AP Physics 2

Revision Sheet · 考前速记

Learn these by heart before the exam. 考试前把这些内容背熟。

Thermodynamics

$PV = nRT = Nk_BT$ T must be in kelvin, always 理想气体定律

$K_{\text{avg}} = \frac{3}{2}k_BT, \quad v_{\text{rms}} = \sqrt{\frac{3k_BT}{m}}$ temperature IS average molecular kinetic energy 分子平均动能与均方根速率

$\Delta U = Q + W$ AP sign convention: W is work done ON the gas, so compression is positive 热力学第一定律

$W = -P\Delta V$ work is the AREA under a PV curve; no area means no work 恒压做功

$Q = mc\Delta T, \quad Q = mL$ 显热与潜热

Second law: entropy of an isolated system never decreases. Heat flows hot to cold on its own.

Isothermal $\Delta U = 0$; adiabatic $Q = 0$; isochoric $W = 0$; isobaric P constant.

Electric Force, Field, and Potential

$F_E = \frac{kq_1q_2}{r^2}, \quad k = 9.0 \times 10^9\ \text{N m}^2/\text{C}^2$ 库仑定律

$\vec{E} = \frac{\vec{F}_E}{q}, \quad E = \frac{kQ}{r^2}$ field points AWAY from positive, TOWARD negative 电场强度

$U_E = \frac{kq_1q_2}{r}, \quad V = \frac{kQ}{r}, \quad V = \frac{U_E}{q}$ 电势能与电势

$E = -\frac{\Delta V}{\Delta r}, \quad \Delta U_E = q\Delta V$ 场与电势的关系

Field is a VECTOR, potential is a SCALAR. Two equal charges can give zero field where potential is not zero.

Inside a conductor in equilibrium $E = 0$ and the whole conductor is one equipotential.

Electric Circuits

$I = \frac{\Delta q}{\Delta t}, \quad V = IR, \quad P = IV = I^2R = \frac{V^2}{R}$ 电流、欧姆定律与功率

$R = \frac{\rho L}{A}$ 电阻率

$R_s = \sum R_i, \quad \frac{1}{R_p} = \sum \frac{1}{R_i}$ 串联与并联电阻

$C = \frac{Q}{V}, \quad C = \frac{\kappa\varepsilon_0 A}{d}, \quad U_C = \frac{1}{2}QV = \frac{1}{2}CV^2$ 电容

$C_p = \sum C_i, \quad \frac{1}{C_s} = \sum \frac{1}{C_i}$ capacitors combine the OPPOSITE way to resistors 电容的并联与串联

Kirchhoff: charge is conserved at a junction ($\sum I_{in} = \sum I_{out}$); energy is conserved round a loop ($\sum \Delta V = 0$).

Series shares current; parallel shares voltage.

Magnetism and Electromagnetism

$F_B = qvB\sin\theta, \quad F_B = BIL\sin\theta$ use the right hand; reverse it for a negative charge 洛伦兹力与安培力

$B = \frac{\mu_0 I}{2\pi r}$ 长直导线的磁场

$\Phi_B = BA\cos\theta, \quad \varepsilon = -\frac{\Delta\Phi_B}{\Delta t}$ 磁通量与法拉第定律

Lenz: the induced current opposes the CHANGE in flux. The minus sign is the whole physics.

A magnetic force does NO work: it is always perpendicular to v, so it turns but never speeds up.

Geometric Optics

$n = \frac{c}{v}, \quad n_1\sin\theta_1 = n_2\sin\theta_2$ 折射率与斯涅尔定律

$\sin\theta_c = \frac{n_2}{n_1}$ only when going from denser to less dense, $n_1 > n_2$ 全反射临界角

$\frac{1}{s_o} + \frac{1}{s_i} = \frac{1}{f}, \quad M = -\frac{s_i}{s_o} = \frac{h_i}{h_o}$ 成像公式与放大率

Sign rules: $f > 0$ converging, $f < 0$ diverging; $s_i > 0$ real image (other side), $s_i < 0$ virtual.

Waves, Sound, and Physical Optics

$v = f\lambda, \quad T = \frac{1}{f}$ 波速与周期

$d\sin\theta = m\lambda$ $m = 0, 1, 2\ldots$; destructive at $(m + \frac{1}{2})\lambda$ 双缝/光栅相长干涉

Standing wave on a string fixed both ends: $\lambda_n = \frac{2L}{n}$.

Open-closed pipe: only odd harmonics.

Diffraction and interference need waves. A single slit spreads more when the slit is NARROWER.

Modern Physics

$E = hf = \frac{hc}{\lambda}, \quad h = 6.63 \times 10^{-34}\ \text{J s}$ 光子能量

$K_{\max} = hf - \phi$ below the threshold frequency NO electron is emitted, however bright the light 光电效应

$\lambda = \frac{h}{p}$ 德布罗意波长

$E = mc^2, \quad \Delta E = \Delta mc^2$ mass defect is the binding energy of the nucleus 质能关系

Nuclear reactions conserve charge (subscripts) and nucleon number (superscripts). Check both sides balance.

Exam technique

Free-response: name the principle, state the equation, then substitute. Method earns marks even when the number is wrong.

Circuits: redraw with the combined resistances step by step, then work back to find each branch.

Justify with physics, not with algebra: 'the field is zero because the contributions are equal and opposite' beats a bare calculation.