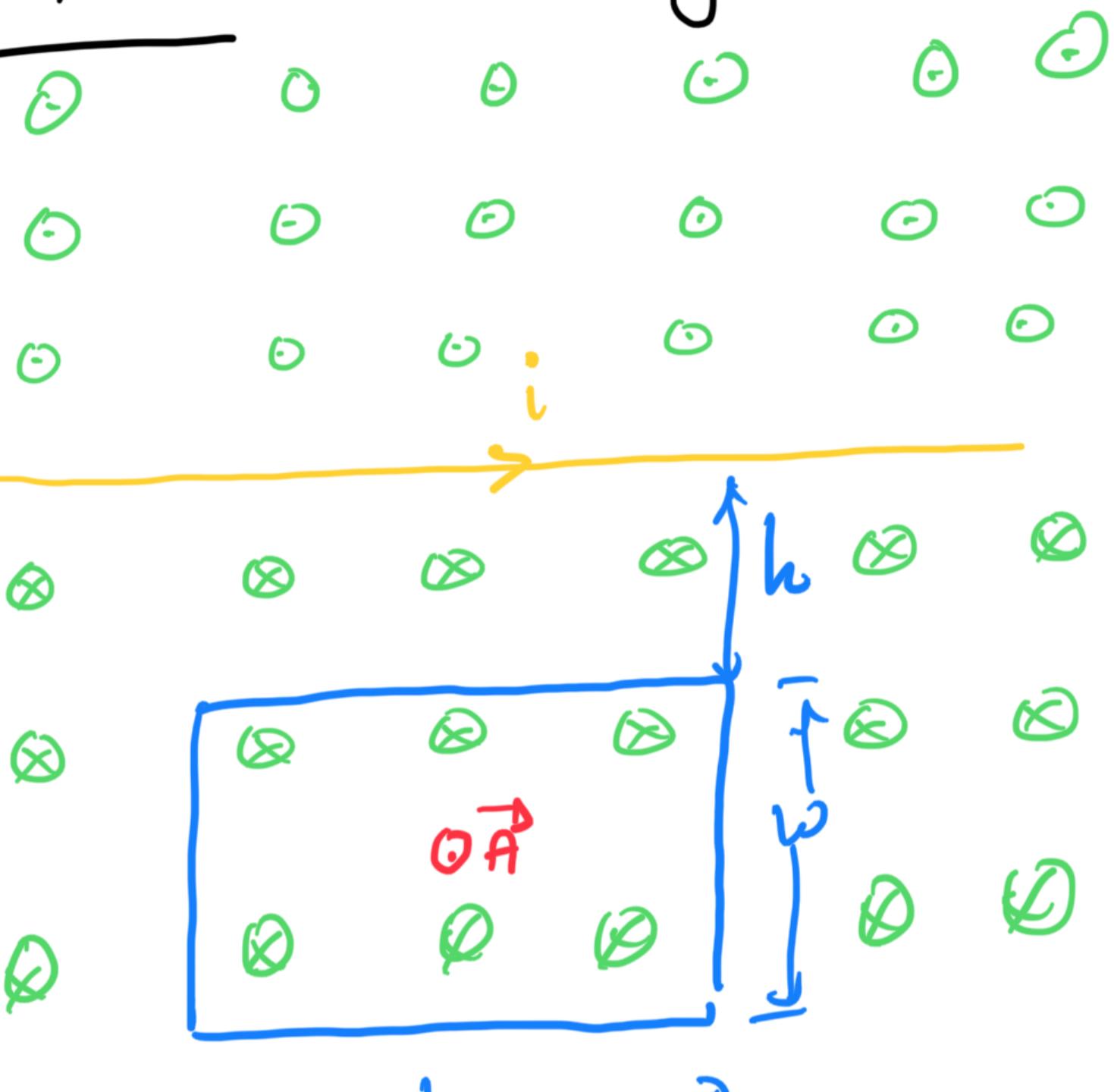


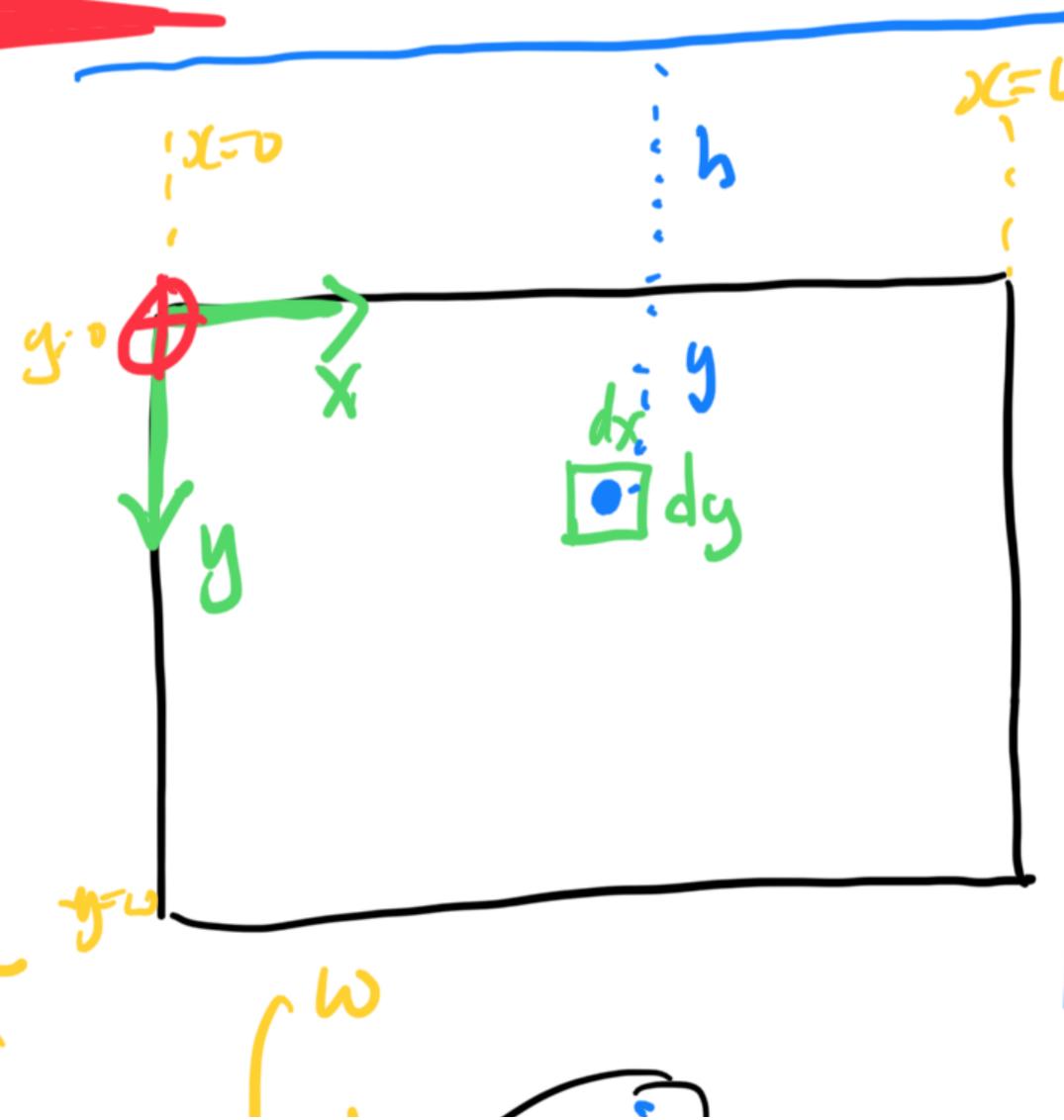
9, 10, 11, 12 → Assignment 6.



