Magnetism #~~1~~5

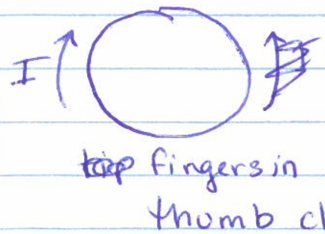
p688 mc 5, 10 C 14, 17
p690 Problems 24, 27
Online - Induced Current
- Understand Changing Flux

~~0~~5

(9)

p688 - MC

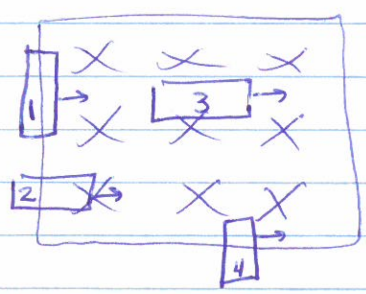
5) Metal ring lies on table   S pole moves down



X goes ~~in~~ down from magnet
• added going in from nature

(2)   Clockwise

10)



Identical loops, same v

· Rank induced current

1 > 2 > 3 = 4

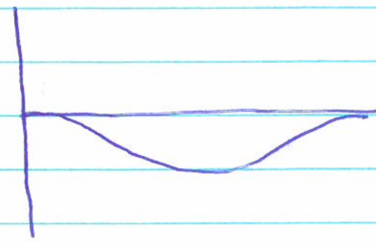
most area   no changing flux

- Concept

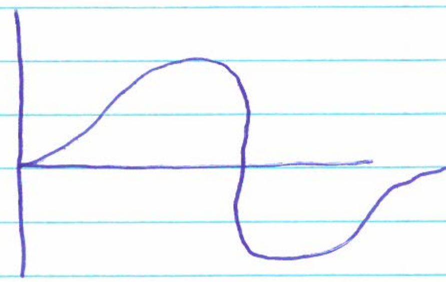
14) Bar magnet falling w/ N pole down passes through vertical coil

(1) Flux vs Time

dots go in so nature adds x



EMF vs Time



~~7~~ 5

- Concept

17) Why does B of induced I oppose change in external?

Energy conservation would be violated if the induced current were to enhance the magnetic field.

To illustrate this point, consider the setup of a coil and a bar magnet. If you move the N pole of magnet to opening of coil, and the magnetic field through the coil would increase and induce an electric current that would cause an induced magnetic field in the same direction as the external bar magnet magnetic field.

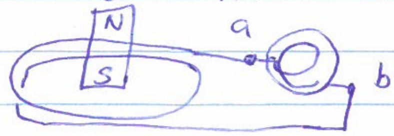
(1)

This would cause a larger increasing magnetic field and a larger induced electric current which would cause a larger induced magnetic field and so forth. The result would be a run-away induced current that would melt the coil.

~~7~~ 5

- Problems

24) bar magnet induces current in N turn coil
as it moves closer



radius R ~~5~~m
avg emf ε V

A) Rate change of magnetic field

$$\left|\frac{\Delta B}{t}\right| = ? \qquad \varepsilon = N\left|\frac{\Delta \Phi}{\Delta t}\right| = N\left|\frac{\Delta B}{\Delta t}\right|\pi R^2$$

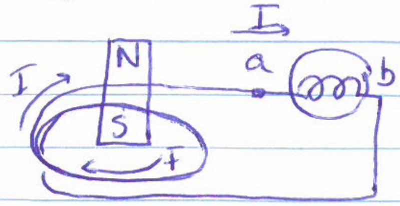
(1)

$$\left|\frac{\Delta B}{\Delta t}\right| = \frac{\varepsilon}{N\pi R^2}$$
↖ radius

B) Induced current?

$$I = \frac{\varepsilon}{R_o}$$ ← resistance

c) direction of induced current?



