed in medium v.

$$n = \frac{\text{real depth}}{\text{apparent depth}}$$

Real and apparent depth relationship for a flat surface.

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

Critical angle C for total internal reflection. TIR occurs when $i > C$
and light travels from denser to less dense medium.

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

Lens magnification and lens formula: image distance v, object distance u, focal length f
. All distances measured from the optical centre; real distances are positive.

Section D — Electricity and Magnetism

$$I = \frac{Q}{t}$$

Current I (A), charge Q (C), time t (s).

$$R = \frac{V}{I}$$

Resistance R (Ω), potential difference V (V), current I (A).

$$R_s = R_1 + R_2 + R_3 + \cdots$$

Series circuit: resistances add directly.

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \cdots$$

Parallel circuit: reciprocals add.

$$P = IV = I^2R = \frac{V^2}{R}$$

Electrical power P (W). Choose the form that matches the given quantities.

$$E = Pt$$

Electrical energy E (J), power P (W), time t (s).

$$1\ \text{kWh} = 3.6 \times 10^6\ \text{J}$$

Unit conversion for electricity bills.

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} = \frac{I_p}{I_s}$$

Transformer ratios: secondary/primary voltage, turns, and current. For an ideal transformer: $VpIp = VsIs$.

Section E — Physics of the Atom

$$A = Z + N$$

Mass number A equals proton number Z plus neutron number N.

$$\Delta E = \Delta m c^2$$

Mass-energy equivalence: energy released ΔE (J), mass deficit Δm (kg), $c = 3 \times 10^8$ m s{.

Constants and Values

Quantity	Symbol	Value
Speed of light in vacuum	[Math: c]	[Math: 3 \times 10^8] m s{
Gravitational field strength (Earth)	[Math: g]	[Math: 10] N kg{
Speed of sound in air (approx.)	[Math: v_s]	[Math: 330] m s{
Absolute zero		[Math: -273] °C = [Math: 0] K
1 kilowatt-hour	1 kWh	[Math: 3.6 \times 10^6] J