

Grade 12 Physics: Key Formulas and Concepts for Revision

Physics marks come from three skills: knowing the formula, knowing when to use it, and keeping units straight. This note maps the main areas of Grade 11-12 physics with the formulas you need and the traps examiners like.

The chapters and marks follow your current NEB syllabus and textbook. Use this note to revise and to find weak areas.

1. Mechanics

- Equations of motion: $v = u + at$; $s = ut + \frac{1}{2}at^2$; $v^2 = u^2 + 2as$.
- Projectile (launch speed u at angle θ): range $R = \frac{u^2 \sin 2\theta}{g}$; maximum height $H = \frac{u^2 \sin^2 \theta}{2g}$; time of flight $T = \frac{2u \sin \theta}{g}$.
- Newton's laws: $F = ma$; momentum $p = mv$; impulse = change in momentum.
- Work $W = Fd \cos \theta$; power $P = W/t$; kinetic energy $\frac{1}{2}mv^2$; potential energy mgh ; energy is conserved in the absence of friction.
- Circular motion: centripetal force $F = \frac{mv^2}{r} = m\omega^2 r$.
- Gravitation: $F = G \frac{m_1 m_2}{r^2}$; $g = \frac{GM}{R^2}$; escape velocity = $\sqrt{2gR}$.

Trap: mass is in kg, distance in m, time in s. Convert km/h to m/s before you substitute.

2. Heat and thermodynamics

- Heat $Q = mc(\text{change in } T)$; latent heat $Q = mL$.
- Ideal gas: $PV = nRT$; first law: $Q = \text{change in internal energy} + W$.
- Linear expansion: change in $L = L \alpha (\text{change in } T)$.

3. Waves and oscillations

- Wave speed $v = f \lambda$. Simple pendulum $T = 2\pi \sqrt{l/g}$; spring $T = 2\pi \sqrt{m/k}$.
- Simple harmonic motion: acceleration is proportional to displacement and directed towards the mean position.
- Doppler effect: the observed frequency rises when source and observer approach.

4. Electrostatics

- Coulomb's law: $F = k q_1 q_2 / r^2$, with k about $9 \times 10^9 \text{ N m}^2/\text{C}^2$.
- Electric field $E = F/q$; potential $V = W/q$; for a point charge $E = kq/r^2$ and $V = kq/r$.
- Capacitance $C = Q/V$; energy stored $U = 1/2 CV^2$; series $1/C = 1/C_1 + 1/C_2$; parallel $C = C_1 + C_2$.

5. Current electricity

- Ohm's law $V = IR$; resistivity $R = \rho L / A$.
- Series $R = R_1 + R_2$; parallel $1/R = 1/R_1 + 1/R_2$. Power $P = VI = I^2R$.
- Kirchhoff's laws: the sum of currents at a junction is zero; the sum of voltage changes around a loop is zero.
- Emf of a cell $E = V + Ir$ (r is the internal resistance).

6. Magnetism and induction

- Force on a moving charge $F = qvB \sin \theta$; on a current-carrying wire $F = BIL \sin \theta$.
- Faraday's law: induced emf = $-(\text{rate of change of flux})$; Lenz's law gives the direction (it opposes the change).
- Transformer: $V_s / V_p = N_s / N_p$.

7. Optics

- Mirror and lens formula: $1/f = 1/v + 1/u$ (mirror, with sign convention) and $1/f = 1/v - 1/u$ (lens). Magnification $m = v/u$ in magnitude.
- Refractive index $n = c/v$; Snell's law $n_1 \sin i = n_2 \sin r$; critical angle $\sin C = 1/n$.
- Young's double slit: fringe width $\beta = \lambda D / d$.

8. Modern physics

- Photon energy $E = hf = hc / \lambda$; the photoelectric equation $hf = \text{work function} + \text{maximum kinetic energy}$.
- de Broglie wavelength $\lambda = h / p$.
- Radioactive decay: $N = N_0 e^{-\lambda t}$; half-life $T = 0.693 / \lambda$.
- Mass-energy: $E = mc^2$.

How to revise physics

1. Write each formula with the meaning and unit of every symbol.

2. Do at least five numerical problems per chapter, with units written at every step.
3. Learn the derivations your syllabus asks for; they often carry guaranteed marks.
4. Draw neat diagrams (ray diagrams, circuits, field lines) and label them.

Practice questions

1. A body is thrown up at 20 m/s. Find the maximum height ($g = 10 \text{ m/s}^2$).
2. A 12 V battery drives a 4 ohm resistor. Find the current and the power.
3. A photon has frequency $6 \times 10^{14} \text{ Hz}$. Find its energy ($h = 6.6 \times 10^{-34} \text{ J s}$).

Answers: 1) $H = v^2 / 2g = 400 / 20 = 20 \text{ m}$. 2) $I = 12/4 = 3 \text{ A}$; $P = VI = 36 \text{ W}$. 3) $E = hf = 3.96 \times 10^{-19} \text{ J}$.

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