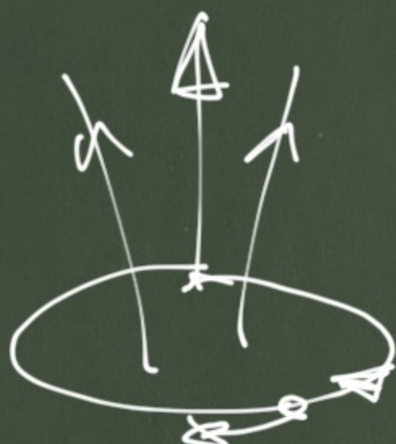
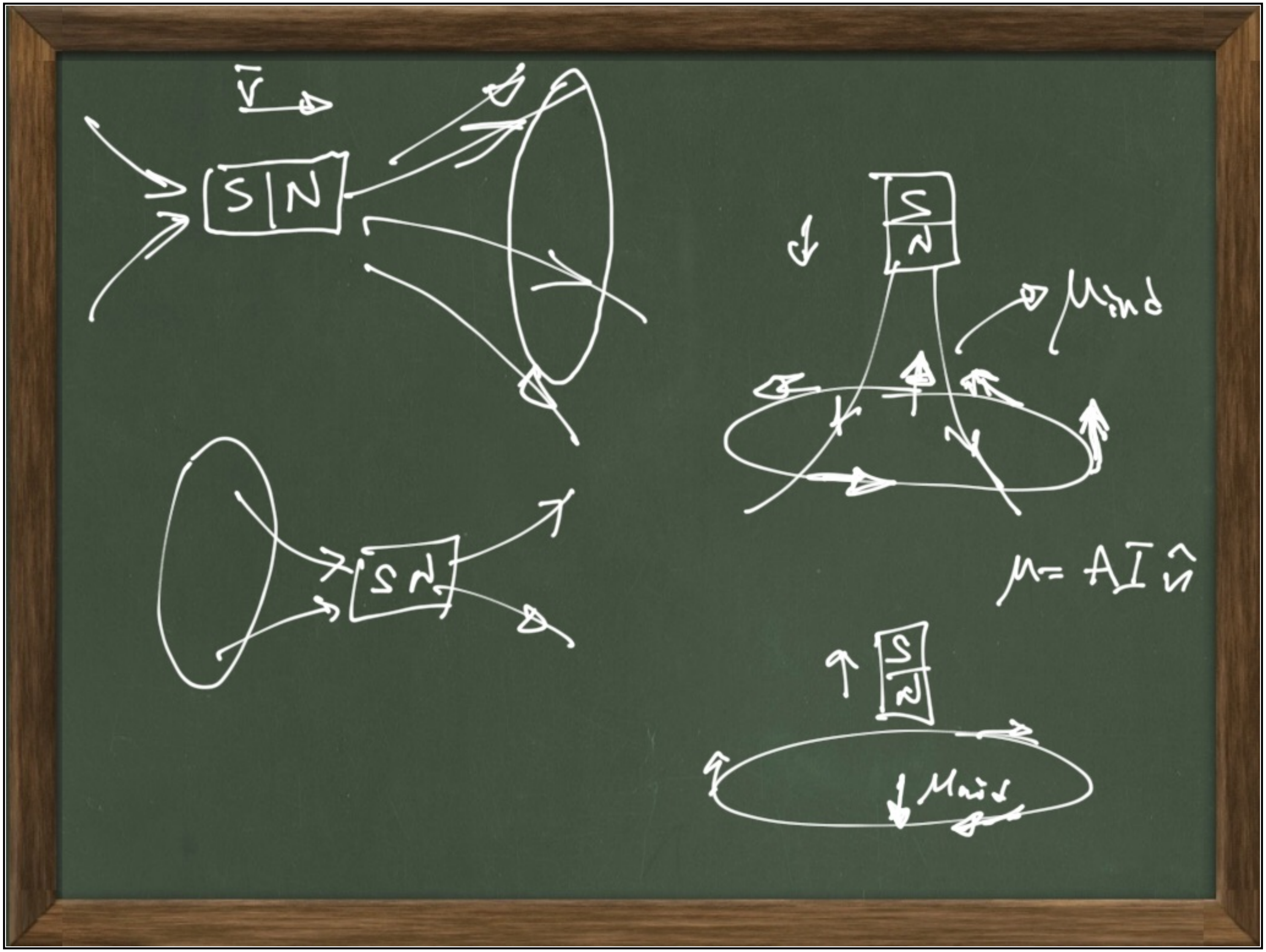
FARADAY - LENZ

$$\mathcal{E}_{ind} = -\frac{d\phi_B}{dt} = -\frac{d}{dt}\int_S \bar{B}\cdot d\bar{A}$$



