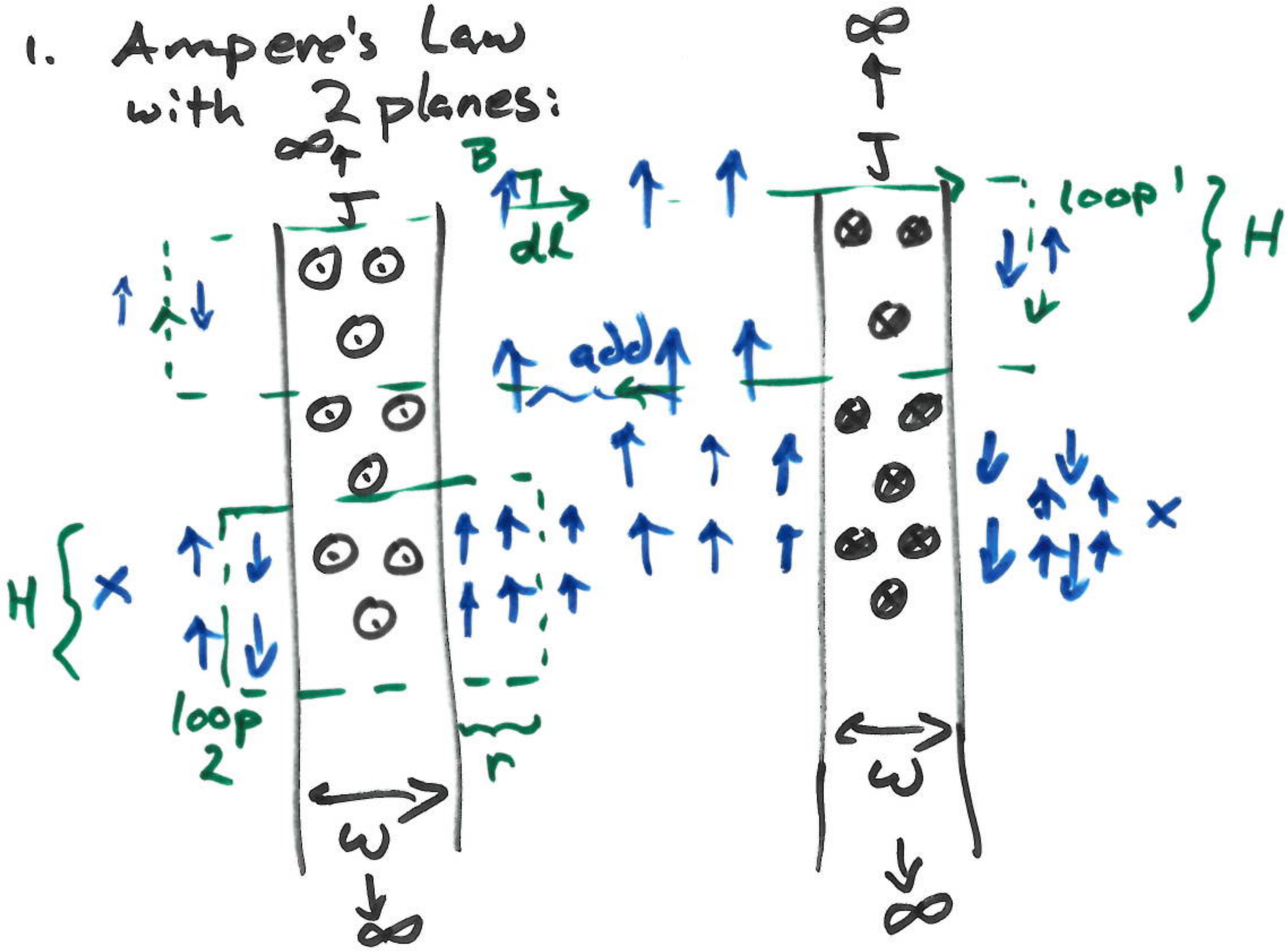
# P201 Exam 2 : Extra Review Session

1. Ampere's Law with 2 planes:




$$\oint \vec{B} \cdot \vec{dl} = \mu_0 I_{IN}$$

Super position $\quad \vec{B}_{Tot} = \vec{B}_1 + \vec{B}_2$

$$\oint_{loop\,1} \vec{B} \cdot \vec{dl} = \mu_0 I_{IN} = 0 \quad \text{No net current}$$

$B_{right} H + B_{left} H = 0$

top and bottom $\vec{B} \cdot \vec{dl} = 0$ because $\theta = 90°$

Thus $B = 0$ outside the walls.

