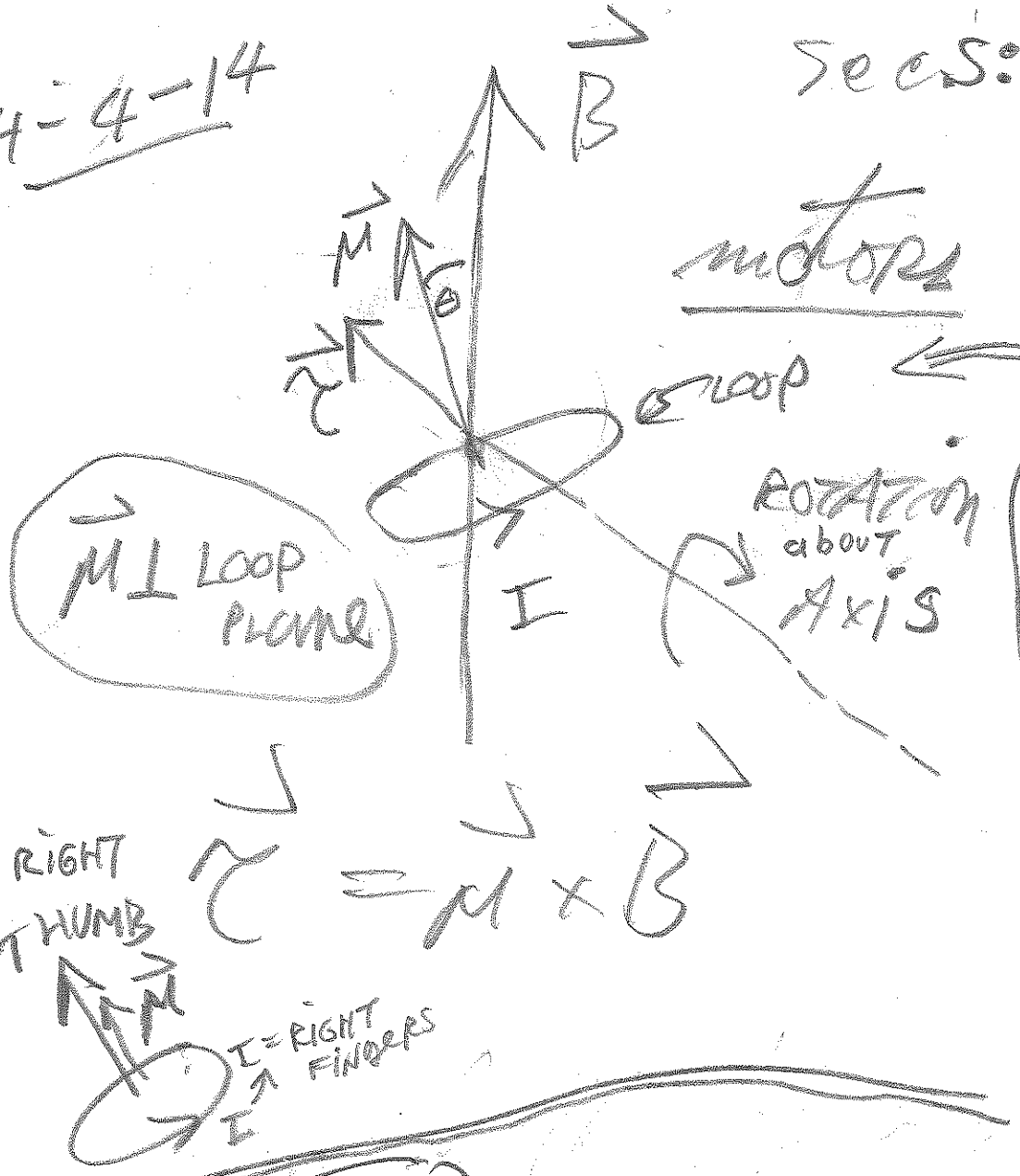
4-4-14

Secs: 27.7, 27.8

# motors




$\vec{\tau} = \vec{\mu} \times \vec{B}$

RIGHT THUMB $\vec{\mu}$

I = RIGHT FINGERS

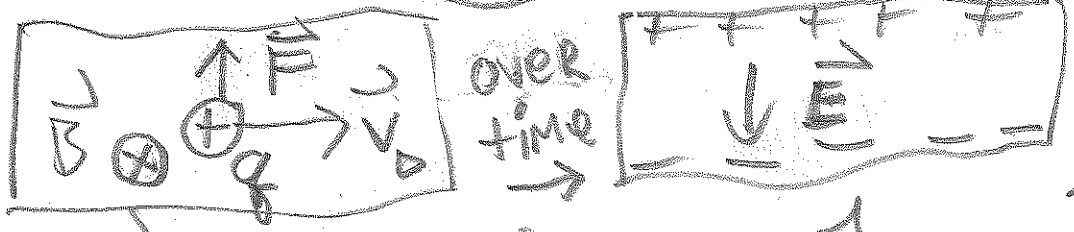
React ABOUT commutators: Fig 27.39. They change I-direction to keep $\vec{\tau}$ IN SAME direction ALONG AXIS