"NO FREE LUNCH"
theorem


v
S N
S N
S
N
μind
μ = AI n̂
S
N
μind

$$\mathcal{E}_{ind} = -\frac{d\phi_B}{dt} = -\frac{d}{dt}\int_S \bar{B}\cdot d\bar{A}$$

$$\oint E\cdot ds = 0$$

$$\oint \bar{E}\cdot d\bar{s} = -\frac{d}{dt}\oint \bar{B}\cdot d\bar{A}$$

$$\oint B\cdot ds = \mu_0 I$$

$$\mathrm{rot}\,\bar{E} = 0$$

$$\oint \bar{B}\cdot d\bar{A} = 0 \implies \mathrm{div}\, B = 0$$

$$\oint \bar{E}\cdot d\bar{A} = Q/\varepsilon_0 \implies \mathrm{div}\, \bar{E} = \rho/\varepsilon_0$$

$$\oint \bar{E}\cdot d\bar{s} = \oint \left(-\frac{\partial \bar{B}}{\partial t}\right)\cdot d\bar{A}$$

$$\boxed{\mathrm{rot}\,\vec{E} = -\frac{\partial \bar{B}}{\partial t}}$$

$$\mathrm{div}\,\vec{E} = \emptyset$$

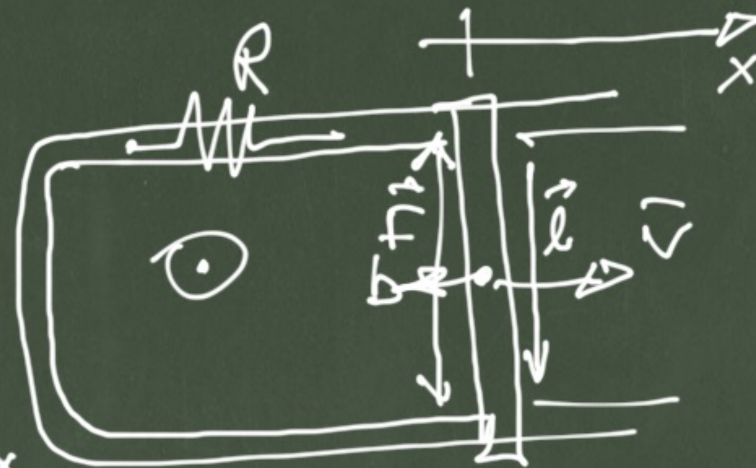
$$\mathrm{div}\,B = \emptyset$$

$$\boxed{\mathrm{rot}\,\vec{B} = \cancel{\mu_0 \vec{J}} + \varepsilon_0 \mu_0 \frac{\partial \bar{E}}{\partial t}}$$

