

COLLEGE BOARD · AP PHYSICS C

AP Physics C: E&M Formula Sheet

The 2025 AP Physics C: Electricity and Magnetism equations.

1 Electric force, field and potential

Electrostatics from the Electricity and Magnetism table.

Coulomb's law	$ F_E = \frac{1}{4\pi\epsilon_0} \frac{ q_1q_2 }{r^2} = k \frac{ q_1q_2 }{r^2}$
Electric field	$E = \frac{F_E}{q}, E = \frac{1}{4\pi\epsilon_0} \int \frac{dq}{r^2} \hat{r}$
Electric flux	$\Phi_E = \int E \cdot dA$
Gauss's law	$\oint E \cdot dA = \frac{q_{\text{enc}}}{\epsilon_0}$
Total charge	$Q_{\text{total}} = \int \rho(r) dV$
Electric potential energy	$U_E = \frac{1}{4\pi\epsilon_0} \frac{q_1q_2}{r}$
Electric potential	$V = \frac{1}{4\pi\epsilon_0} \int \frac{dq}{r}$
Potential difference	$\Delta V = -\int E \cdot dr$ (from a to b)
Field from potential	$E_x = -\frac{dV}{dx}, \Delta U_E = q\Delta V$

2 Capacitors and circuits

Capacitance, current and resistance.

Capacitance	$C = \frac{Q}{\Delta V}, C = \frac{\kappa\epsilon_0 A}{d}$
Energy stored in a capacitor	$U_C = \frac{1}{2} Q\Delta V$
Dielectric constant	$\kappa = \frac{\epsilon}{\epsilon_0}$
Current and current density	$I = \frac{dq}{dt}, I = \int J \cdot dA, E = \rho J$
Resistance	$R = \frac{\rho\ell}{A}, I = \frac{\Delta V}{R}$
Power	$P = I\Delta V$
Resistors	$R_{\text{series}} = \Sigma R_i, \frac{1}{R_{\text{parallel}}} = \Sigma \frac{1}{R_i}$
Capacitors	$\frac{1}{C_{\text{series}}} = \Sigma \frac{1}{C_i}, C_{\text{parallel}} = \Sigma C_i$
RC time constant	$\tau = R_{\text{eq}} C_{\text{eq}}$

3 Magnetism and induction

Magnetic fields, induction and inductors.

Gauss's law for magnetism	$\oint B \cdot dA = 0$
Magnetic force on a charge	$F_B = q(v \times B)$
Biot-Savart law	$dB = \frac{\mu_0}{4\pi} \frac{I(d\ell \times \hat{r})}{r^2}$
Force on a current	$F_B = \int I(d\ell \times B)$
Ampère's law	$\oint B \cdot d\ell = \mu_0 I_{\text{enc}}$
Field in a solenoid	$B_{\text{sol}} = \mu_0 nI$
Magnetic flux	$\Phi_B = \int B \cdot dA$
Faraday's law	$\epsilon = \oint E \cdot d\ell = -\frac{d\Phi_B}{dt}, \epsilon_{\text{sol}} = N \left \frac{d\Phi_B}{dt} \right $
Inductance of a solenoid	$L_{\text{sol}} = \frac{\mu_{\text{core}} N^2 A}{\ell}$
Inductor energy and e.m.f.	$U_L = \frac{1}{2} LI^2, \epsilon = -L \frac{dI}{dt}$

$$\tau = \frac{L}{R_{\text{eq}}}, \quad \omega_{\text{LC}} = \frac{1}{\sqrt{LC}}$$

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