HALL EFFECT: see 27.9

$\vec{F} = q\vec{v}_D \times \vec{B}$ ↑ THUMB

$B = |\vec{B}|$

$E = |\vec{E}|$



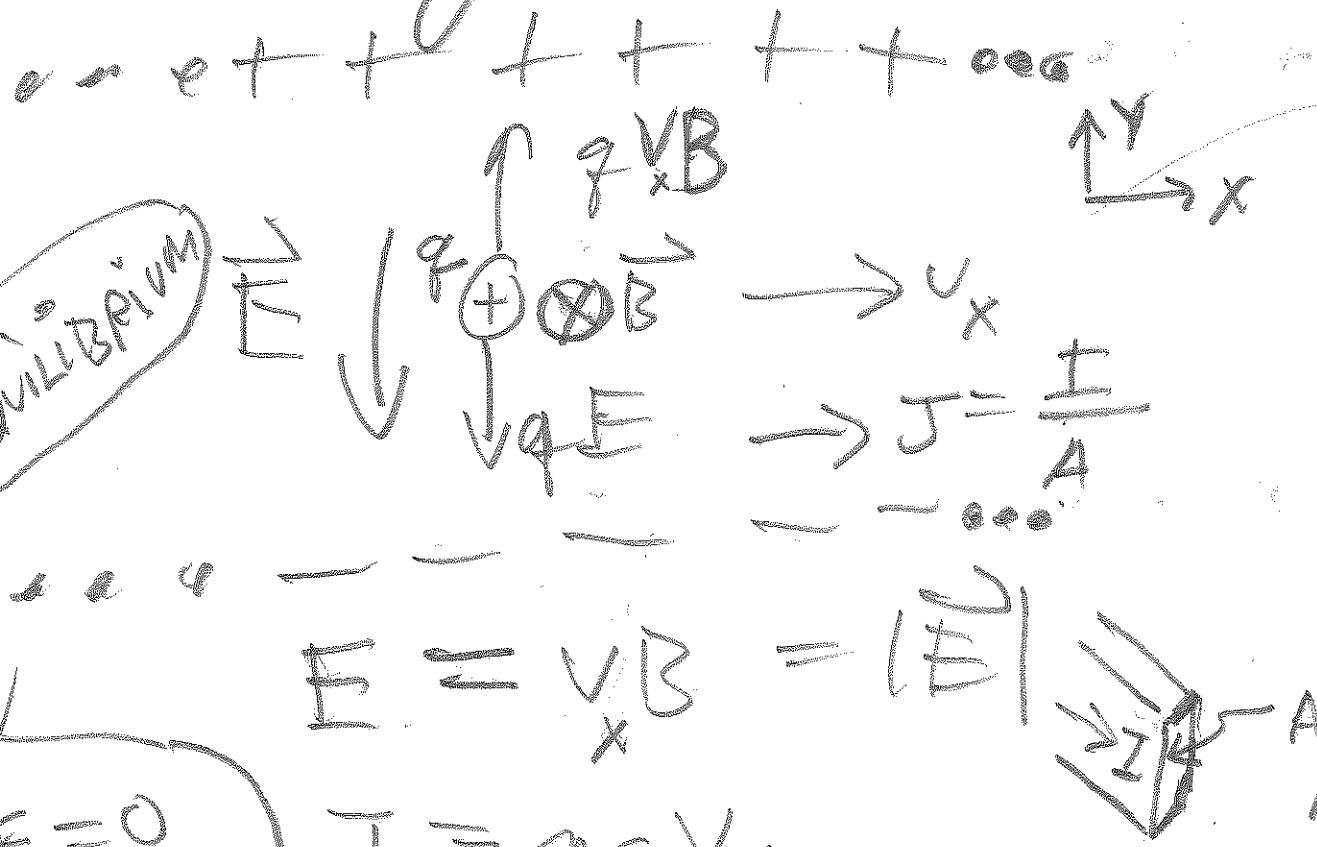

$\vec{v}_D = v_x \hat{i}$

$q = +e$ for "positrons."

$v_D$ = DRIFT velocity

# HALL effect

## velocity selector




$$\Rightarrow J = \frac{I}{A}$$

$$E = v_x B = |\vec{E}|$$




$$\sum F_y = 0$$

$$J = n q v_x$$

$$q v_x B - qE$$

$$\Rightarrow v_x = \frac{E}{B} \rightarrow J = n q \frac{E}{B}$$