Generatore

$\bar{B} \odot \hat{z}$ $\qquad$ $\bar{B} = B\hat{z}$

$\bar{v} = v\hat{x}$

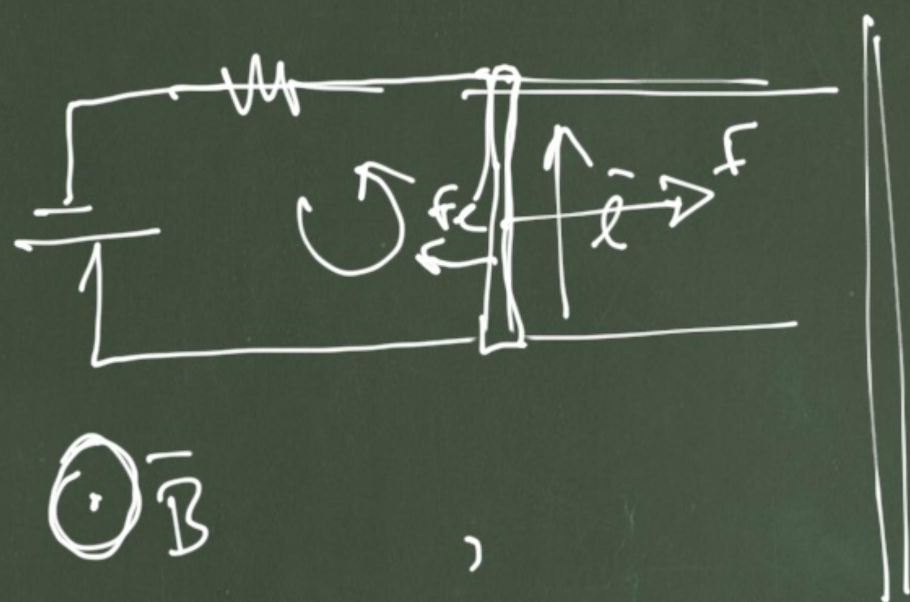


$$\mathcal{E} = -\frac{d\Phi_B}{dt} = -Bb\frac{dx}{dt} = -Bbv$$

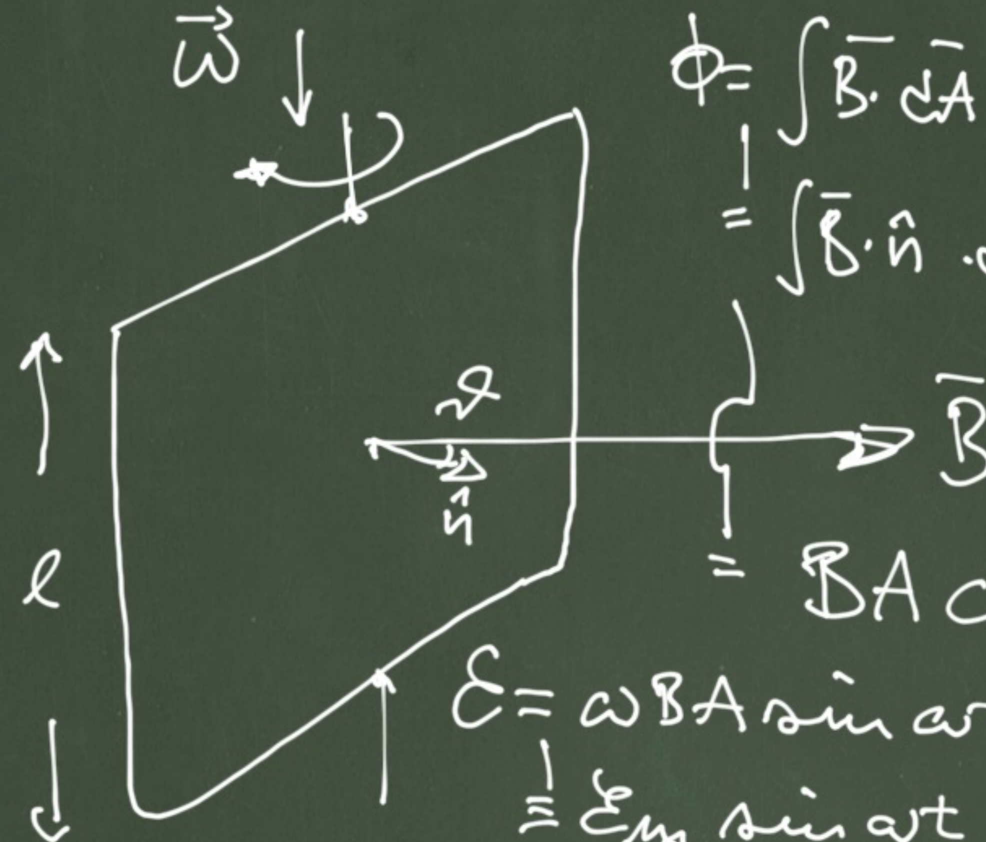
$$I = \frac{\mathcal{E}}{R} = \frac{|vBb|}{R} \qquad \bar{I} = I\vec{\ell}$$

$$\vec{f} = I\bar{\ell} \times \vec{B} = -\frac{B^2 b^2}{R}\bar{v}$$

$$P = \bar{F}_{ext} \cdot \bar{v} = \frac{B^2 b^2}{R}\, \bar{v} \cdot \bar{v} = \frac{(B b v)^2}{R} = \frac{\mathcal{E}^2}{R}$$



