

Classical Physics

The Laws That Govern Our Universe

Demo Document

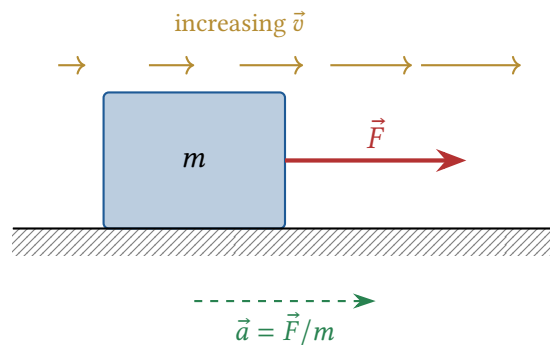
January 22, 2026

1 Newtonian Mechanics

Law 1.1: Newton's Second Law

The acceleration of an object is proportional to the net force and inversely proportional to its mass:

$$\vec{F} = m\vec{a} = m \frac{d^2\vec{r}}{dt^2} \quad (1)$$



2 Electromagnetism

Law 2.1: Maxwell's Equations

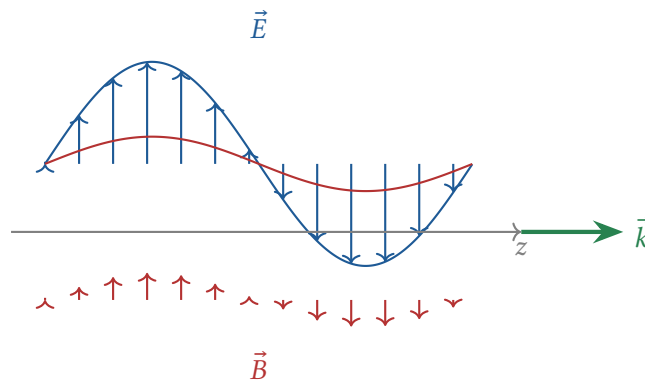
The four equations governing all electromagnetic phenomena:

$$\nabla \cdot \vec{E} = \frac{\rho}{\epsilon_0} \quad (\text{Gauss's Law}) \quad (2)$$

$$\nabla \cdot \vec{B} = 0 \quad (\text{No Magnetic Monopoles}) \quad (3)$$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \quad (\text{Faraday's Law}) \quad (4)$$

$$\nabla \times \vec{B} = \mu_0 \vec{J} + \mu_0 \epsilon_0 \frac{\partial \vec{E}}{\partial t} \quad (\text{Ampère-Maxwell}) \quad (5)$$



Electromagnetic Wave: $\vec{E} \perp \vec{B} \perp \vec{k}$

3 Special Relativity

Principle 3.1: Mass-Energy Equivalence (Einstein, 1905)

Mass and energy are interchangeable:

$$E = mc^2 \quad (6)$$

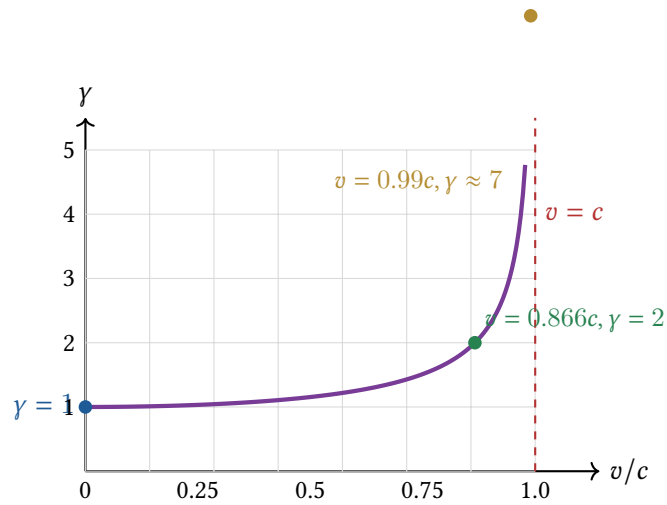
where $c = 299,792,458$ m/s is the speed of light.

Equation 3.1: The Lorentz Factor

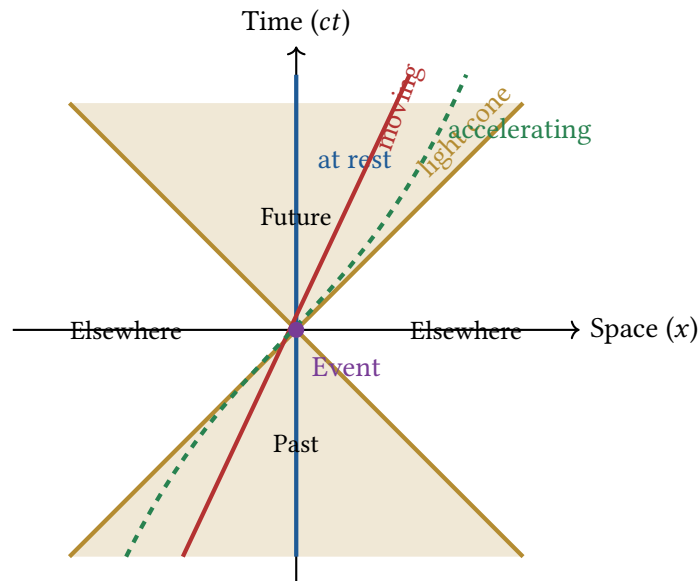
Time dilation and length contraction are governed by:

$$\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{1}{\sqrt{1 - \beta^2}} \quad (7)$$

where $\beta = v/c$ is the velocity as a fraction of light speed.



4 Spacetime Diagrams



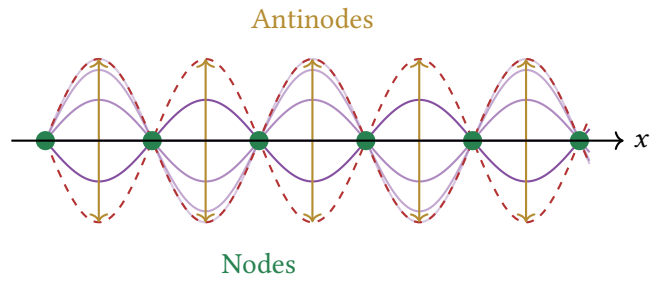
5 Wave Mechanics

Equation 5.1: The Wave Equation

All waves satisfy:

$$\frac{\partial^2 \psi}{\partial x^2} = \frac{1}{v^2} \frac{\partial^2 \psi}{\partial t^2} \quad (8)$$

with general solution $\psi(x, t) = f(x - vt) + g(x + vt)$



Standing Wave: $\psi(x, t) = A \sin(kx) \cos(\omega t)$

“The important thing is not to stop questioning. Curiosity has its own reason for existing.”

— Albert Einstein