$$|\vec{B}| = \frac{\mu_0 i}{2\pi r}$$

$$\Phi_M = ? = \oint_{\text{loop}} \vec{B} \cdot d\vec{A}$$

~~not instant~~



$$B = \frac{\mu_0 i}{2\pi(h+y)}$$

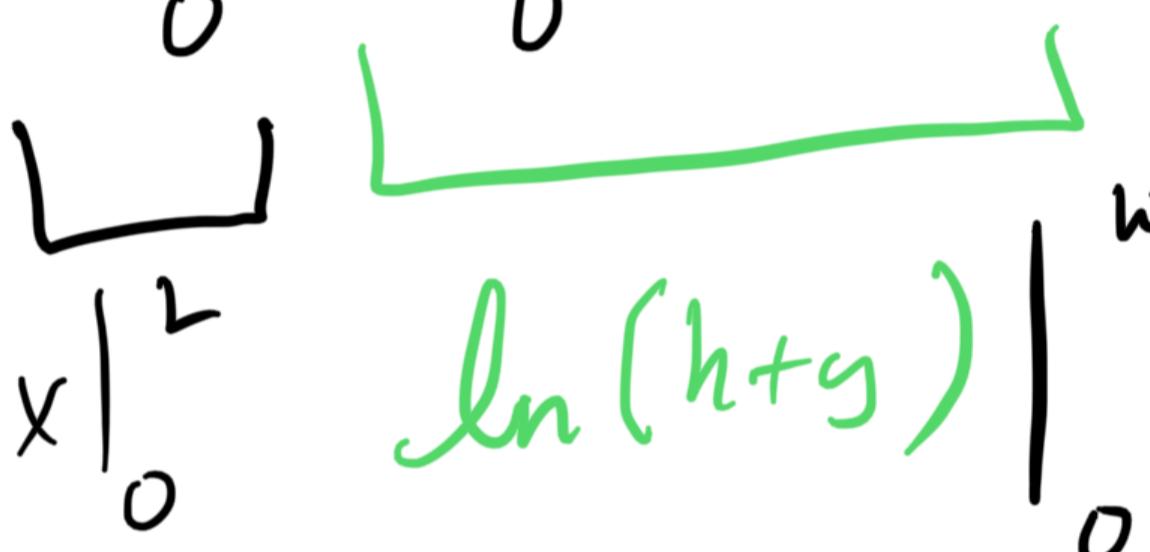
① coordinate system.

② choose area elemt.

$$dA = dx dy$$

$$\Phi_M = \int_0^L dx \int_0^y dy \quad \text{(Moi)} \\ \text{2π} (h+y)$$

$$= \frac{\mu_0 i}{2\pi} \int_0^L dx \int_0^\omega dy \left( \frac{1}{h+y} \right)$$

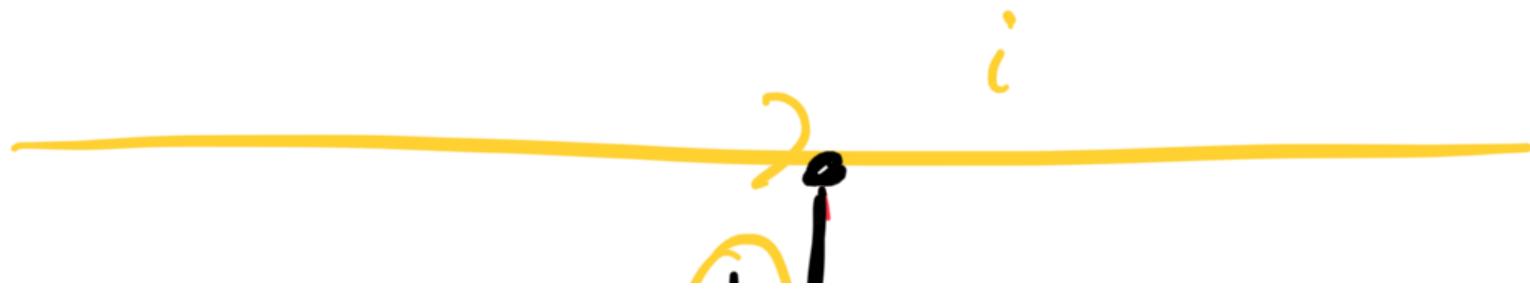

  
 x |  
 0    L

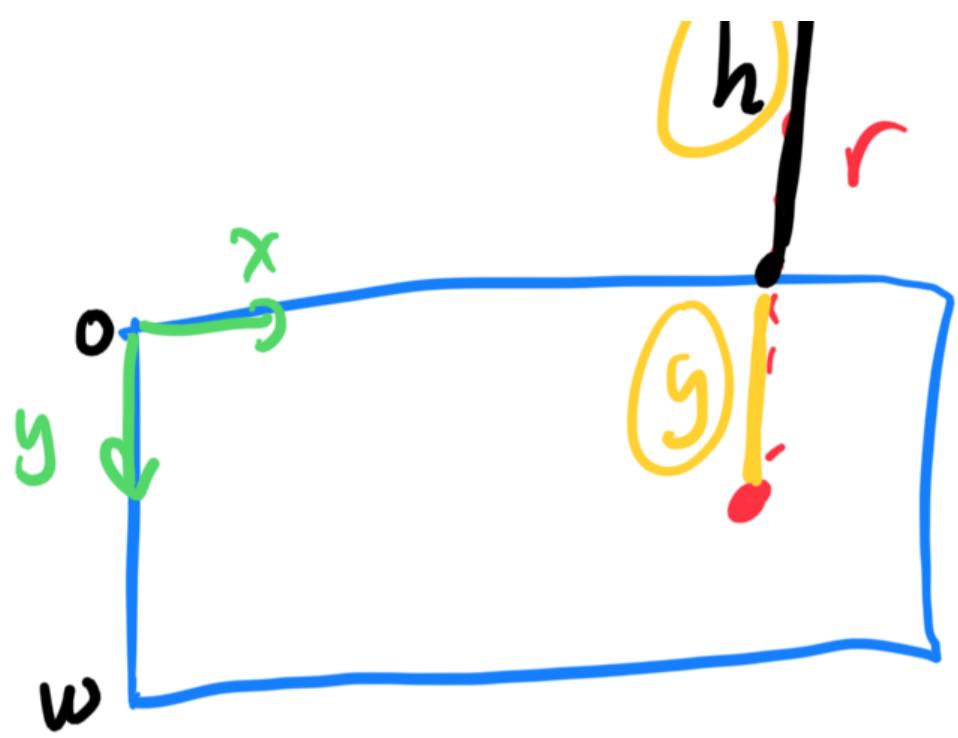
$$= L - 0 \quad \ln(h+\omega) - \ln(h)$$

$$= L \quad \ln\left(\frac{h+\omega}{h}\right)$$

$$\Phi_M = \frac{\mu_0 i L}{2\pi} \ln\left(\frac{h+\omega}{h}\right)$$

b)





$$\beta = \frac{\mu_0 i}{2\pi r}$$

d. stat.

