A-Level Physics

Formula Sheet · 公式表

The paper supplies a Data and Formulae sheet, and every year candidates memorise what is already printed on it and derive what is not. This booklet separates the two. Everything in the "you must know" sections is absent from that sheet and is examined as if it were obvious. 考卷附有数据与公式表: 本册区分 " 卷上已给 " 与 " 必须自己记住 " 的公式。

Printed on the exam formula sheet – do not memorise these

The uniform-acceleration (suvat) equations, and the equations of simple harmonic motion including $a = -\omega^2 x$ and $v = \pm\omega\sqrt{x_0^2 - x^2}$.

Gravitational and electric field and potential relationships: $g = GM/r^2$, $\phi = -GM/r$, $E = Q/4\pi\varepsilon_0 r^2$, $V = Q/4\pi\varepsilon_0 r$.

Capacitance in series and parallel, the stored energy $W = \frac{1}{2}QV$, and the exponential discharge $x = x_0 e^{-t/RC}$.

Ideal gas and kinetic theory: $pV = nRT$ and $pV = \frac{1}{3}Nm\langle c^2\rangle$.

Radioactive decay $x = x_0 e^{-\lambda t}$ with $\lambda = 0.693/t_{1/2}$, and the mass-energy relation.

The de Broglie wavelength, the photon energy $E = hf$, and the Doppler shift for a moving source.

The data section: values of g, c, e, h, ε_0, G, the Avogadro constant and the electron and proton masses.

You must know – mechanics

Density 密度 — $\rho = m/V$

Moment of a force 力矩 — moment = force × perpendicular distance from the pivot. The word perpendicular carries the mark.

Work done 功 — $W = Fs\cos\theta$, using the component of the force along the displacement

Kinetic and potential energy 动能与势能 — $E_k = \frac{1}{2}mv^2$ and $\Delta E_p = mg\Delta h$ close to the Earth's surface

Power 功率 — $P = W/t$, and for a constant force $P = Fv$

Efficiency 效率 — useful output energy divided by total input energy, usually stated as a percentage

Momentum and impulse 动量与冲量 — $p = mv$ and $Ft = \Delta p$; momentum is conserved in every collision, kinetic energy only in an elastic one

Centripetal acceleration 向心加速度 — $a = v^2/r = \omega^2 r$, directed towards the centre

Stress, strain and the Young modulus 应力、应变与杨氏模量 — $\sigma = F/A$, $\varepsilon = \Delta L/L$, $E = \sigma/\varepsilon$; strain energy is the area under the force-extension graph

You must know – electricity and circuits

Charge, potential difference, resistance 电荷、电势差、电阻 — $Q = It$, $V = W/Q$, $R = V/I$

Resistivity 电阻率 — $R = \rho L/A$, where A is the cross-sectional area, not the surface area

Electrical power 电功率 — $P = VI = I^2R = V^2/R$; choose the form using the quantity you actually know

Resistors in series and parallel 电阻串并联 — series $R = R_1 + R_2$; parallel $1/R = 1/R_1 + 1/R_2$

Electromotive force and internal resistance 电动势与内阻 — $E = I(R + r)$, so the terminal potential difference is $V = E - Ir$

Potential divider 分压电路 — $V_{out} = V_{in} \times R_2/(R_1 + R_2)$

You must know – waves, thermal and fields

Wave equation 波速公式 — $v = f\lambda$, with the period $T = 1/f$

Double slit and diffraction grating 双缝与光栅 — $\lambda = ax/D$ for the double slit; $d\sin\theta = n\lambda$ for the grating

Intensity 强度 — intensity is proportional to amplitude squared, and for a point source falls as $1/r^2$

Specific heat capacity and specific latent heat 比热容与比潜热 — $E = mc\Delta\theta$ for a temperature change; $E = mL$ for a change of state, where the temperature does not change

Transformer 变压器 — $V_s/V_p = N_s/N_p$, and for an ideal transformer $V_pI_p = V_sI_s$

Force on a current and on a moving charge 安培力与洛伦兹力 — $F = BIL\sin\theta$ and $F = BQv\sin\theta$; both are zero when the motion is parallel to the field

Magnetic flux and induced e.m.f. 磁通量与感应电动势 — $\Phi = BA\cos\theta$, and the induced e.m.f. equals the rate of change of flux linkage $N\Delta\Phi/\Delta t$

Constants worth knowing even though they are given

Knowing an order of magnitude catches an absurd answer in seconds: $g \approx 9.81$ m s^{-2}, $c = 3.00 \times 10^8$ m s^{-1}, $e = 1.60 \times 10^{-19}$ C, $h = 6.63 \times 10^{-34}$ J s, and one electronvolt is 1.60×10^{-19} J.

Check every numerical answer against a magnitude you know. An electron mass of 10^{-19} kg, a speed above c, or an efficiency over 100 per cent all mean arithmetic went wrong, and spotting that costs nothing.