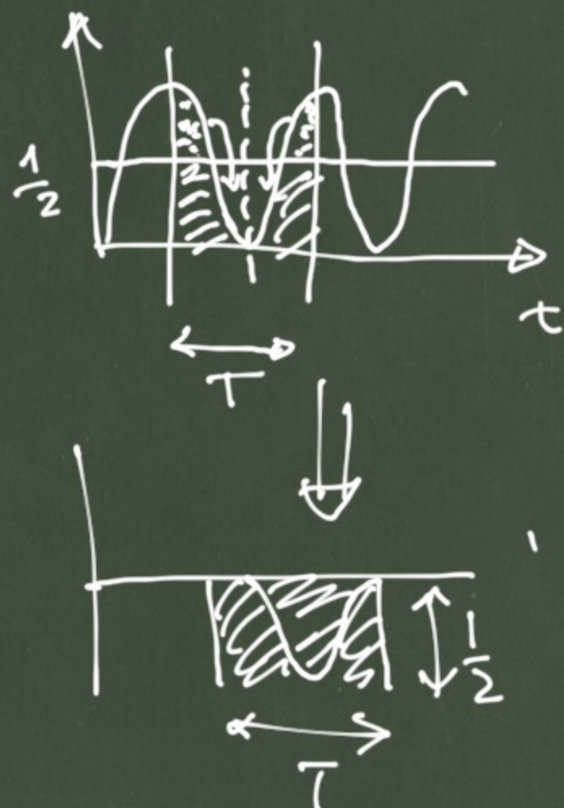
$\theta = \omega t$



$$\Phi = \int \bar{B} \cdot d\bar{A} = \int \bar{B} \cdot \hat{n} \, dA = BA \cos \omega t$$

$$\mathcal{E} = \omega BA \sin \omega t = \mathcal{E}_m \sin \omega t$$

$$I = \frac{\omega BA}{R} \sin \omega t \; ; \; P = \mathcal{E} I = \frac{(\omega BA)^2}{R} \sin^2 \omega t$$



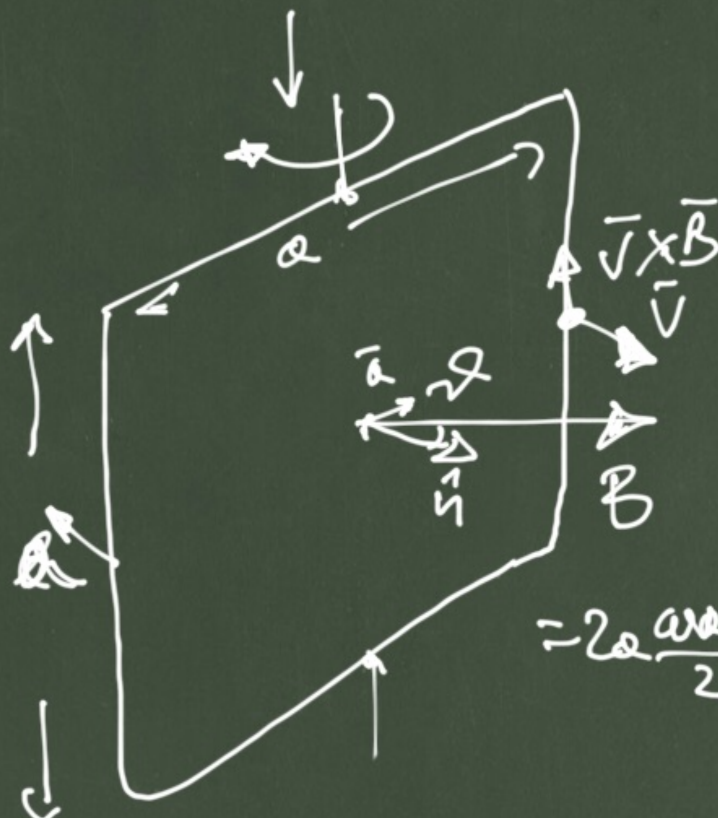
$$P_{rms} = \frac{\mathcal{E}_m^2}{R}\left[\frac{1}{T}\int_0^T \sin^2\omega t\right] = \frac{\mathcal{E}_m^2}{2R} = \frac{\mathcal{E}_{rms}^2}{R}$$

