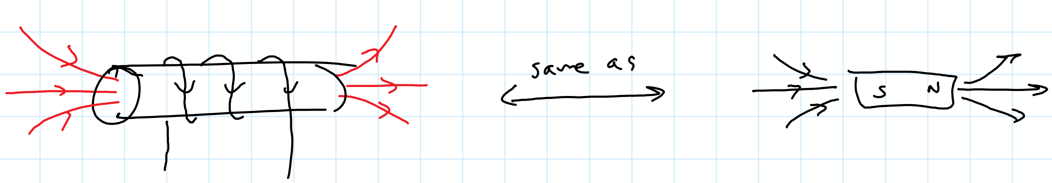
Phy 4B 6/6

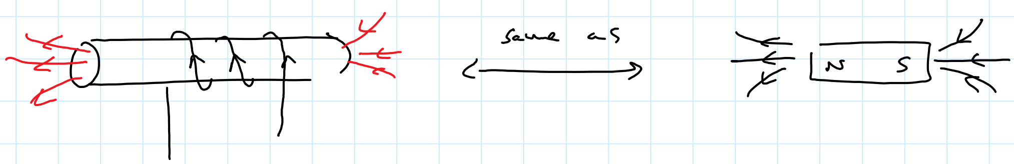
Tuesday, June 6, 2017 5:26 PM

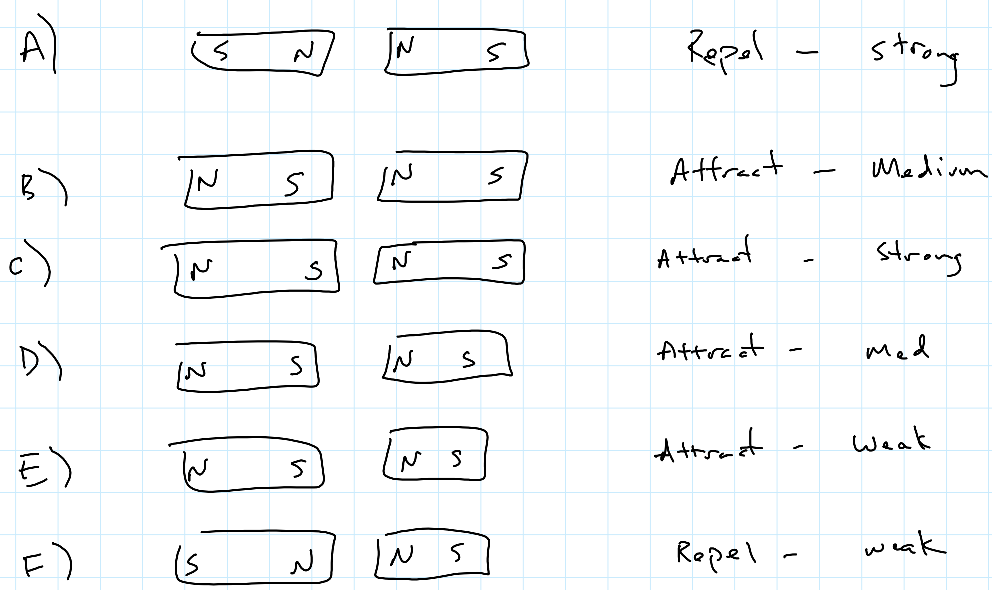
Goals for the Lecture:

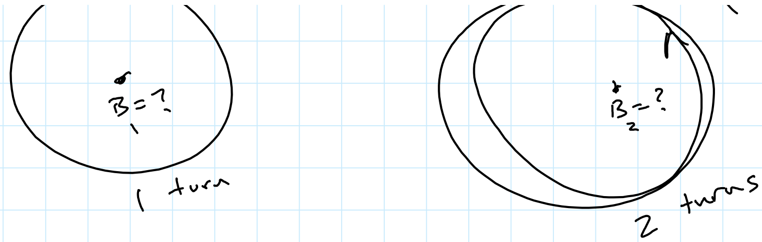
1) Understand what the magnetic field looks like in and around a solenoid, including what makes an ideal solenoid
2) Be able to use Ampere's Law to calculate the magnetic field inside an ideal solenoid
3) Understand Guess's Law for Magnetism, that there are no magnetic monopoles (at least, none have been found in nature)
4) Have a conceptual understanding of how permanent magnets work
5) Focus on ferromagnetism