$$B = \frac{\mu_0 i}{2\pi(h+y)}$$

$$\Phi_m = \frac{\mu_0 i L}{2\pi} \ln\left(\frac{h+\omega}{h}\right)$$

$$C = \frac{d\phi}{dt} \left( \frac{h+\omega}{h} \right)$$

$$\Phi_m = C i \quad \neq$$

$$\frac{d\Phi_m}{dt} = C \frac{di}{dt} \quad i = a + bt$$

$$\frac{di}{dt} = b$$

$$= Cb$$

$$V_{ind} = -N \frac{d\Phi_m}{dt}$$

$$= -Cb = -\frac{\mu_0 L b}{2\pi} \ln\left(\frac{h+\omega}{h}\right)$$

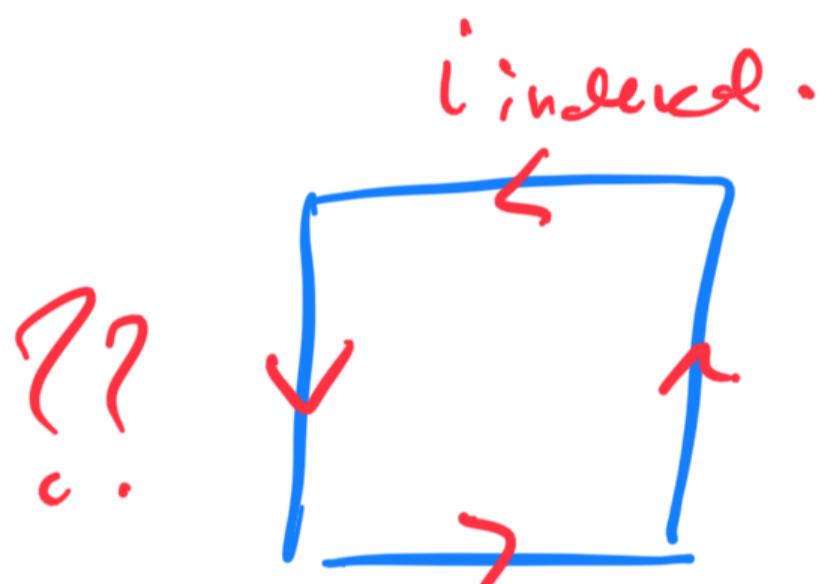
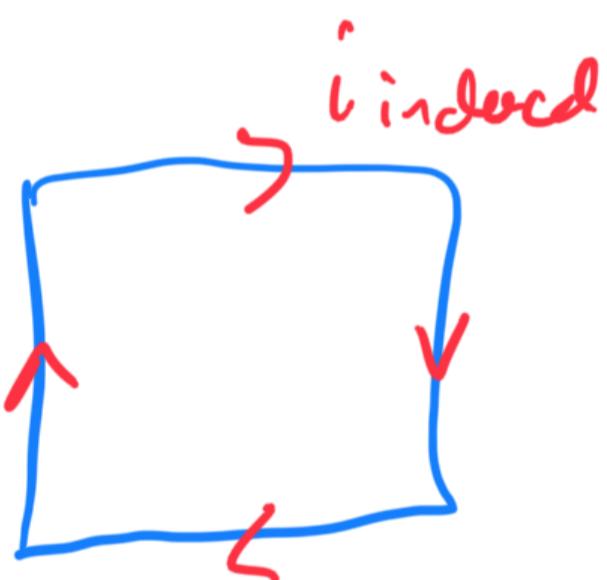
$$\downarrow \quad \swarrow 1.15 \quad \downarrow \quad 14 \quad \downarrow$$

$$= -\frac{\mu_0 L b}{2\pi} \ln\left(\frac{h+\omega}{h}\right)$$

$$= -7.72 \times 10^{-6} \text{ V}$$

$$= -7.72 \mu\text{V}$$

What direction does the current flow  
in ????



**Lenz's Law**

→ Nature hat os es!

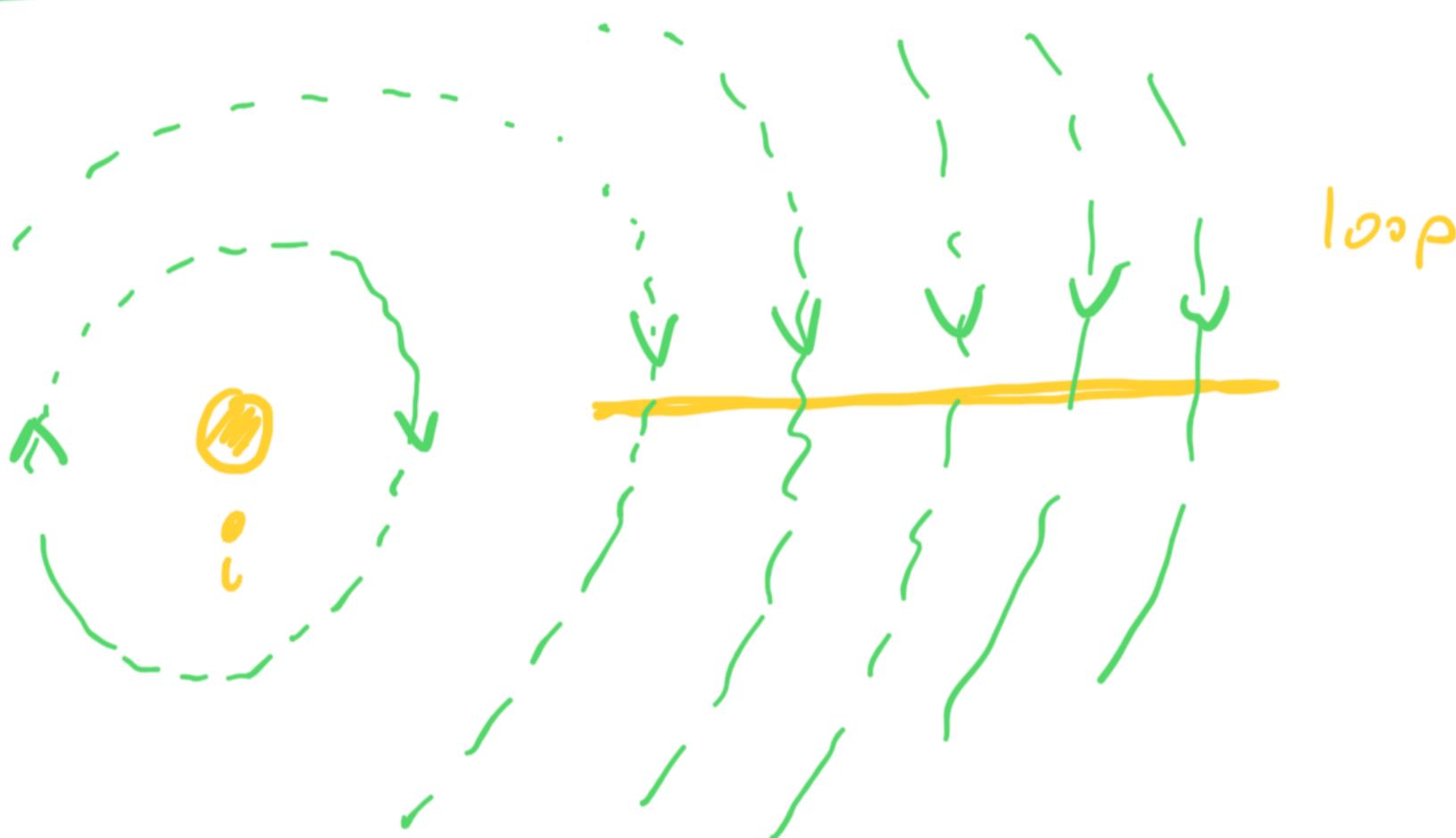
→ The current in the loop will flow in a direction that creates a magnetic field so as to flux that

Oppose The changing flux

created it.