$$\mathcal{E}_{rms} = \frac{\mathcal{E}_m}{\sqrt{2}}$$

$N = 20 \quad r = 0.2 \quad f = 50\ Hz \quad B = 0.39$

$\mathcal{E}_m = \omega B A = 2\pi f B \pi r^2 N = 311\ V$

$\mathcal{E}_{rms} = 220\ V$



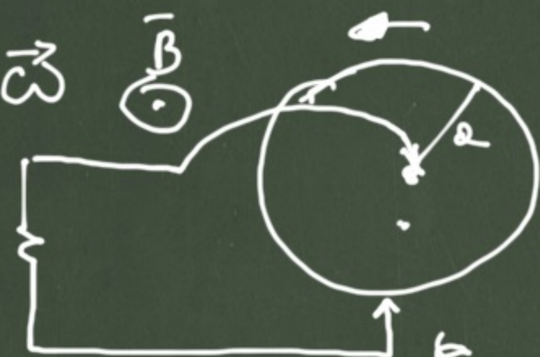
$$v = \frac{\omega a}{2} \qquad \bar{v} = \frac{\bar{\omega} \times \bar{a}}{2}$$

$$\bar{E}_i = \frac{\bar{F}}{-e} = \bar{v} \times \bar{B}$$

$$\mathcal{E}_{ind} = \oint \bar{E}_i \cdot d\bar{s} = \oint (\bar{v} \times \bar{B}) \cdot d\bar{s}$$

$$= 2a \frac{\omega a}{2} B \sin\vartheta = \omega A B \sin\omega t$$

$\bar{B} \parallel \vec{\omega}$



$$\bar{E} = \bar{v} \times \bar{B} = \bar{\omega} \times \bar{r} \times \bar{B} = \omega r B \hat{r}$$

$$\mathcal{E}_{ind} = \int_0^a \bar{E} \cdot d\bar{s} = \int_0^a \omega r B \hat{r} \cdot \hat{r} \, dr = \left(\int_0^a r \, dr \right) \omega B = \frac{\omega a^2 B}{2}$$

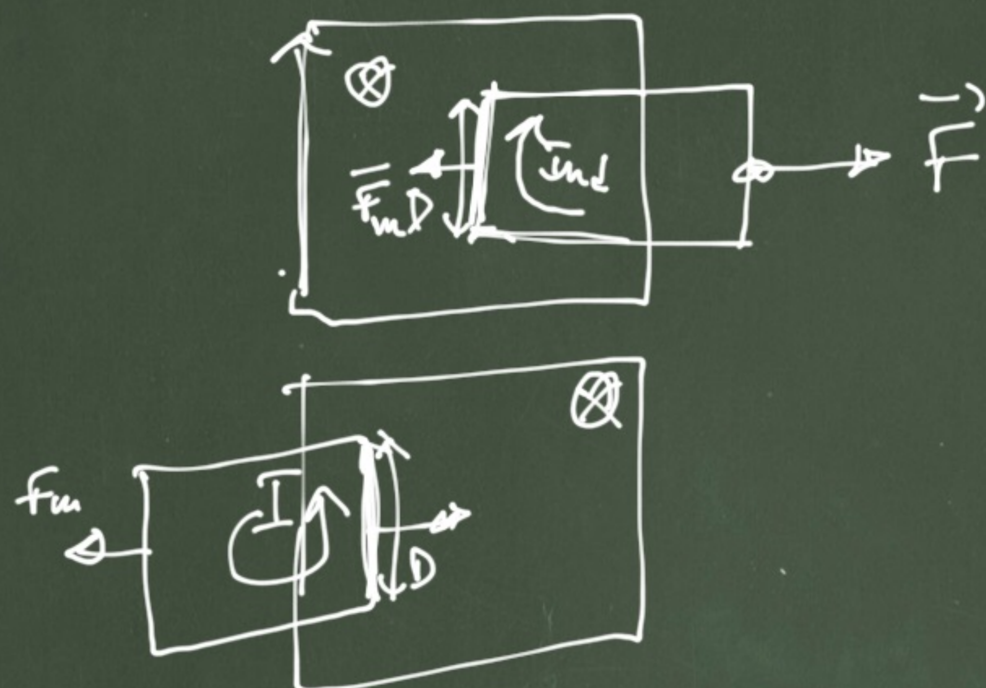
$$d\bar{F} = I \, d\vec{r} \times \bar{B}$$

