Physics Notes

Maxwell's Equations

The four Maxwell equations in differential form:

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0}$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla \times \mathbf{B} = \mu_0\mathbf{J} + \mu_0\epsilon_0\frac{\partial \mathbf{E}}{\partial t}$$

Energy-Mass Equivalence

Einstein's famous equation $E = mc^2$ shows the equivalence of mass and energy.

The full relativistic energy is:

$$E^2 = (pc)^2 + (m_0c^2)^2$$

For a particle at rest ($p = 0$), this reduces to $E = m_0c^2$.

Schrödinger Equation

The time-dependent Schrödinger equation:

$$i\hbar\frac{\partial}{\partial t}\Psi(\mathbf{r}, t) = \hat{H}\Psi(\mathbf{r}, t)$$

where $\hat{H}$ is the Hamiltonian operator and Ψ is the wave function.

Gaussian Integral

A fundamental result in probability theory:

$$\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$$