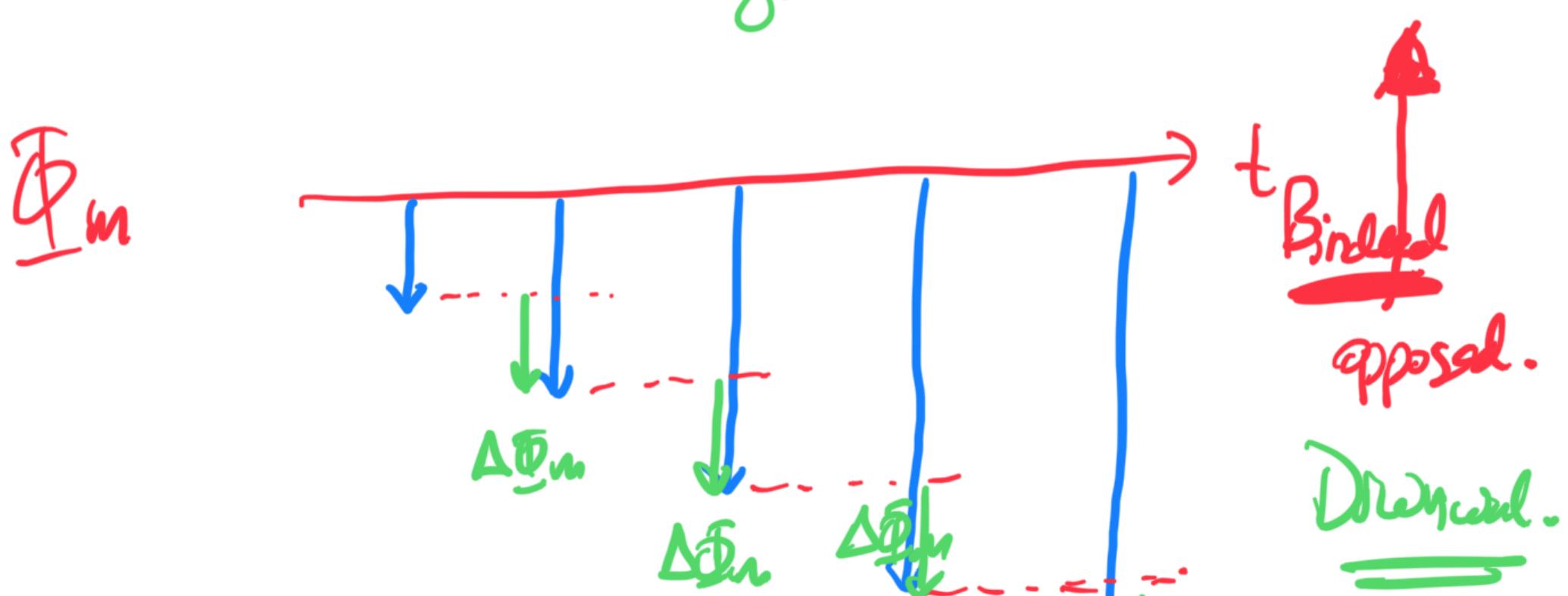
Side View



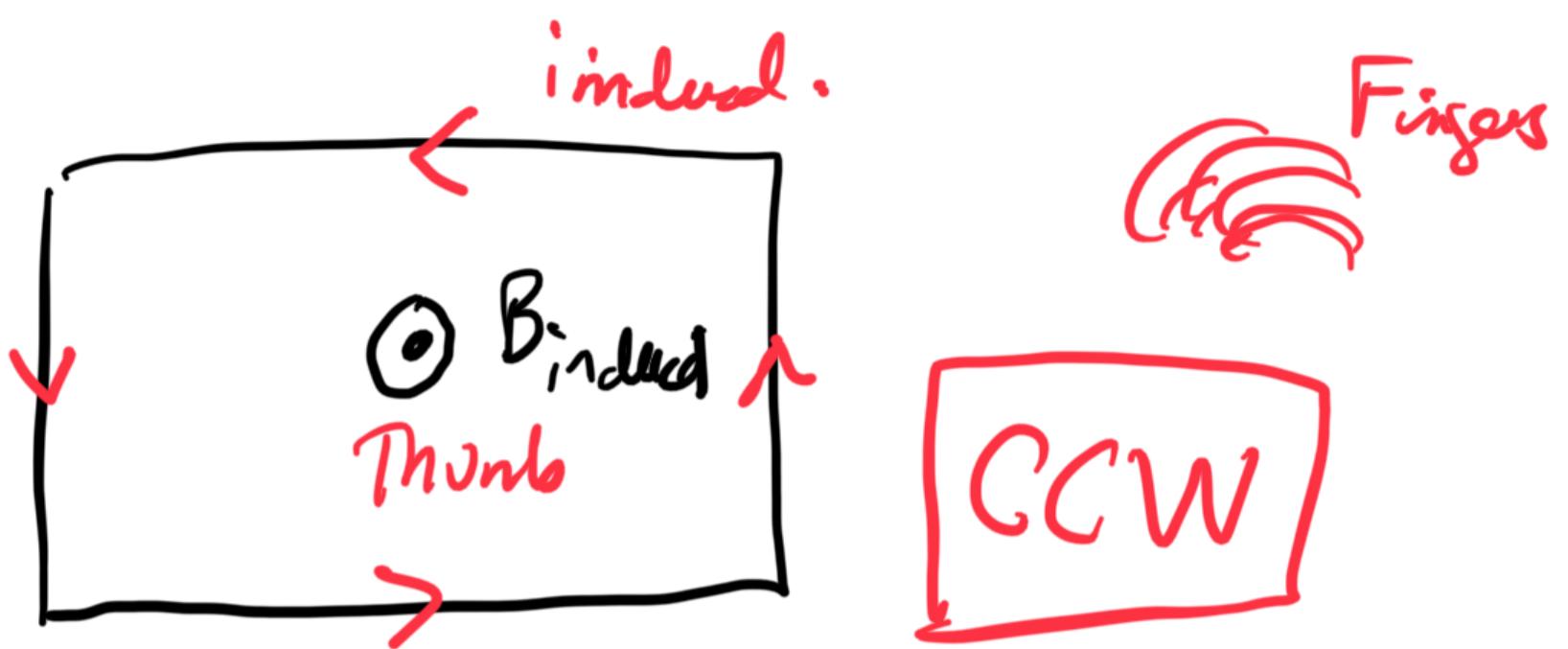
$i = a + bt$  → magnetic flux is increasing with time!!