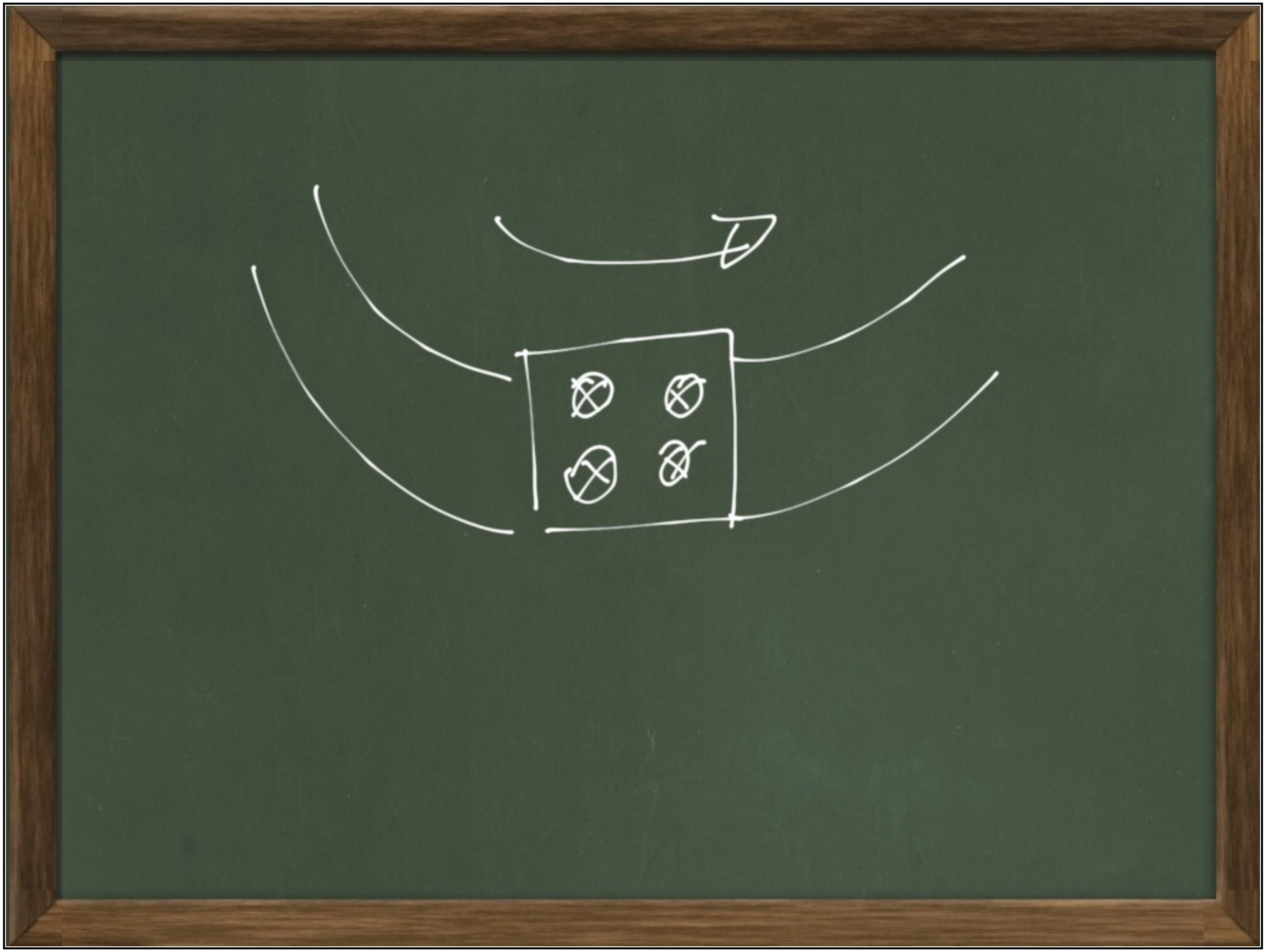
$$d\bar{M} = \bar{r} \times d\bar{F} = -\hat{\omega} \, \frac{r B \omega a^2 B}{2R} dr = -\vec{\omega} \, \frac{a^2 B^2 r}{2R} dr$$

$$\bar{M} = -\bar{\omega} \frac{a^4}{4} \frac{B^2}{R} = -\bar{M}_{ext}$$

$$P = \frac{\omega^2 a^4 B^2}{4R} = \frac{\mathcal{E}^2}{R}$$

eddy currents





$$|\mathcal{E}| = BD\frac{dx}{dt} = vBD \qquad I = \frac{BDv}{R}$$

$$-IDB\hat{x} = F_m$$

$$P = \bar{F}_{ext} \cdot \bar{v} = -\bar{F}_m \cdot v = IDBv = \mathcal{E} \cdot I$$