Maxwell equations (static) Differential + integral

$\nabla \cdot \vec{E} = \rho/\varepsilon_0$

$\vec{F} = q(\vec{E} + \vec{v} \times \vec{B})$

$\nabla \cdot \vec{B} = 0 \quad \oint \vec{B} \cdot d\vec{A} = 0$

voltage

$\rightarrow \nabla \times \vec{E} = 0 \quad \int (\nabla \times \vec{E}) \cdot d\vec{A} = 0 \Rightarrow \oint \vec{E} \cdot d\vec{l} = 0$

$\int (\nabla \cdot \vec{E}) dV = \int \rho/\varepsilon_0 \, dV \quad \oint \vec{E} \cdot d\vec{A} = Q_{enc}/\varepsilon_0$

$\nabla \times \vec{B} = \mu_0 \vec{J} \Rightarrow \oint \vec{B} \cdot d\vec{l} = \mu_0 I_{enc}$

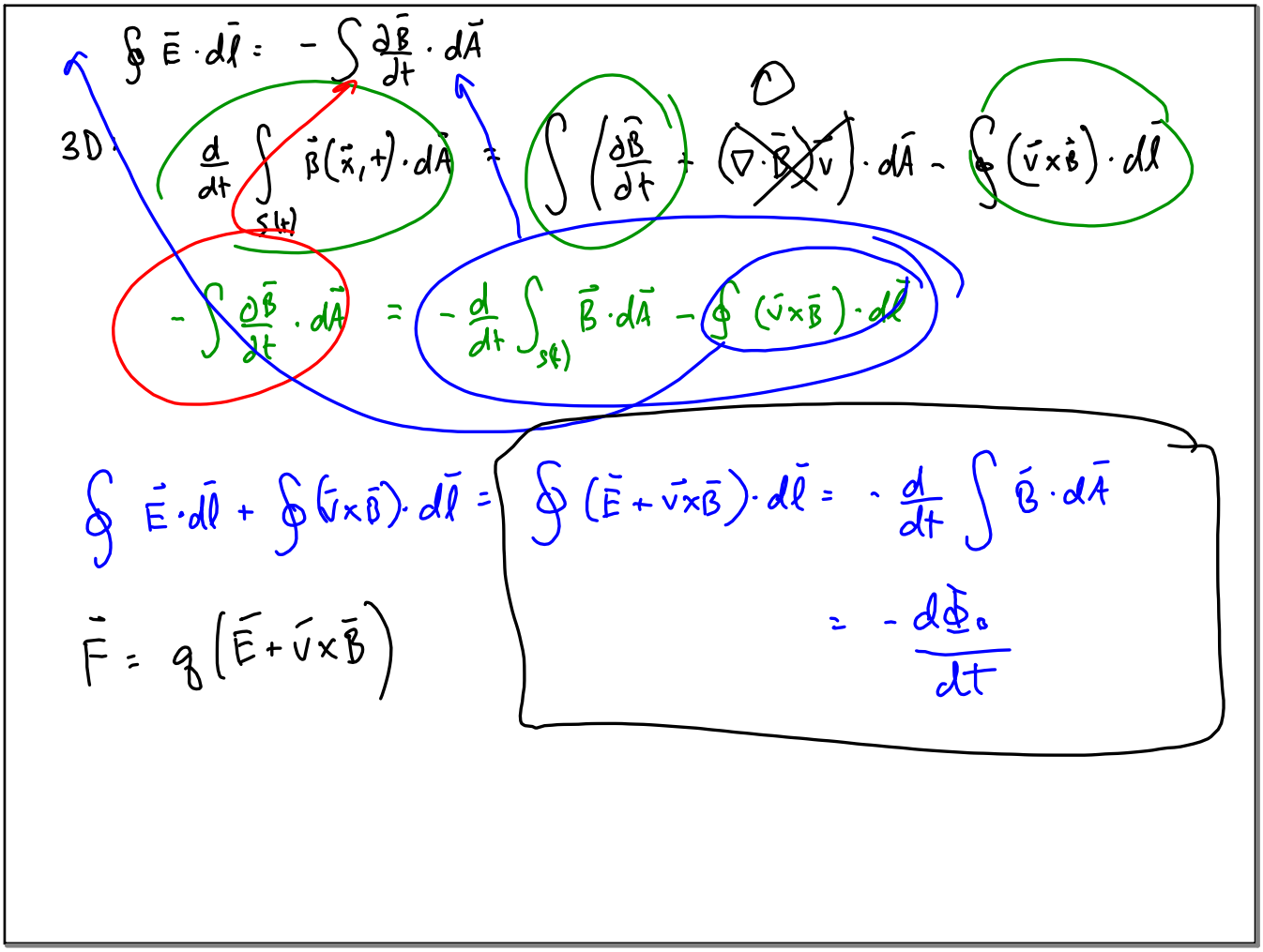
Faraday's law $\quad EMF = -\frac{d\Phi_B}{dt}$