$$V_{\text{ind}} = -N \frac{d\Phi_m}{dt} \quad \text{tre}$$

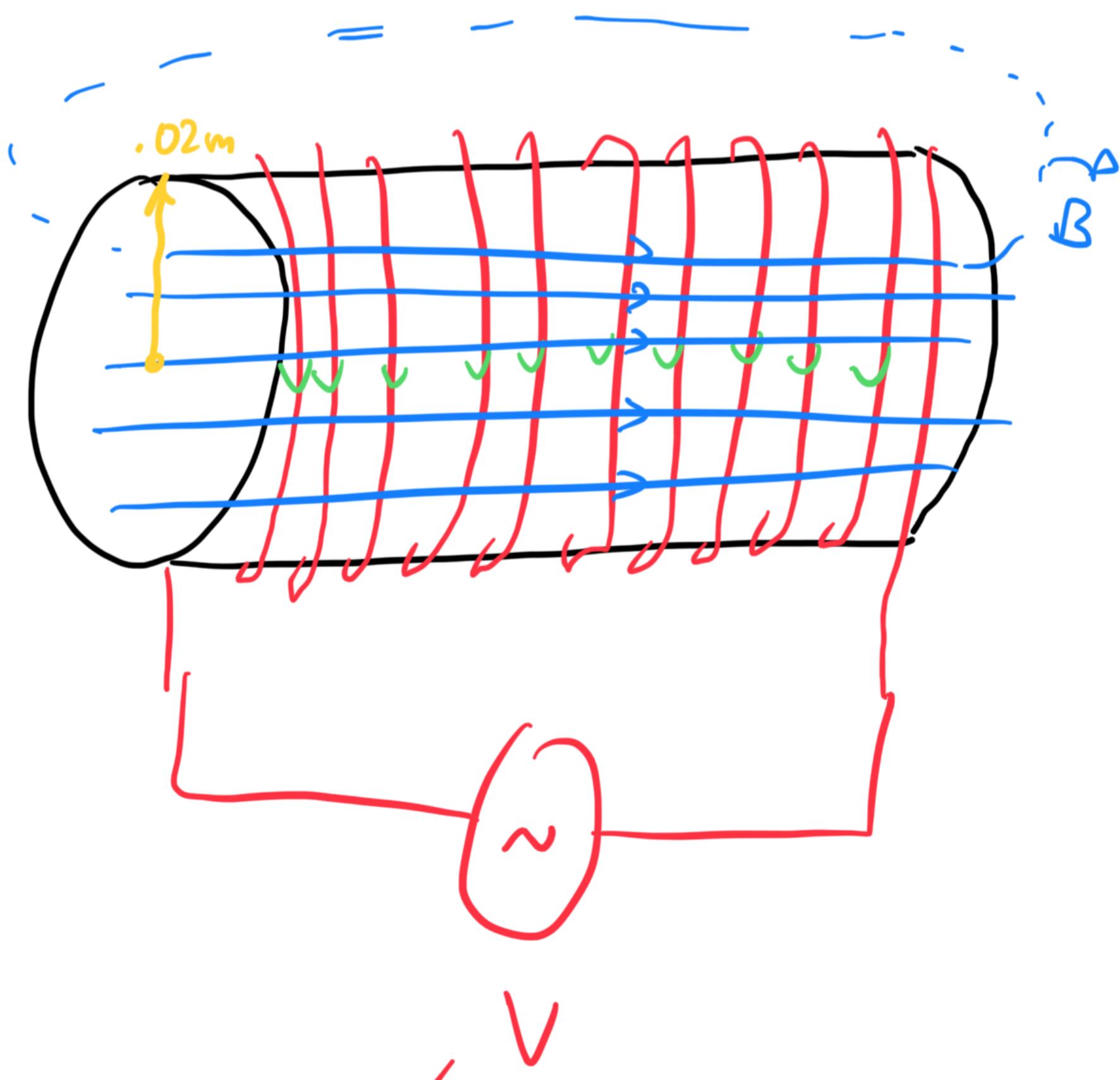
↑  
negative.



$\downarrow \Delta Dm$



(b.)



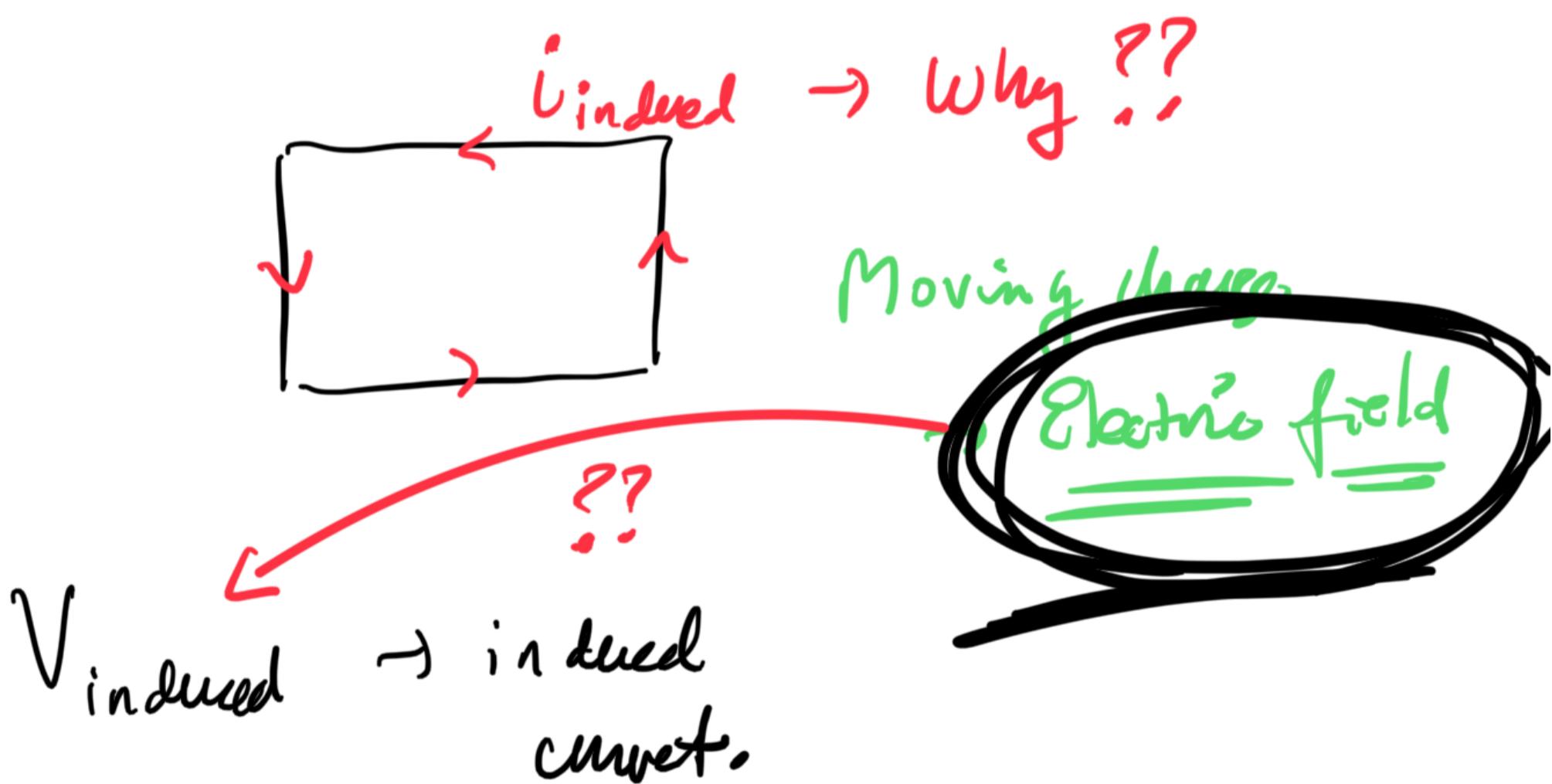
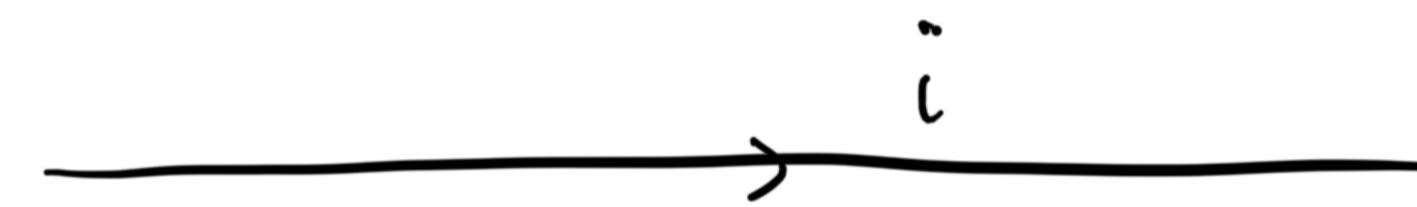
$$|\vec{B}_c| = \mu_0 \left( \frac{N}{L} \right) i$$

