AP Physics 1

Revision Sheet · 考前速记

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

Kinematics

$v = v_0 + at, \quad x = x_0 + v_0 t + \frac{1}{2}at^2, \quad v^2 = v_0^2 + 2a\Delta x$
constant acceleration only 匀加速公式

$\bar{v} = \frac{\Delta x}{\Delta t}, \quad \bar{a} = \frac{\Delta v}{\Delta t}$ 平均速度与加速度

Graphs: slope of x-t is velocity; slope of v-t is acceleration; AREA under v-t is displacement.

Projectiles: horizontal $a = 0$ so $x = v_{0x}t$; vertical is free fall. The two axes share only t.

$g = 9.8\ \text{m/s}^2$ (downward) free fall means gravity is the only force; mass does not appear

Force and Translational Dynamics

$\sum \vec{F} = m\vec{a}$ always start with a free-body diagram, then apply per axis 牛顿第二定律

$F_g = mg, \quad F_f \le \mu_s F_N, \quad F_f = \mu_k F_N$ static friction is an inequality; it takes whatever value is needed up to the maximum 重力与摩擦力

$F_s = k|\Delta x|$ 胡克定律

$F_G = \frac{Gm_1m_2}{r^2}, \quad g = \frac{GM}{r^2}$ 万有引力

$a_c = \frac{v^2}{r}, \quad F_c = \frac{mv^2}{r}$ centripetal is a direction, not a new force; some real force supplies it 向心加速度与向心力

Newton's third law: the pair acts on DIFFERENT bodies, so it never cancels on a free-body diagram.

Work, Energy, and Power

$W = Fd\cos\theta, \quad P = \frac{W}{\Delta t} = Fv\cos\theta$ 功与功率

$K = \frac{1}{2}mv^2, \quad U_g = mgh, \quad U_s = \frac{1}{2}k(\Delta x)^2$ 动能与势能

$W_{\text{net}} = \Delta K$ 功能定理

Energy is conserved when only conservative forces act. Friction converts mechanical energy to thermal: $\Delta E = -F_f d$.

Work is the AREA under a force-displacement graph, even when F varies.

Linear Momentum

$\vec{p} = m\vec{v}, \quad \vec{J} = \vec{F}\Delta t = \Delta\vec{p}$ impulse is the AREA under a force-time graph 动量与冲量

Momentum is conserved in EVERY collision with no external force. Kinetic energy is conserved only if the collision is elastic.

Perfectly inelastic: the objects stick together and share one final velocity.

Torque and Rotational Dynamics

$\tau = rF\sin\theta, \quad \sum\tau = I\alpha$ 力矩与转动定律

$\omega = \omega_0 + \alpha t, \quad \theta = \theta_0 + \omega_0 t + \frac{1}{2}\alpha t^2$ 转动运动学

$v = r\omega, \quad a_t = r\alpha$ 线量与角量的关系

$I_{\text{point}} = mr^2, \quad I = \sum m_i r_i^2$ mass far from the axis raises I sharply 转动惯量

Equilibrium needs BOTH $\sum F = 0$ and $\sum\tau = 0$. Take torques about a point that kills an unknown.

Energy and Momentum of Rotating Systems

$K_{\text{rot}} = \frac{1}{2}I\omega^2, \quad L = I\omega$ 转动动能与角动量

$\Delta L = \tau\Delta t$ 角冲量

Angular momentum is conserved with no external torque: pull the arms in, I falls, so ω rises.

Rolling without slipping: $v = r\omega$ and total $K = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2$.

Oscillations

$T = \frac{1}{f}, \quad \omega = 2\pi f$ 周期与频率

$T_s = 2\pi\sqrt{\frac{m}{k}}, \quad T_p = 2\pi\sqrt{\frac{L}{g}}$ neither period depends on amplitude (small angles for the pendulum) 弹簧与单摆周期

$x = A\cos(\omega t)$ a is largest at maximum displacement; v is largest at equilibrium 简谐运动

SHM needs a restoring force proportional to displacement and directed back to equilibrium.

Fluids

$\rho = \frac{m}{V}, \quad P = \frac{F}{A}$ 密度与压强

$P = P_0 + \rho gh$ gauge pressure is ρgh; absolute pressure adds P_0 液体压强

$F_b = \rho_{\text{fluid}} V_{\text{disp}} g$ a floating object displaces its own WEIGHT of fluid 浮力 (阿基米德原理)

$A_1v_1 = A_2v_2$ narrower pipe means faster flow 连续性方程

$P_1 + \rho g y_1 + \frac{1}{2}\rho v_1^2 = P_2 + \rho g y_2 + \frac{1}{2}\rho v_2^2$ faster flow means lower pressure 伯努利方程

Exam technique

Free-response: define your symbols, draw the free-body diagram, then write the principle BEFORE substituting numbers. Method earns marks even if the arithmetic slips.

Always check units and direction. A negative answer usually means 'opposite to the axis I chose', not 'wrong'.

Paragraph-length response: make a claim, cite the physics principle by name, then link it to the specific situation.