Worksheet p 131









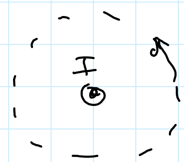
$$\vec{B} = \frac{\mu_0 I}{4\pi}\int \frac{d\vec{s}\times\hat{r}}{r^2}$$

Worksheet Top:

A) I_1 I_2 $\times$ B_1 B_2

$$\vec{B} = \vec{B}_1 + \vec{B}_2 = \frac{\mu_0 I}{2\pi r_1} + \frac{\mu_0 I}{2\pi r_2}$$

$r_1 = 2r_2$



$$\oint \vec{B}\cdot d\vec{s} = \mu_0 I$$

$$B\, 2\pi r = \mu_0 I$$

$$B = \frac{\mu_0 I}{2\pi r}$$ long, straight wire

B) I_1 $\times$ I_2 B_1 B_2

$$\vec{B} = \vec{B}_1 + \vec{B}_2 = \frac{\mu_0 I}{2\pi r} + \frac{\mu_0 I}{2\pi r} = \frac{\mu_0 I}{\pi r}$$

c) I_1 I_2 $\times$ B_1 B_2

$$B = \frac{\mu_0 I_1}{2\pi (2r_2)} - \frac{\mu_0 I_2}{2\pi r_2}$$ $\uparrow +$

bottom: Force on F due to G and H:

Find B from H at location of F:

$$B = \frac{\mu_0 I_H}{\ } \quad \mu_0(2) \quad \mu_0 \quad I \quad I$$

Find B from H at location of F:

$$B_H = \frac{\mu_0 I_H}{2\pi r} = \frac{\mu_0 (2)}{2\pi (2)} = \frac{\mu_0}{2\pi} \text{ out of page}$$

Find Force on F due to B_H:

$$F_{H \to F} = I \vec{L} \times \vec{B} = I_F L B_H = (6) L \frac{\mu_0}{2\pi} = \left(\frac{3\mu_0}{\pi}\right) L \downarrow$$

to bottom of page

Do the same for G and F and add

$$\vec{F}_{Net} = \vec{F}_{H \to F} + \vec{F}_{G \to F}$$

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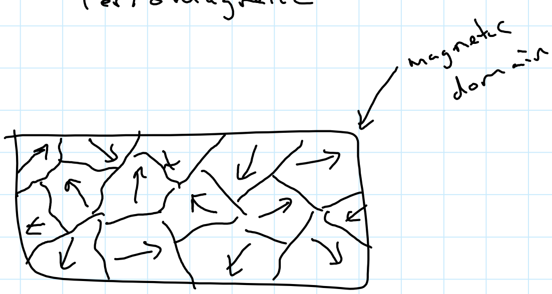
permanent Magnets:

most common type: Iron

Ferromagnetic

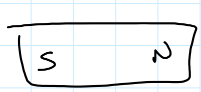
Iron



randomly oriented domains, so
No Net magnetic moment

turn on an external B field:

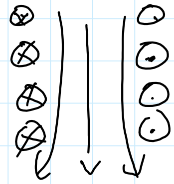
iron acts
like a magnet



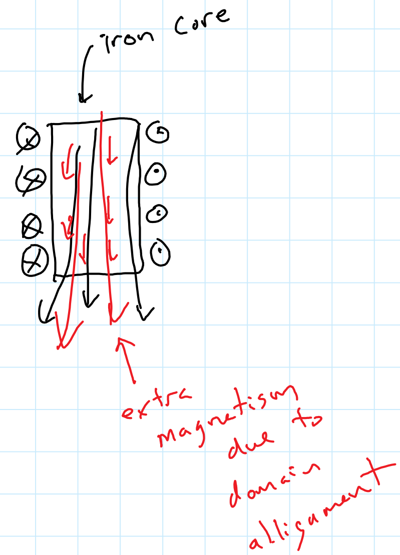
electro-magnets

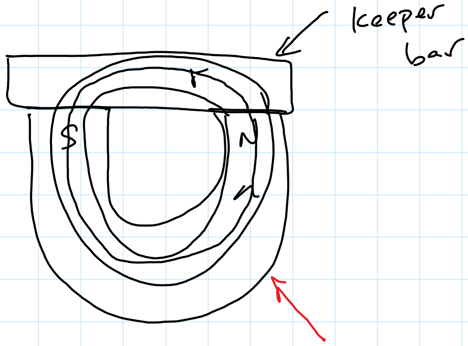
iron core

electro-magnets

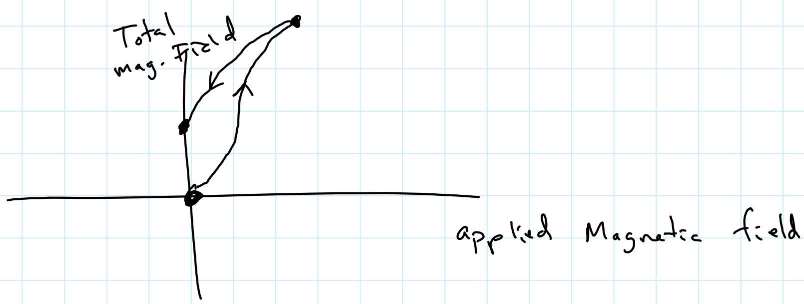


or with an iron core

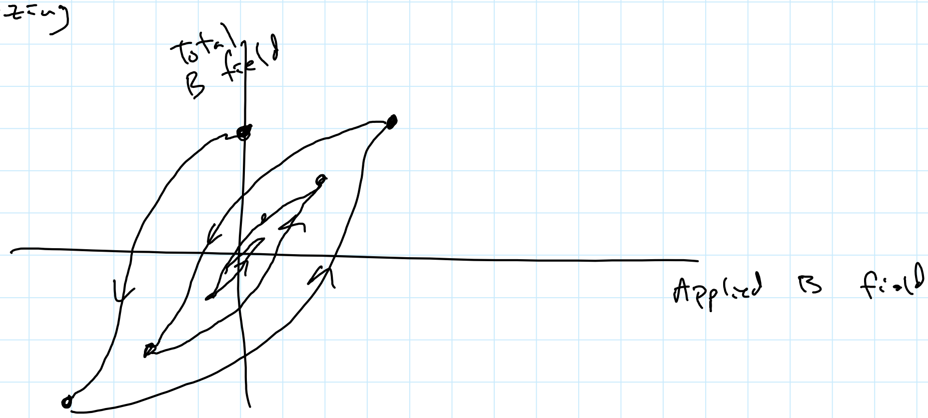




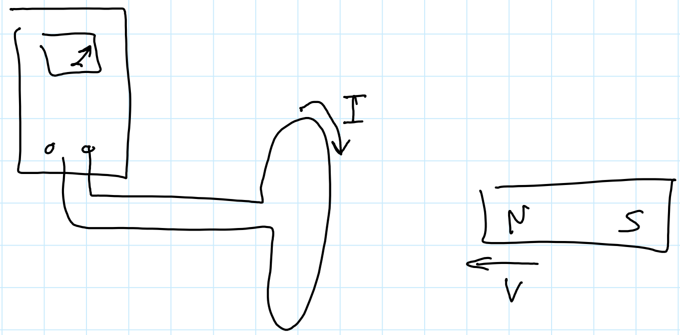
Magnetizing:

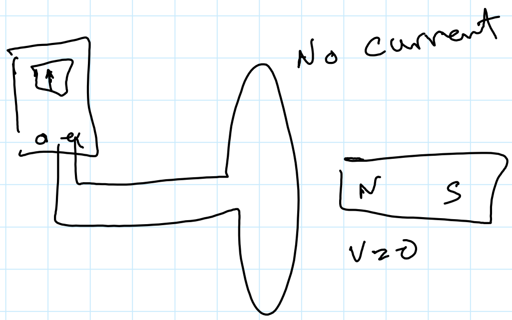


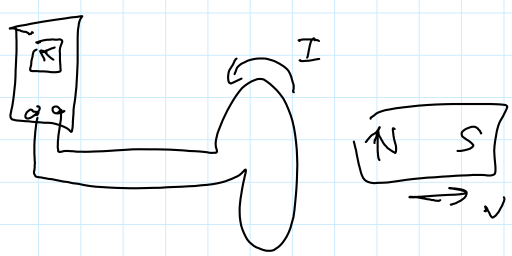
Demagnetizing



Induction:







$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

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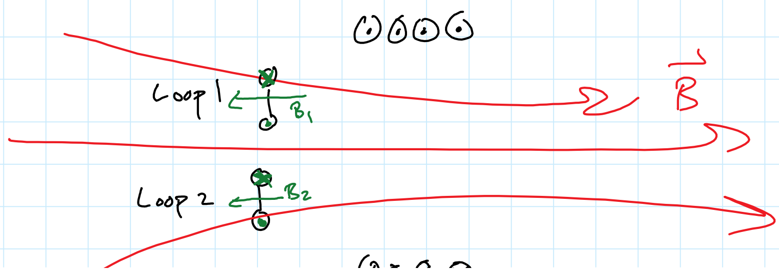
worksheet p. 139