$$\oint_{\text{loop 2}} \vec{B} \cdot d\vec{l} = \mu_0 I_{in}$$

$$B\, H = \mu_0 J (H w)$$

on inside between sheets

$$I = J \text{ Area}$$

$$J = \frac{I}{\text{Area}}$$

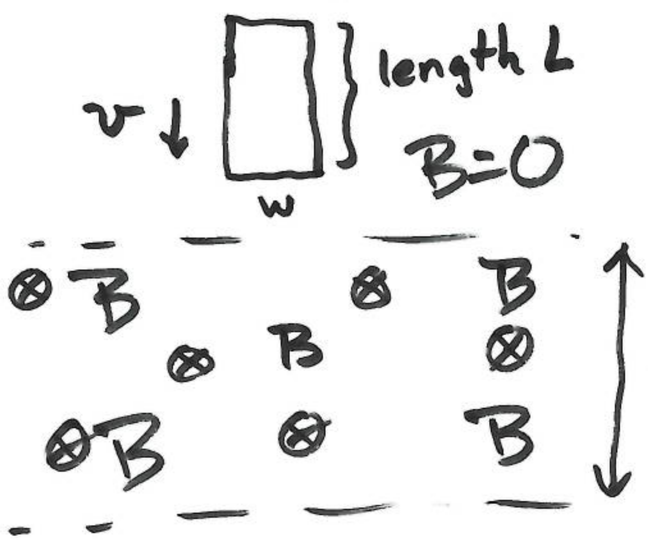
$$B = \mu_0 J \cdot w$$

---

Faraday's Law

$$V = -\frac{d}{dt} \int \vec{B} \cdot d\vec{a}$$

$$\Phi_B = \int \vec{B} \cdot d\vec{a} \qquad V = -\frac{d}{dt} \Phi_B$$




uniform field B inside this region. (B=0 outside)

B=0

There are $\underline{5}$ cases to consider: I. Before loop enters field

II. Entering: bottom wire in field, but top is not yet.

III. If $H > L$, there is some time when entire loop is in field, and moving.

IV. Leaving: bottom wire is out, but top is in.

V. Left the field (below).

---

Given: $B$, $w$, $L$, $H$, $v$ and $H > L$ so that case III exists. Find $V(t)$ in each case.

---

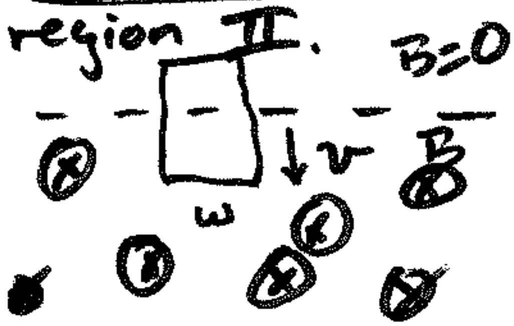
Answer: In cases I and V, $\Phi_B = 0$ since $B = 0$ in loop thus $V = 0$.

In region III, $\Phi_B = B L w$
B times area of loop, but $\Phi_B$ is not changing in time, thus $\underline{V = 0}$.

wow!

---

region II.

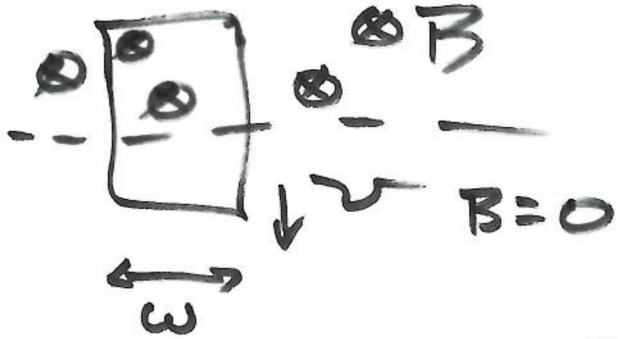



$$\Phi = B \cdot w \, (\text{length in the field})$$
"$y(t)$"

$$V = \frac{d}{dt} B w \text{ "}y(t)\text{"}$$

$$V = B \cdot w \cdot \underbrace{\frac{dy}{dt}}_{v}$$

Same in ~~region~~ case IV, except direction.