turns/m  
 = 1000

$\uparrow$   
 $3 \sin(90\pi t)$



Take a step back:



$V_{\text{induced}} \equiv - \int_{\text{loop}} \vec{E} \cdot d\vec{l}$

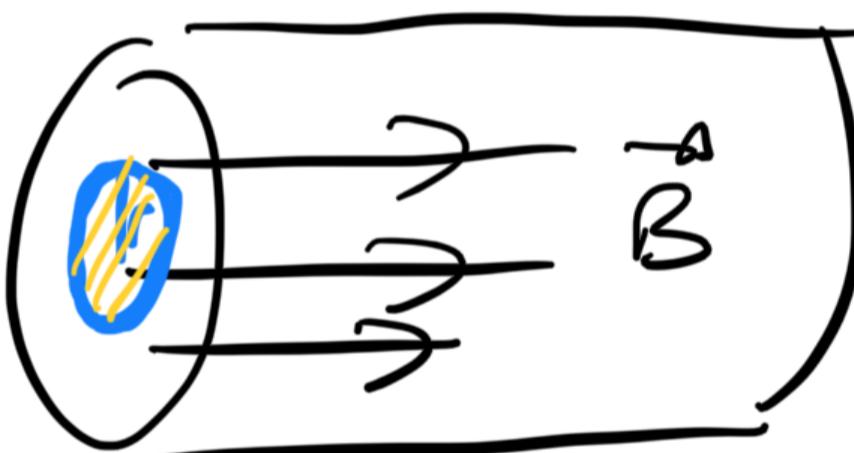
$\uparrow$   
 loop

Maxwell's Equations

The diagram illustrates Faraday's Law of Induction. A rectangular loop represents a coil with N turns. A red arrow labeled 'I' indicates current flowing clockwise through the loop. A vertical green line segment, representing a magnetic field vector, passes through the center of the loop. A yellow oval encloses the left-hand side (LHS) of the equation, which contains the integral  $\int \vec{E} \cdot d\vec{l}$ . A black oval encloses the right-hand side (RHS), which contains the term  $-N \frac{d\Phi_m}{dt}$ . A red circle with a checkmark is drawn next to the LHS.

$$\int \vec{E} \cdot d\vec{l} = -N \frac{d\Phi_m}{dt}$$

RHS



$$|\vec{B}| = \mu_0 \left(\frac{N}{L}\right) i$$

$1000 \quad \leftarrow 3 \sin 90\pi t$

$$\Phi_m = BA = 3000 \mu_0 \sin 90\pi t$$

$$\Phi_m = \frac{3000 \mu_0 \sin(90\pi t) \cdot \pi r^2}{L}$$

$$\frac{d\Phi_m}{dt} = \frac{3000 \mu_0 \cos(90\pi t)}{\pi r^2} \times 90\pi$$

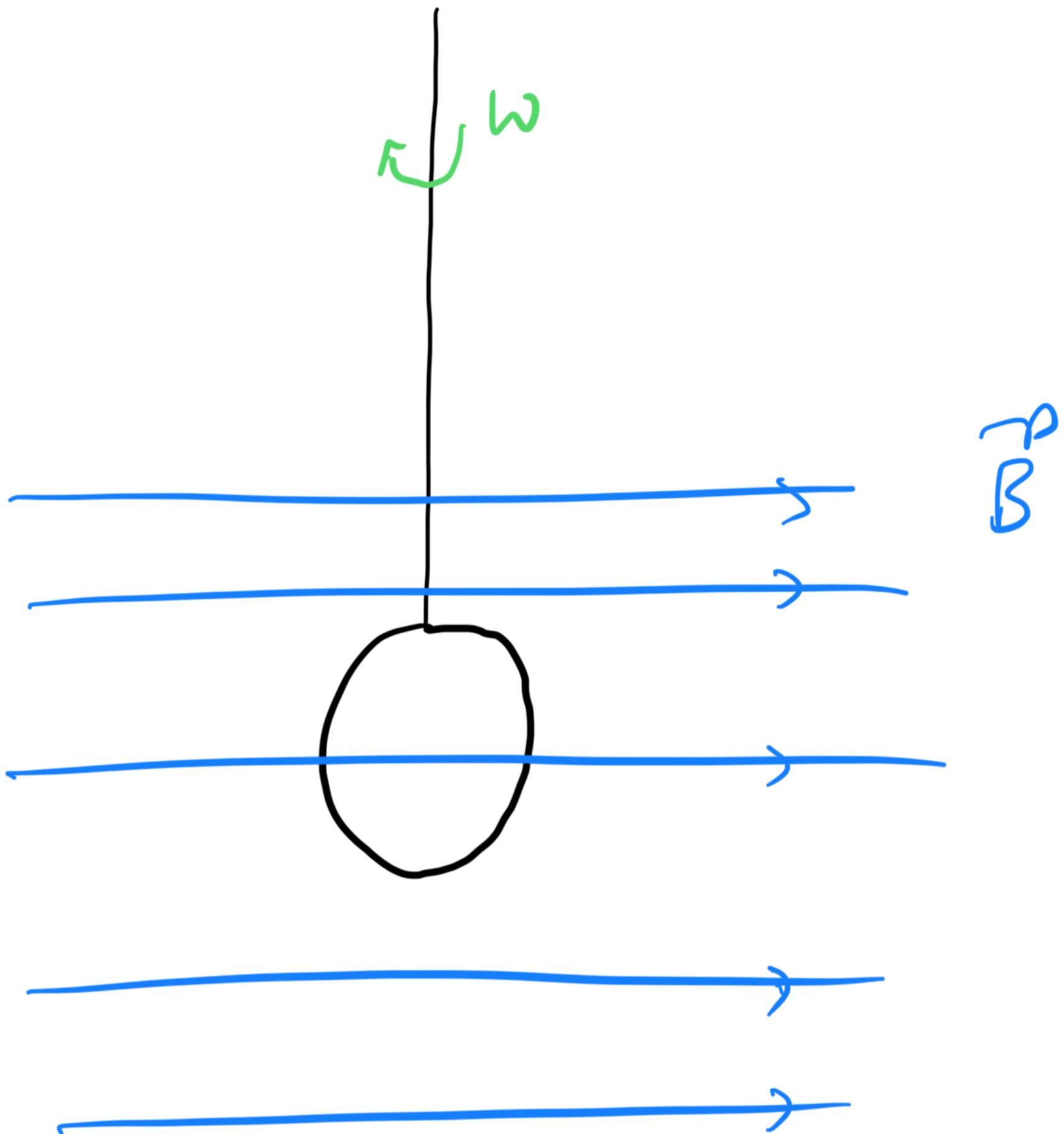
= RHS

LHS

$$\oint_{\text{loop}} \vec{E} \cdot d\vec{l} = E \cdot \underline{2\pi r}$$

$$E \cdot \cancel{2\pi r} = \frac{3000 \mu_0 \cos(90\pi t)}{\cancel{90\pi} \cdot \cancel{\pi r^2}}$$
$$E = \cancel{5.33} \times \cancel{10^{-3}} \cos(90\pi t)$$