$$\Rightarrow E = v_x B$$

$$\Longrightarrow \quad n q = \frac{B \cdot J}{E}$$

tool to measure n for a specific metal.

measure n given q.

Lab 5: Hall effect sensor was used in Lab 5 to measure B via E, n, q, J.

Test 3 review:

- See Sample exam problems

www.nvaphysics.com

MAP → Quiz 5, Quiz 6, Quiz 7

NOTE: CH25 starts at date 2-7-14 (CH25 sec 25.6)

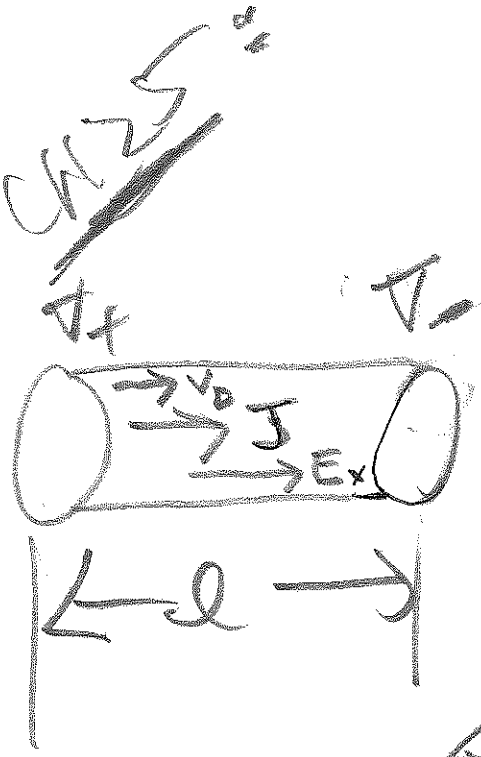
FORMULAS: $v_d = \frac{eE}{m}\tau$, $J = nev_d$