$$\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t} \qquad EMF$$

$$\int (\nabla \times \vec{E}) \cdot d\vec{A} = -\int_{S(t)} \frac{\partial \vec{B}}{\partial t} \cdot d\vec{A} = \oint \vec{E} \cdot d\vec{l}$$

Leibniz rule

$$\frac{d}{dt} \int_{a(t)}^{b(t)} f(x,t)\,dx = \frac{db}{dt} f(b,t) - \frac{da}{dt} f(a,t) + \int_a^b \frac{\partial}{\partial t} f(x,t)\,dx$$


$\oint \vec{E}\cdot d\vec{l} = -\int \frac{\partial \vec{B}}{\partial t}\cdot d\vec{A}$
3D:
$\frac{d}{dt}\int_{S(t)} \vec{B}(\vec{x},t)\cdot d\vec{A} = \int \left(\frac{\partial \vec{B}}{\partial t} + (\nabla\cdot\vec{B})\vec{v}\right)\cdot d\vec{A} - \oint (\vec{v}\times\vec{B})\cdot d\vec{l}$
$-\int \frac{\partial \vec{B}}{\partial t}\cdot d\vec{A} = -\frac{d}{dt}\int_{S(t)} \vec{B}\cdot d\vec{A} - \oint (\vec{v}\times\vec{B})\cdot d\vec{l}$
$\oint \vec{E}\cdot d\vec{l} + \oint (\vec{v}\times\vec{B})\cdot d\vec{l} = \oint (\vec{E}+\vec{v}\times\vec{B})\cdot d\vec{l} = -\frac{d}{dt}\int \vec{B}\cdot d\vec{A}$
$= -\frac{d\Phi_B}{dt}$
$\vec{F} = q(\vec{E}+\vec{v}\times\vec{B})$

$\nabla \cdot \bar{E} = \rho/\varepsilon_0$

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

$\nabla \times \bar{E} = -\partial \bar{B}/\partial t \rightarrow \oint \bar{E} \cdot d\bar{l} = -\int \frac{\partial \bar{B}}{\partial t} \cdot d\bar{A}$

$\nabla \times \bar{B} = \mu_0 \bar{J} \rightarrow \oint \bar{B} \cdot d\bar{l} = \mu_0 I_{enc}$

$$\mathcal{E}MF = -\frac{d\Phi_B}{dt}$$

$$\oint (\bar{E} + \bar{v}\times\bar{B})\cdot d\bar{l} = -\frac{d}{dt}\int \bar{B}\cdot d\bar{A}$$

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

~~$$\oint \bar{E}\cdot d\bar{l} = -\frac{d}{dt}\int \bar{B}\cdot d\bar{A}$$~~

$$\oint \bar{E}\cdot d\bar{l} = -\int \frac{\partial\bar{B}}{\partial t}\cdot d\bar{A}$$

$$\nabla\times\bar{E} = -i\omega\bar{B}$$