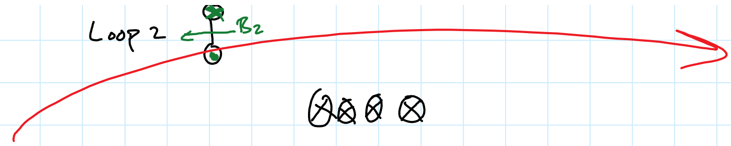
1) A) 1) before switch is closed → No

Just after → yes

Long time after → No

2)





3) $V = IR$

$$\frac{I_1}{I_2} = \frac{\frac{V_1}{R_1}}{\frac{V_2}{R_2}} = \frac{V_1}{V_2}\,\frac{R_2}{R_1}$$

So, $V_1 = V_2$

B) Emf $\rightarrow$ yes

current $\rightarrow$ No

C) Emf $\rightarrow$ yes

current $\rightarrow$ No

Faraday's Law: $\mathcal{E} = -\dfrac{d\Phi_B}{dt}$ single loop

$$\Phi_B = \int \vec{B} \cdot d\vec{A}$$

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

N = # of turns or loops

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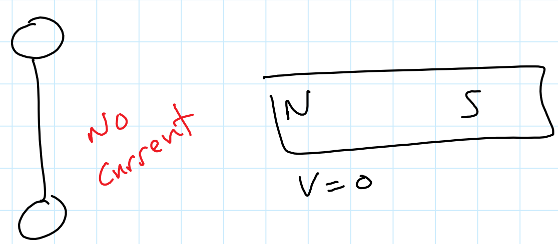
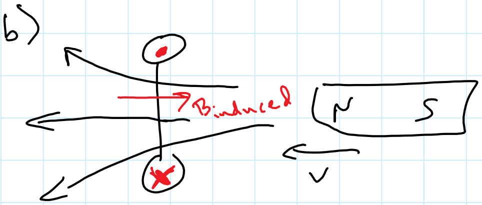
worksheet p 134

a)

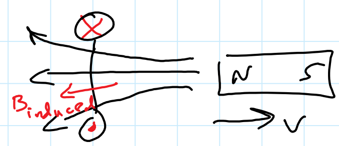


b)



Φ getting bigger, so induced current creates B to subtract from Φ

c)



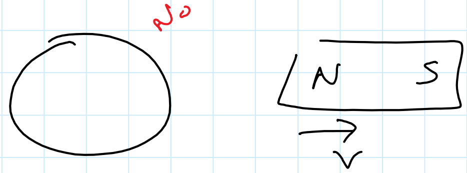
Φ_B getting smaller, so induced current creates B to add to Φ

d)

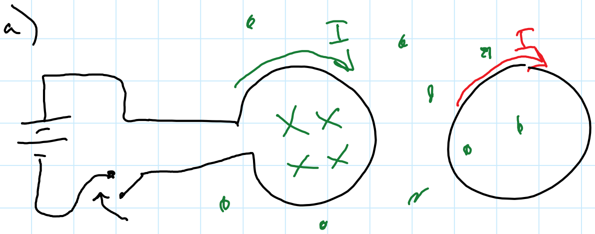
No current

e)

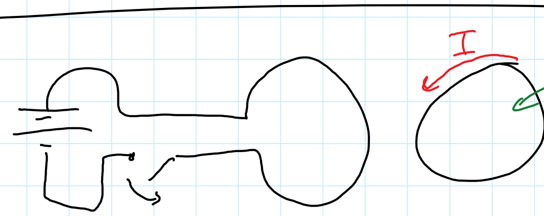
No current



p. 135 a)

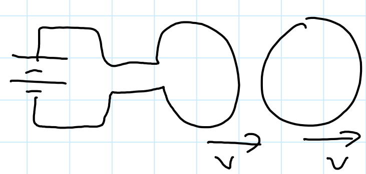


b)



B decreased so, I tries to add B out of page

c)

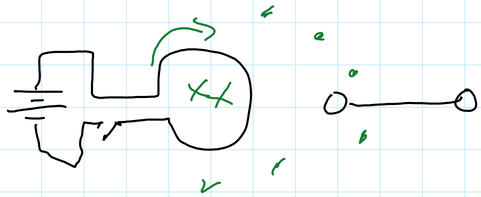


No current

d)

...rent

e)



No current
No flux in Right Loop

f)