II.



$$\Phi_m = BA \cos \theta$$

$$\Phi_m = BA \cos(\omega t)$$

$$\frac{d\Phi_m}{dt} = -BA\omega \sin(\omega t)$$

$$V_{ind} = -NAB\omega \sin(\omega t)$$

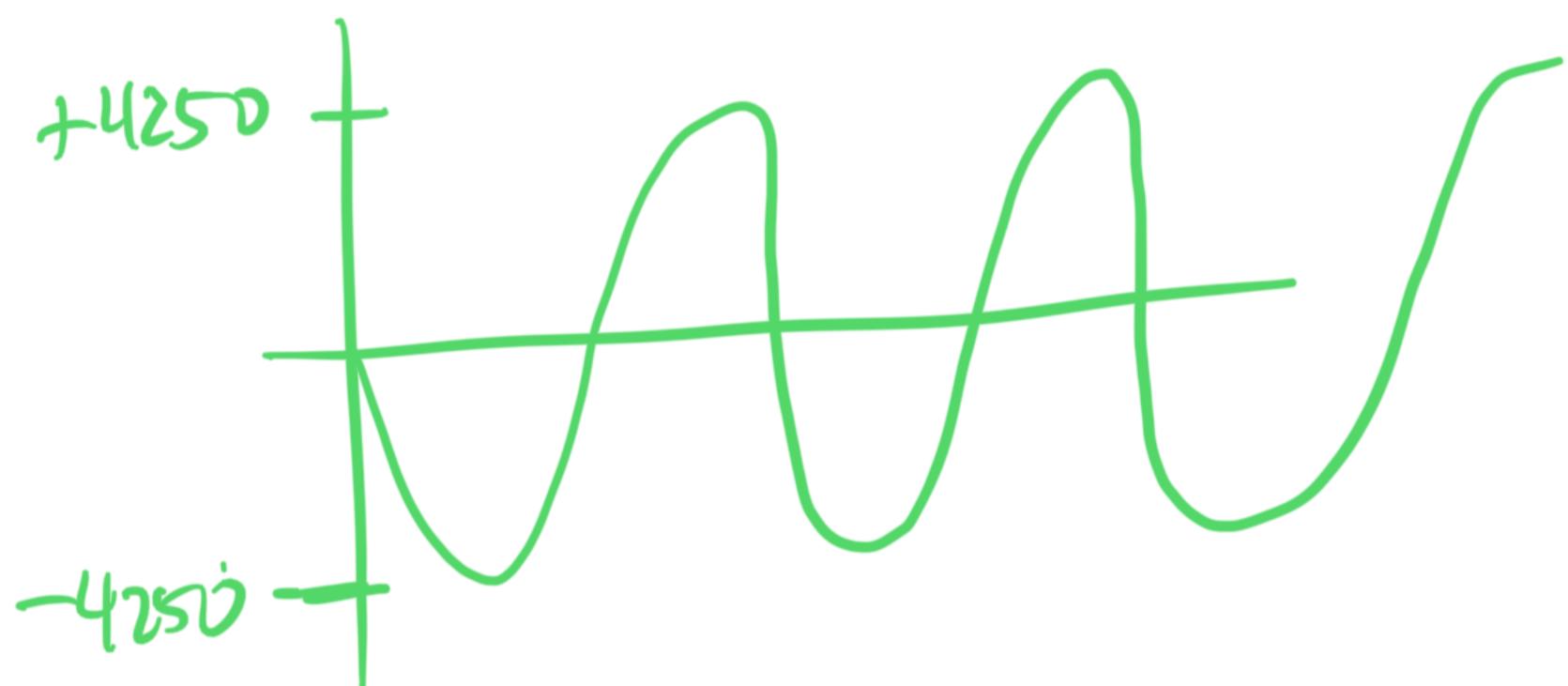
$$600 \cdot 1 \text{ m}^2$$

$$60 \frac{\text{rev}}{\text{s}}$$

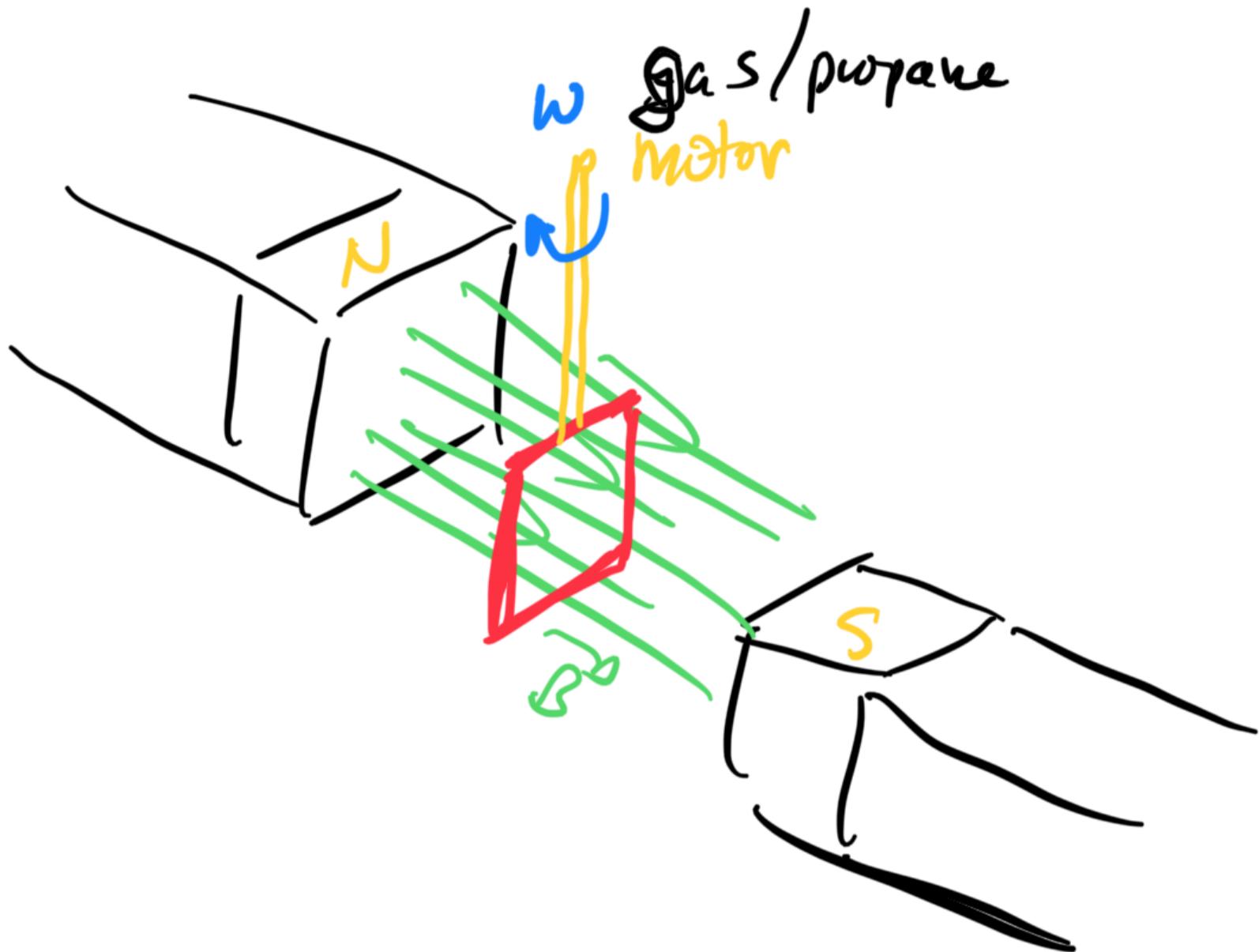
$$\times 2\pi \frac{\text{rad}}{\text{rev}}$$