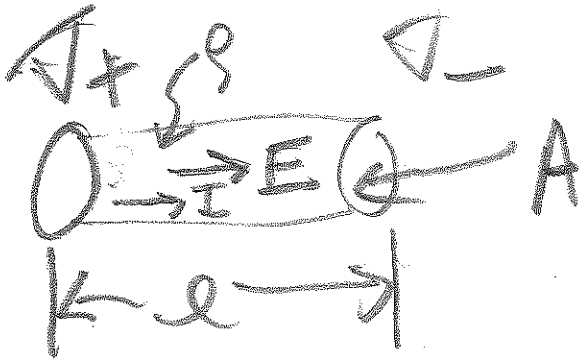
$$I = \frac{dQ}{dt} \quad , \quad J = \frac{I}{A}$$

$$J = \sigma E_x$$

$$\sigma = \frac{n e^2 \tau}{m}$$

$$J = \frac{E_x}{\rho}$$




$$V_+ - V_- = I \cdot R$$

$$R = \frac{\rho l}{A}$$

- Links Test 3
- 2-7 — CH 25 Base resistivity
- 3-5 — CH 26 RC circuits
- 3-7 — CH 25: $I^2 \cdot R = \frac{\Delta V^2}{R}$

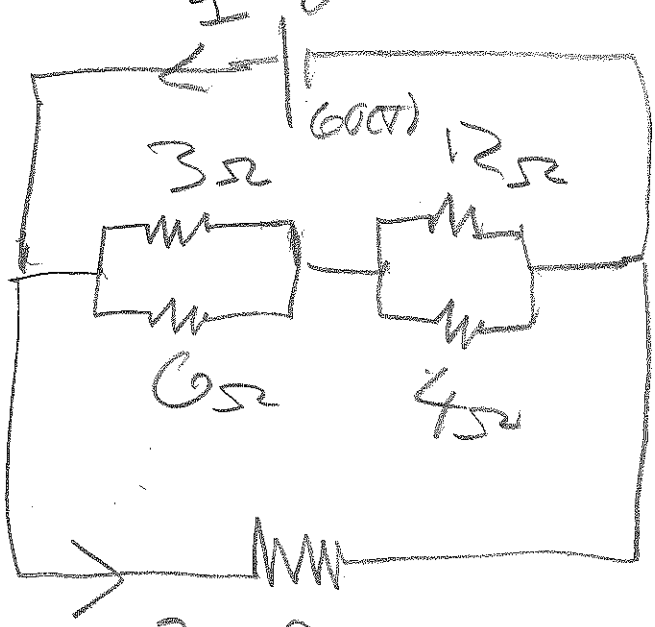
$P = I \cdot \Delta V$ = power delivered by battery at voltage $\Delta V$, CH 26: series, parallel.

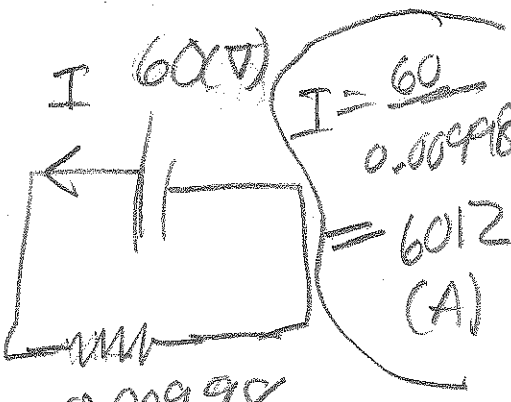
- 3-12 — RC THEORY
- 3-17 — problem in CH 26

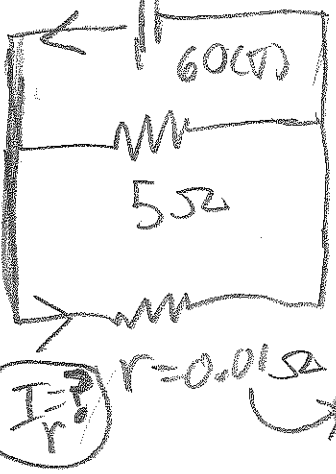
(6)

(#14) Test 3 "what if?"

modify it:




$R_p = \frac{(5\Omega)(0.01\Omega)}{5\Omega + 0.01\Omega}$

$= \frac{0.05}{5.01}$

$= 0.009$

Guess:

$I = \frac{60(V)}{0.01\Omega}$

$= 6000\ (A)$

short

huge!

(#65) test 3 problem like (#65):

(a.) set up equations

(b.) solve [good luck!]