from a to b

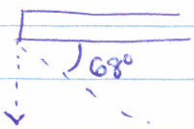
X go in
∘ made by nature go in

~~7~~
5

27) Two horizontal rails
distance = 1.5 m
Connect by $R = 3.0\Omega$
$V = 25\ m/s$
$B = 5.0 \times 10^{-5}\ T$
$\theta = 68°$ below horizon

long thin U shape
metal axl rolls along

a) $\mathcal{E} = ?$ $\quad \mathcal{E} = \left|\frac{\Delta\Phi}{\Delta t}\right| = \frac{B\Delta A}{t}\cos\theta = BLv\cos\theta$ $\quad$ [$\Delta A \to L\cdot d$, $\frac{d}{t} \to v$]



$\theta = 22°$

$= (5.0\times10^{-5}T)(1.5m)(25m/s)\cos 22°$
$= 1.74 \times 10^{-3}\ V$

(2)

angle from normal

b) Induced current $\quad I = \frac{\mathcal{E}}{R} = \frac{1.74\times10^{-3}V}{3.0\Omega} =$

$= 5.8 \times 10^{-4}\ A$

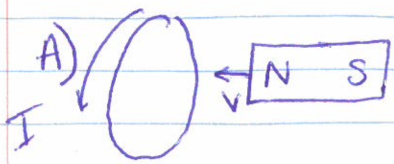
c) Power through R

$P = I^2R$
$= (5.8\times10^{-4}A)^2(3.0\Omega)$
$= 1.01 \times 10^{-6}\ W$

~~7~~ 5

- Online

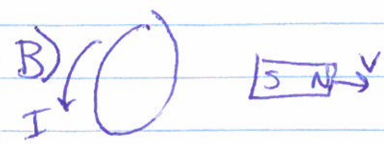
① Induced Current in Metal loop

A) 

View from R

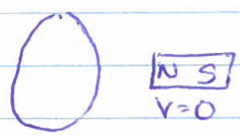
· extra dots go in · nature adds x in

CCW

B) 

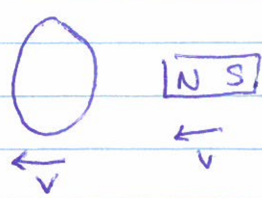
· fewer x go in · nature adds x in

CCW

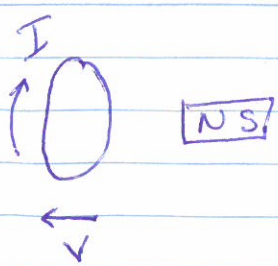
c) 

zero (no change flux)

1

D) 

zero (no change flux)

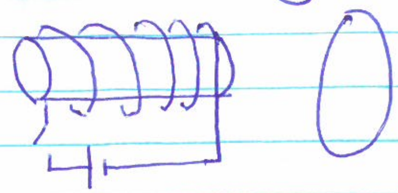
e) 

· fewer dots in · nature adds dots in

Clockwise

~~7~~ 5

② Understanding Changing Flux



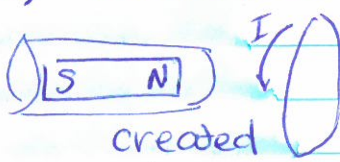
A) open switch magnetic flux?

No magnetic flux (~~no movement~~, broken circuit)

B) ~~close~~ open switch induced current? in loop

No induced current (no change flux)

c) switch closed induced current in loop



. extra dots in nature adds x in

CCW

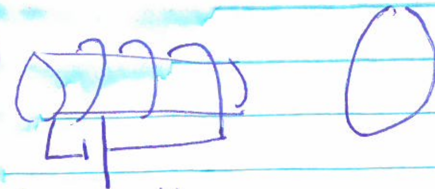
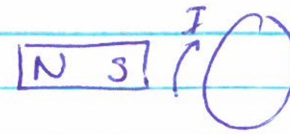
(2)

d) switch opened

① external flux B) decreases

② induced current B) Clockwise (opposite part c)

~~7~~ 5

e)  creates 

(opposite other picture)

Switch open, then close

Induced current?

extra x in

nature add • in

Clockwise

f) switch reopen

① external flux B) decreases

② induced current C) CCW (opposite parte)