AP Physics 1

AP Physics 1 supplies the equations and the constants, so memorising them earns nothing. What the sheet does not print is the part that is graded: which equation is legal in the situation, what has to be true before you may use it, and how to justify the choice in words. That is what this booklet lists. AP 考试提供公式表, 因此本册讲的是每个公式的适用条件与选择理由。

The kinematic equations – conditions the sheet does not state

Constant acceleration only — Every suvat equation on the sheet assumes acceleration is constant. On a graph with curved acceleration, or a spring, or anything with changing force, they are simply invalid – use energy or momentum instead.

One dimension at a time — Projectile motion is two independent problems sharing one clock. Horizontal has $a = 0$; vertical has $a = -g$. Never mix a horizontal and a vertical quantity in the same equation.

Signs come from your axes — Choose a positive direction, state it, and keep it. Most sign errors on the exam are not arithmetic; they are an axis chosen halfway through.

Newton's laws – what earns the point

Free-body diagram first — Draw only forces acting ON the object, each from a named physical agent. A "force of motion", a "centripetal force" drawn as an extra arrow, or an ma arrow all lose the diagram point.

Newton's third law pairs — The pair acts on two different objects, is the same type of force, and is always equal – including during a collision between a truck and a bicycle. If both arrows are on one object, it is not a third-law pair.

Friction — $f \le \mu_s N$ for static friction: it is an inequality, and the equality holds only at the point of slipping. Kinetic friction is $f = \mu_k N$ exactly. N is not always mg – on an incline it is $mg\cos\theta$.

Circular motion — Net force towards the centre equals mv^2/r. Centripetal force is a role, not a new force: identify which real force (tension, gravity, normal, friction) is playing it.

Energy and momentum – choosing between them

Use momentum when — The problem is a collision or an explosion and no external force acts during it. Momentum is conserved in every collision; kinetic energy only in an elastic one.

Use energy when — The problem connects two positions or speeds and the forces are conservative or you know the work done. $W = Fd\cos\theta$; $\Delta E = W_{\text{net}}$.

Neither is optional — A question that gives you a collision followed by a rise up a slope needs both, in that order: momentum through the collision, then energy afterwards. Using energy through the collision is the single most common error on this topic.

Systems — Define the system before writing a conservation statement, and say what is inside it. A quantity is only conserved relative to a stated system.

Rotation and oscillation

Rotational analogues — Every translational equation has a rotational twin: $\tau = I\alpha$, $L = I\omega$, $K = \frac{1}{2}I\omega^2$. The sheet gives them; what it does not give is that I depends on the axis, so the same object has different I about different axes.

Torque — $\tau = rF\sin\theta$. A force through the axis produces no torque no matter how large it is.

Simple harmonic motion — A motion is simple harmonic only when the restoring force is proportional to displacement and opposite to it. A pendulum qualifies only for small angles, and that condition must be stated to earn the point.

Writing the justification

Free-response parts asking to "justify your answer" are graded on the physics reasoning, not the number. Name the principle, state why it applies here, then apply it. A correct number with no reasoning frequently scores one point out of three.

When asked to compare two situations, refer to a specific equation and say which quantity changed and which stayed the same. "Because momentum is conserved and the mass doubled, the speed halves" is a complete answer; "it goes slower" is not.

Graph questions want the physical meaning of a slope or an area, so state it: the area under a force-time graph is impulse; the slope of a velocity-time graph is acceleration.