Loop 1:

$$\Sigma \Delta V = 0 = -20 - I_1 \cdot 2 - 14 + I_2 \cdot 4$$

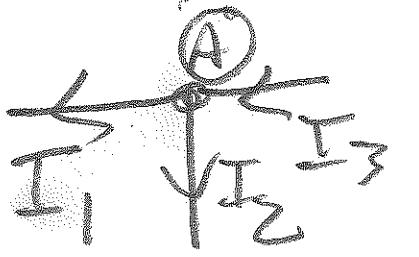
(6 (V))

Loop 2:

$$\Sigma \Delta V = 0 = 36 - I_3 \cdot 5 - I_2 \cdot 4$$

Junction: (A) or (B): $\Sigma I = 0 = I_1 + I_2 - I_3$

(A.)



$I_1$ $I_2$ $I_3$ constant

① $2 \quad -4 \quad 0 \quad = \quad 6$

② $0 \quad 4 \quad 5 \quad = \quad 36$

③ $1 \quad 1 \quad -1 \quad = \quad 0$

$$\begin{vmatrix} 2 & -4 & 0 \\ 0 & 4 & 5 \\ 1 & 1 & -1 \end{vmatrix} = |\text{det}|$$

$$I_1 = \frac{\begin{vmatrix} 6 & -4 & 0 \\ 36 & 4 & 5 \\ 0 & 1 & -1 \end{vmatrix}}{|\text{det}|} = \frac{6\cdot[4\cdot(-1)-5\cdot 1]+4[36\cdot(-1)-0]}{2\cdot(4\cdot(-1)-5\cdot 1)+4\cdot(0-5)+0}$$

$$= \frac{-54-144}{-18-20} = \frac{-198}{-38}$$

$$\begin{array}{r} 5.21 \\ 38\overline{)198.01} \\ -190\downarrow\downarrow \\ \hline 80 \\ -76 \end{array}$$

$$\boxed{I_1 = +5.21}$$

$$I_2 = \frac{\begin{vmatrix} 2 & 6 & 0 \\ 0 & 36 & 5 \\ 1 & 0 & -1 \end{vmatrix}}{-38}$$ needed

$$I_3 = \frac{\begin{vmatrix} 2 & -4 & 6 \\ 0 & 4 & 36 \\ 1 & 1 & 0 \end{vmatrix}}{-38}$$ not needed