$$\Phi = B \cdot w \cdot \underbrace{(\text{length in field})}_{y(t)}$$

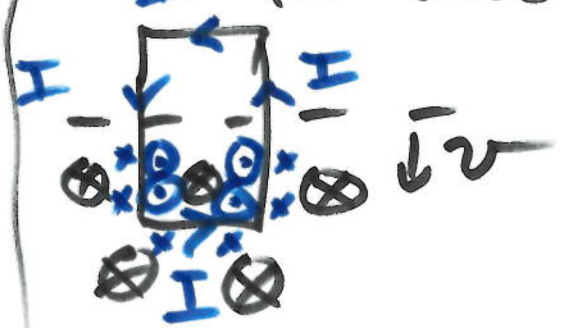
$$= Bw\, y(t)$$

$$V = \frac{d\Phi}{dt} = Bw \underbrace{\frac{dy(t)}{dt}}_{v}$$

$$V = Bwv.$$

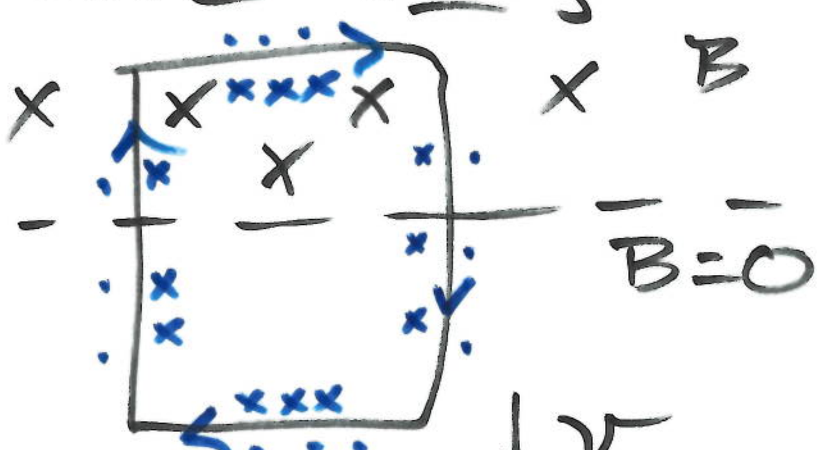
$\boxed{\text{Lenz's Law:}}$ Direction of current flow

in case II, $\Phi_B$ is increasing into page.



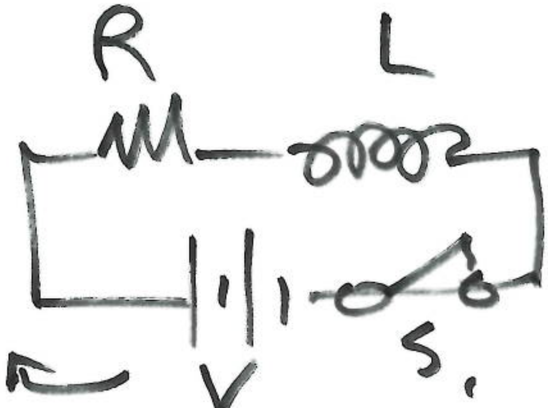

counterclockwise induced current.

Case IV: Leaving




$\Phi_B$ is decreasing because loop is leaving.

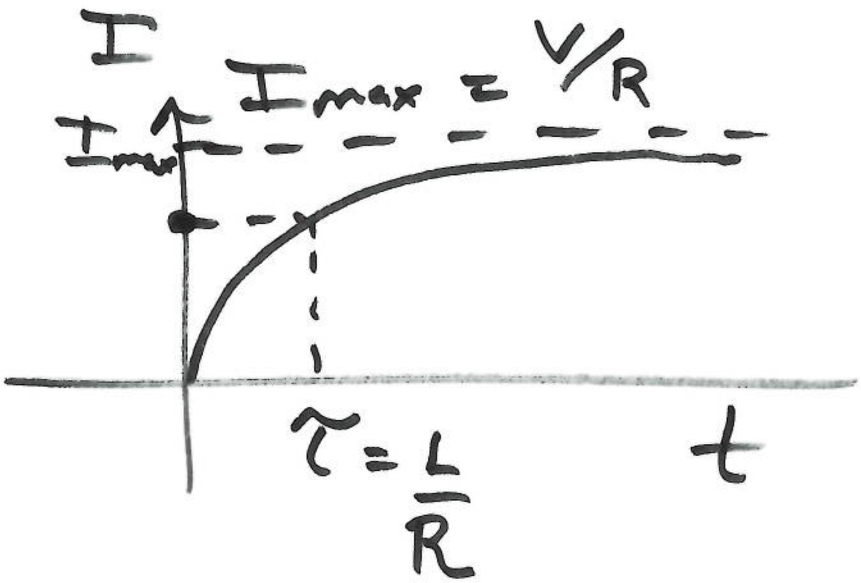
Thus I will generate its own B to "makeup" for lack of B.




$I(t) = ?$

Given $V\ R\ L$
switch s closes at $t = 0$
Sketch/graph/write down $I(t)$.

$I_{max} = V/R$




$$I(t) = I_{max}\left(1 - e^{-t/\tau}\right)$$

$\Phi = \int \vec{B} \cdot \vec{da}$ can change in 3 ways

flux or Green Lantern

$\vec{B} \cdot \vec{da} = B\,da\cos\theta$

$\phi$ lower case phi

$\Phi$ capital Phi

$\pi$ $\Pi$