

MAXWELL'S EQUATIONS

In 1865 James Clerk Maxwell discovered that the fundamental principles of electromagnetism can be concisely expressed in terms of 4 equations. We call these four equations Maxwell's Equations:

Gauss's Law	$\Phi_E = \oint \mathbf{E} \cdot d\mathbf{A} = \frac{q_{enc}}{\epsilon_0}$	Explains how electric fields \mathbf{E} are produced by electric charges. \mathbf{E} -field lines begin and terminate on charges.
Gauss's Law in Magnetism	$\int \mathbf{B} \cdot d\mathbf{A} = 0$	Physically there are NO magnetic monopoles. \mathbf{B} -field lines form closed loops. They do not begin or end!
Ampere's Law	$\oint \mathbf{E} \cdot d\mathbf{l} = -\frac{d\Phi_B}{dt}$	Explains how electric fields \mathbf{E} are produced by a changing magnetic flux.
Faraday's Law	$\oint \mathbf{B} \cdot d\mathbf{l} = \mu_0(I + I_d)$ $I_d = \epsilon_0 \frac{d\phi_E}{dt}$	Explains how magnetic fields \mathbf{B} are produced by both conduction currents and changing electric flux.