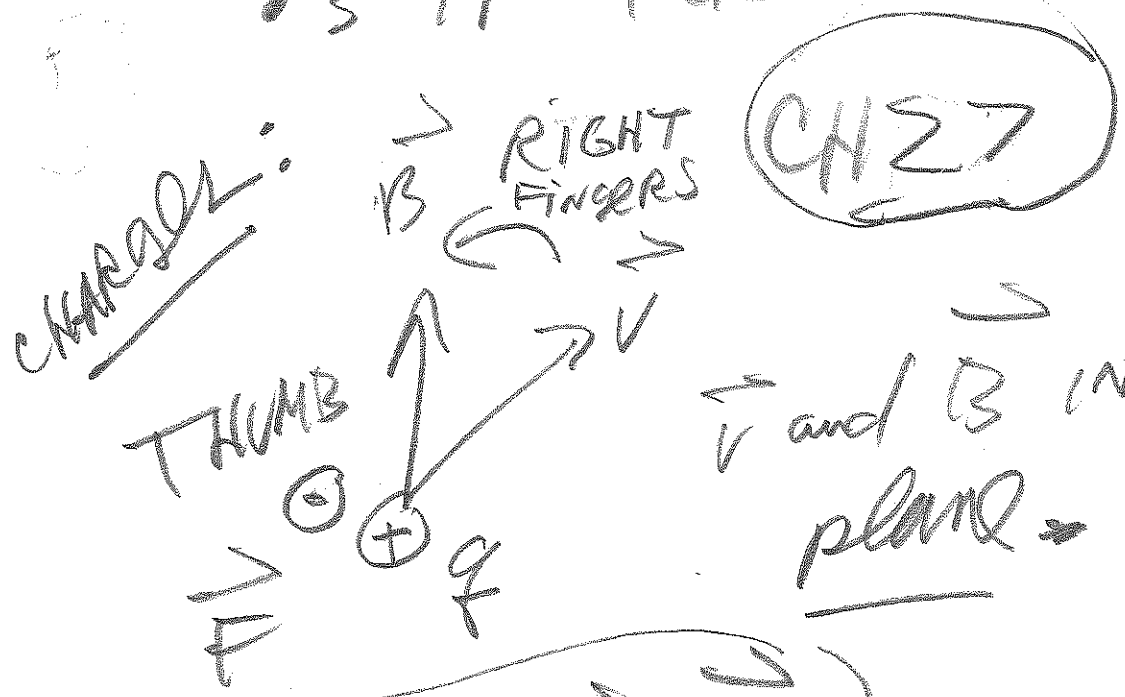
$$0 = I_1 + I_2 - I_3$$

$$I_3 = I_1 + I_2$$

• 3-17
Lab 4 and Lab 5

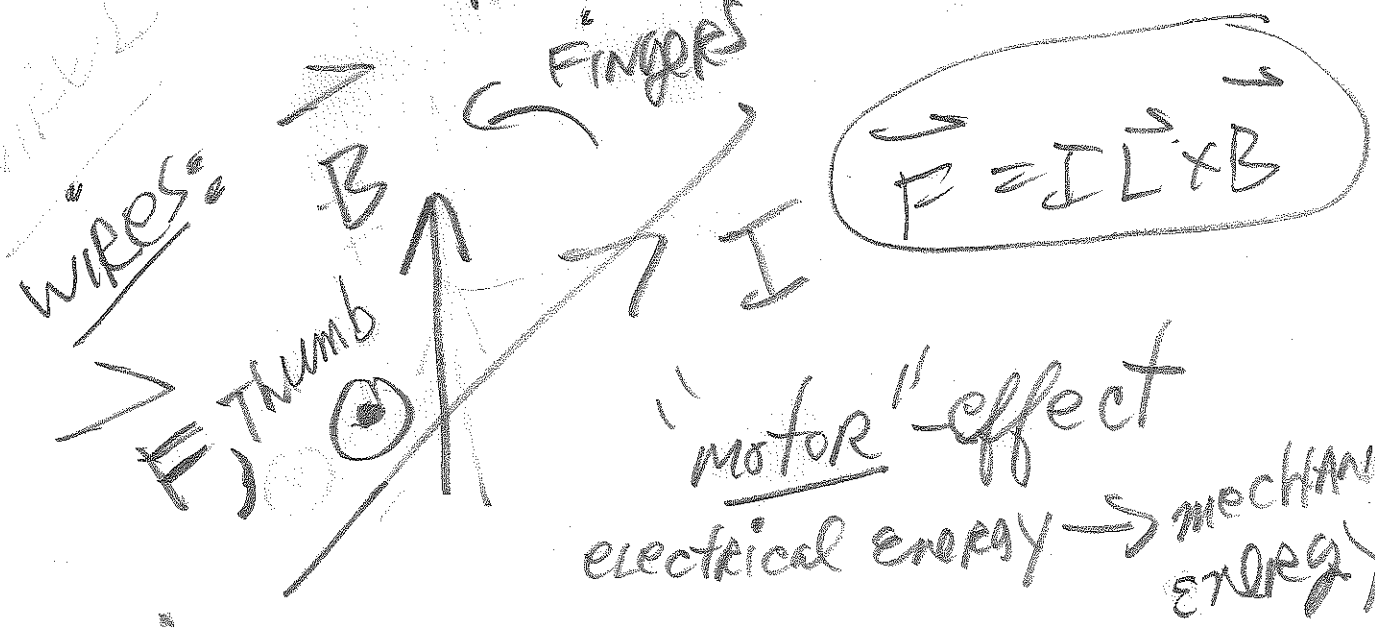
• 3-19 FORCE FORMULAS

CHARGES:




$$\vec{F} = q\vec{v} \times \vec{B}$$

WIRES:




$$\vec{F} = I\vec{L} \times \vec{B}$$

"motor" effect
electrical energy → mechanical energy

- 3-24 link

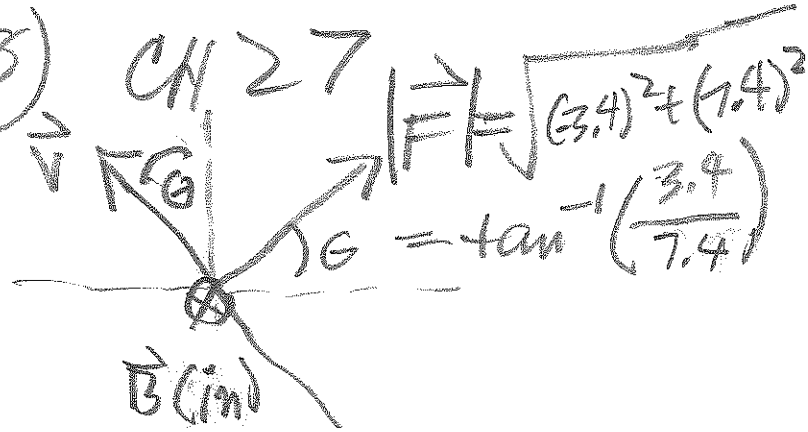
* $\vec{B}$-FIELDS from wire-straight or loop-are E.C.

* Attraction or repulsion of 2 parallel wire is E.C.

- 3-26 repeats 3-24

- 3-31 supplement

(#8)

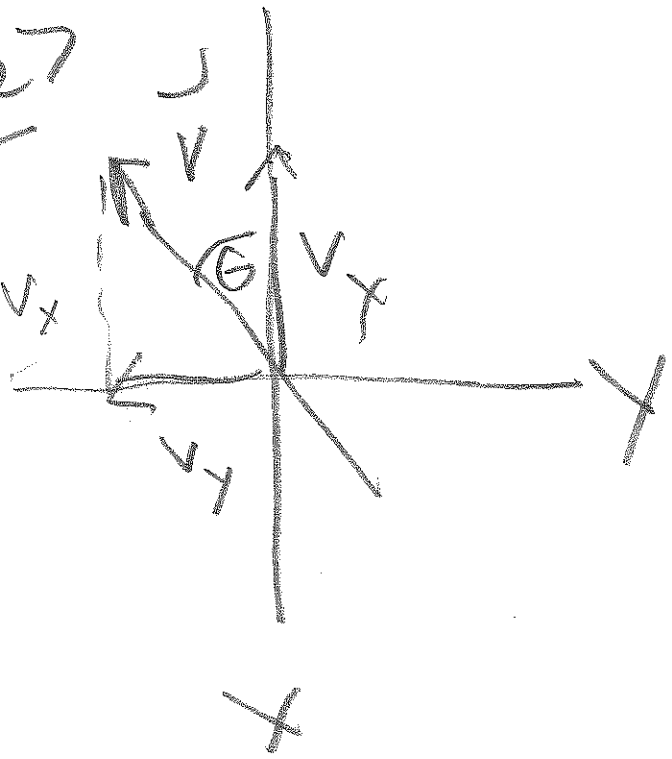



NOTE:

$|\vec{v}| = |\vec{F}|/|q| \cdot B$

● 3-31

(A) 6.1 CH27




$|V_x| = |\vec{V}| \cdot \cos\theta$

$|V_y| = |\vec{V}| \cdot \sin\theta$

● 4-2-19

MAIN TOPICS

see 27.4 → MAP

see 27.8 → MAP

QUIZ problem

#15, 22, 24, 27

#30. $qvB = qE$

$v = E/B$

• 4-2-14

topics

quiz

sec. 27-6 → map → #75

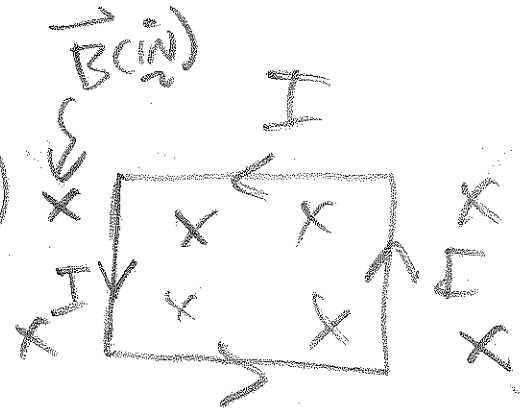
done on 4-2-14

secs. 27-7, 27-8 → map → 46, 47, 48, 49, 50

$\vec{\tau} = \vec{\mu} \times \vec{B}$

motor

46.



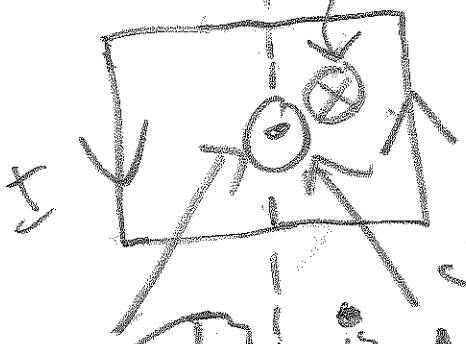

(a) FIND $\vec{\tau}$ and $F_{net}$

(46.) $|\vec{\mu}| = \mu = I \cdot \text{area}$

(a) $|\vec{\tau}| = \mu B \sin\theta \leftarrow$

$\vec{B}$ is $\rightarrow$

right fingers



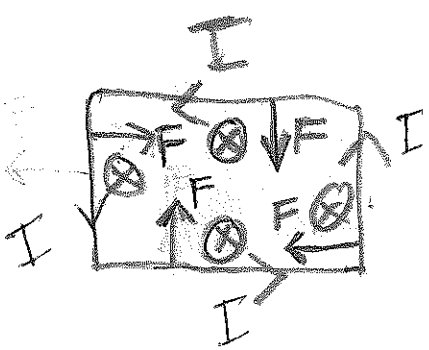

right thumb is $\vec{\mu}$ is OUT

AXIS

unstable equilibrium

$|\vec{\tau}| = \mu B \sin 180 = 0$

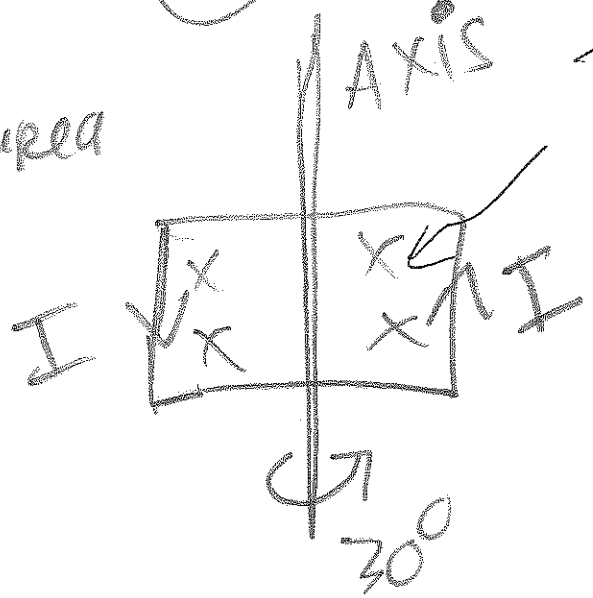
$\vec{F}_{net} = 0$



(46.)

(b.)

$\mu = I \cdot \text{area}$




$\vec{\mu}$ rotates into $\vec{B}$.

(b) $|\vec{\tau}| = \mu B \sin\theta$

$= \mu B \sin 150^\circ$ ✓

$\mu = I \cdot \text{area}$