AP Physics 2

Formula Sheet · 公式表

The AP Physics 2 equation sheet is long, and that is exactly the difficulty: with forty relationships in front of you, the graded skill is picking the right one and saying why. This booklet lists the conditions each major relationship needs, and the choices the sheet cannot make for you. 公式表很长，难点在于选对公式并说明理由。

Fluids

Pressure with depth — $p = p_0 + \rho g h$ holds only in a static fluid of constant density, and h is measured downwards from the free surface. Two points at the same depth in one connected fluid are at the same pressure – that fact solves most manometer questions on its own.

Buoyancy — The buoyant force equals the weight of fluid displaced, $\rho_{\text{fluid}} V_{\text{displaced}} g$. For a floating object the displaced volume is the submerged part, not the whole object.

Continuity and Bernoulli — Continuity $A_1 v_1 = A_2 v_2$ needs an incompressible fluid. Bernoulli additionally needs steady, non-viscous flow along one streamline – say so before using it, because the point is often awarded for the condition.

Thermodynamics

Ideal gas law — $pV = nRT = Nk_BT$. Temperature must be in kelvin, always. The two forms differ only in whether you count moles or molecules.

First law — $\Delta U = Q + W$, with the sign convention that W is work done ON the gas. Half of all lost points on this topic are a sign, so state your convention.

The four processes — Isothermal: $\Delta U = 0$, so $Q = -W$. Adiabatic: $Q = 0$, so $\Delta U = W$. Isobaric: $W = -p\Delta V$. Isochoric: $W = 0$. Identify which one before touching the equation sheet.

Kinetic theory — Average kinetic energy per molecule is $\frac{3}{2}k_BT$ – it depends on temperature alone, not on the gas. Two different gases at the same temperature have the same average molecular kinetic energy but different speeds.

Electrostatics and circuits

Coulomb and the field — $F = kq_1q_2/r^2$ and $E = F/q$. The field exists whether or not a charge is there to feel it; that distinction is worth a point in conceptual questions.

Potential and potential energy — $V = kq/r$ is a scalar and adds with signs; E is a vector and adds by components. Mixing the two is the classic error. $U = qV$, and a negative charge gains potential energy moving to higher potential.

Capacitors — $C = Q/V$, $C = \kappa\varepsilon_0 A/d$, $U = \frac{1}{2}CV^2$. In series the charge is common; in parallel the voltage is. Decide which is common before combining.

Circuits — Kirchhoff's rules are the general tool: charge conservation at a junction, energy conservation around a loop. Series and parallel shortcuts fail on any circuit with more than one battery, and the exam knows it.

Magnetism, optics and modern

Magnetic force — $F = qvB\sin\theta$ and $F = BIL\sin\theta$; zero when velocity or current is parallel to the field. The magnetic force does no work on a charge, because it is always perpendicular to the velocity.

Induction — An e.m.f. appears only when flux CHANGES: $\varepsilon = -\Delta\Phi/\Delta t$, with $\Phi = BA\cos\theta$. Any of B, A or the angle may be doing the changing – say which.

Lens and mirror equation — $1/s_o + 1/s_i = 1/f$ with $m = -s_i/s_o$. The sign conventions are the whole difficulty: a negative image distance means a virtual image on the same side as the object.

Photons and matter waves — $E = hf$, $\lambda = h/p$. The photoelectric effect needs the photon energy to exceed the work function; intensity changes the number of electrons, never their maximum kinetic energy.

What the sheet cannot do for you

Almost every AP Physics 2 free-response part asks for a justification. Name the principle, state the condition that lets you use it here, then apply it. The equation is given; the reasoning is the score.

When two situations are compared, answer with a ratio or a proportionality rather than two computed numbers: doubling the separation quarters the force, and that sentence is a complete justification.

Experimental-design parts ask what you would measure and how you would graph it to get a straight line. Rearrange the given equation into $y = mx + c$ form and say what the slope represents. That is the entire task.