

Physics C is calculus-based, and its free-response points are earned by setting up the correct integral or differential relation and STATING the principle behind it. A numerical answer with no stated principle scores a fraction of the marks. Physics C 用微积分表述, 得分点在于列出正确的积分/微分关系并说明所依据的原理。

Kinematics and dynamics

Velocity 速度 — the derivative of position with respect to time, so displacement is the integral of velocity

Acceleration 加速度 — the derivative of velocity with respect to time; when given as a function of position, use a $dv/dx = v \, dv/dx$ rather than the suvat equations

Newton’s second law 牛顿第二定律 — the net force equals the time derivative of momentum, which reduces to ma only when mass is constant

Drag force 阻力 — a resistive force depending on speed, which makes the equation of motion a differential equation whose solution approaches a terminal velocity

Terminal velocity 收尾速度 — the constant speed reached when the resistive force balances the driving force, so acceleration is zero

Energy and momentum

Work 功 — the line integral of force along the displacement; for a variable force it is the area under a force-position graph

Conservative force 保守力 — a force whose work depends only on the endpoints, so a potential energy function can be defined and the loop integral is zero

Potential energy function 势能函数 — a function $U(x)$ whose negative derivative gives the conservative force, so force is the negative slope of the potential curve

Impulse 冲量 — the time integral of net force, equal to the change in momentum

Centre of mass 质心 — the mass-weighted average position of a system; it moves as though all external forces acted on the total mass there

Rotation

Torque 力矩 — the cross product of position and force, equal to the rate of change of angular momentum

Rotational inertia 转动惯量 — $\int r^2 \, dm$ about a chosen axis; it depends on the axis, which is why the axis must always be stated

Parallel-axis theorem 平行轴定理 — the rotational inertia about any axis equals that about a parallel axis through the centre of mass plus Md^2

Angular momentum 角动量 — the cross product of position and momentum, conserved when the net external torque is zero

Rolling without slipping 纯滚动 — the condition $v = \omega R$ at the contact point, which couples the translational and rotational equations

Oscillation and gravitation

Simple harmonic motion 简谐运动 — motion satisfying $d^2x/dt^2 = -\omega^2x$, whose solution is sinusoidal with angular frequency ω

Restoring force 回复力 — a force proportional to displacement and directed toward equilibrium – the defining condition for SHM

Newton’s law of gravitation 万有引力定律 — every pair of masses attracts with a force proportional to the product of the masses and inversely proportional to the square of their separation

Escape speed 逃逸速度 — the minimum launch speed for which total mechanical energy is zero, so the object never returns

Kepler’s third law 开普勒第三定律 — the square of an orbital period is proportional to the cube of the semi-major axis