



## Dynamics of Charged Particle:

- Newton's equation of motion:  $\vec{F} = m\vec{a}$ .
- Lorentz force:  $\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$ .

## Dynamics of Electric and Magnetic Fields:

- Gauss' law for electric field:  $\oint \vec{E} \cdot d\vec{A} = \frac{q}{\epsilon_0}$ .
- Gauss' law for magnetic field:  $\oint \vec{B} \cdot d\vec{A} = 0$ .
- Faraday's law:  $\oint \vec{E} \cdot d\vec{\ell} = -\frac{d\Phi_B}{dt}$ , where  $\Phi_B = \int \vec{B} \cdot d\vec{A}$ .
- Ampère's law:  $\oint \vec{B} \cdot d\vec{\ell} = \mu_0 I + \mu_0 \epsilon_0 \frac{d\Phi_E}{dt}$ , where  $\Phi_E = \int \vec{E} \cdot d\vec{A}$ .

Maxwell's equations: 4 relations between fields ( $\vec{E}$ ,  $\vec{B}$ ) and sources ( $q$ ,  $I$ ).