$$= 120\pi$$

$$V_{\text{ind}} = -4250 \sin(120\pi t)$$



12.



$$\begin{aligned}\Phi_m &= \vec{B} \cdot \vec{A} = BA \cos \theta \\ &\quad \downarrow 30^\circ = BA \cos(\omega t) \\ \omega &= 2\pi f \\ &= 60\pi \\ &= 188.50 \\ &\quad \cdot 8 (-12)(-12) \\ &\quad \underbrace{\qquad\qquad\qquad}_{11.52 \times 10^{-3}}\end{aligned}$$

$$\boxed{\Phi_m = (11.52 \times 10^{-3}) \cos(188.50 t)}$$

$$V_{\text{induced}} = -N \frac{d\Phi_m}{dt}$$

$$= +1 (11.52 \times 10^{-3})$$

$$(188.50) \sin(188.5t)$$

$$V_{\text{induced}} = 2.171 \sin(188.50t)$$

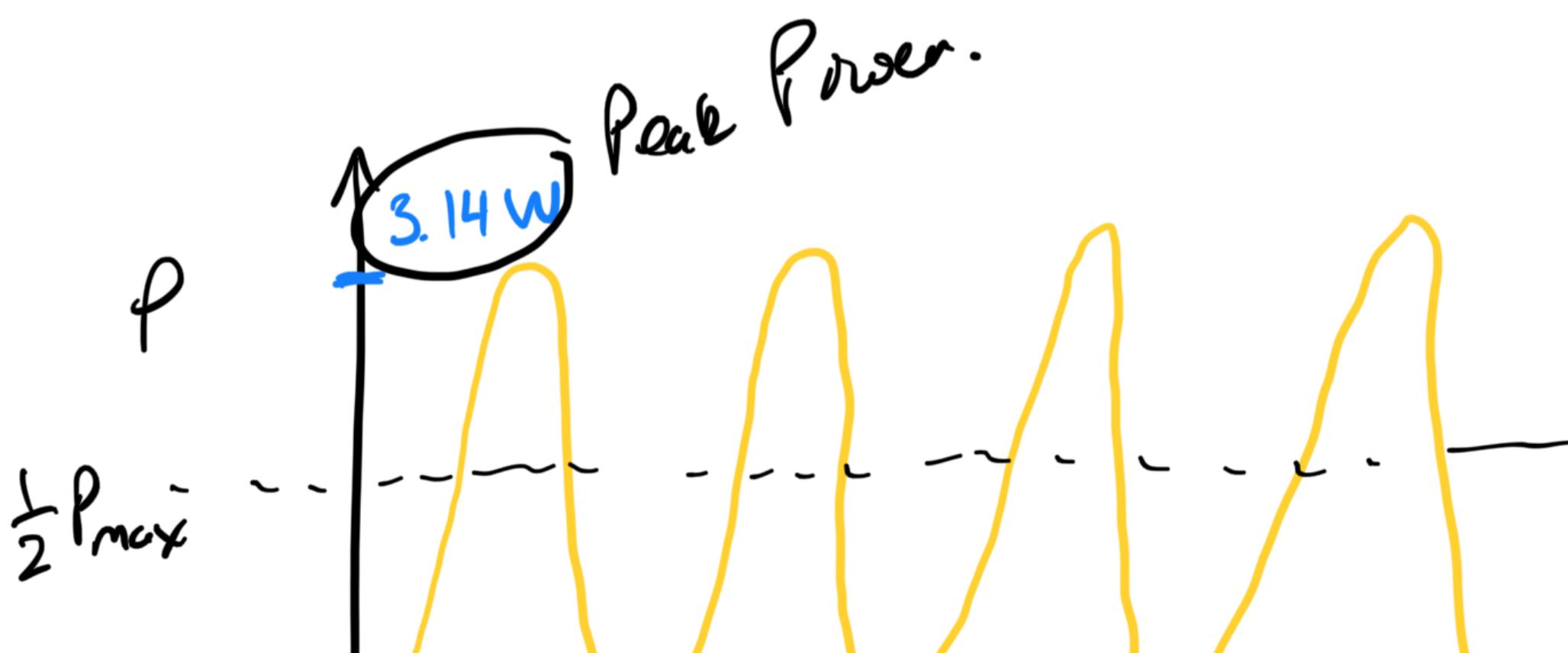
$$i_{\text{induced}} = \frac{V}{R} = 1.448 \sin(188.50t)$$

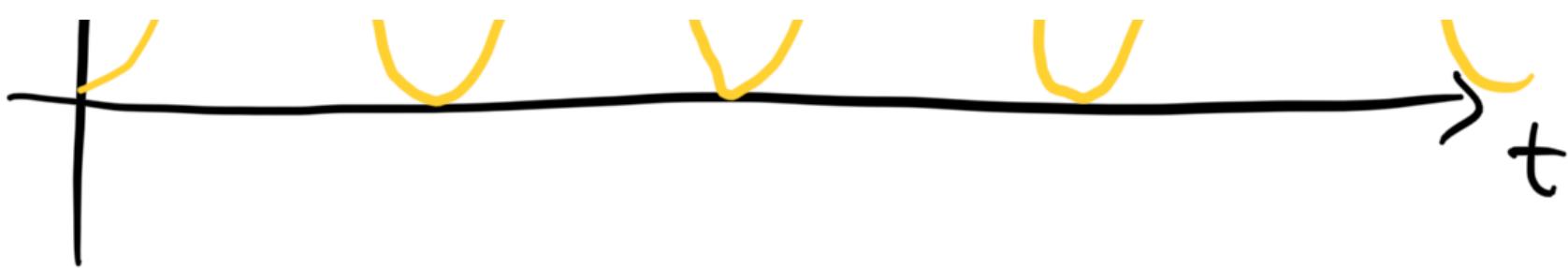
$$P = iV = 3.14 \underline{\sin^2(188.50t)}$$

$$P = \bar{c} \cdot \omega$$

$$\bar{c} = \frac{P}{\omega}$$

$$= 16.68 \times 10^{-3} \sin^2(188.50t)$$





$$P_{avg} = \frac{3.14}{2} = \underline{\underline{1.57 \text{ W}}}$$

—

Home Depot :

12000 W

Peak !!

$$\theta = \omega t$$



$$2\pi f (30) = 60\pi = \underline{\underline{188.50}}$$



Interesting Physics !! :-)