 Phys 1402 2016-10-04 Lec 12

Handed back exams. Missed class?
Come pick up your exam in my office.

Effects of Magnetic Fields

- Forces
- Torques

Force on a moving charge

- Force is perpendicular to $\vec{v}$
- Force is perpendicular to $\vec{B}$
- Depends on angle between $\vec{v}$ and $\vec{B}$
  - Weak when $\vec{v}$ "near" $\vec{B}$
  - Strong when $\vec{v}$ perpendicular to $\vec{B}$
- Strongest Force:

$$F = qvB \quad (\text{if } v \perp B)$$

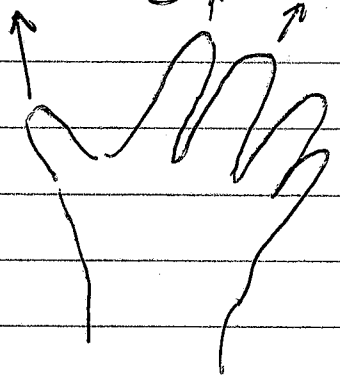
- Force in other cases

$$F = qvB\sin\theta$$

θ: Between $\vec{v}$ and $\vec{B}$

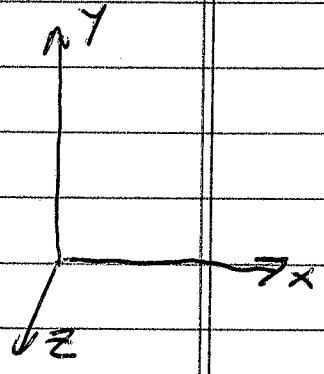
- Direction by Right-hand-rule

$F = qvB$



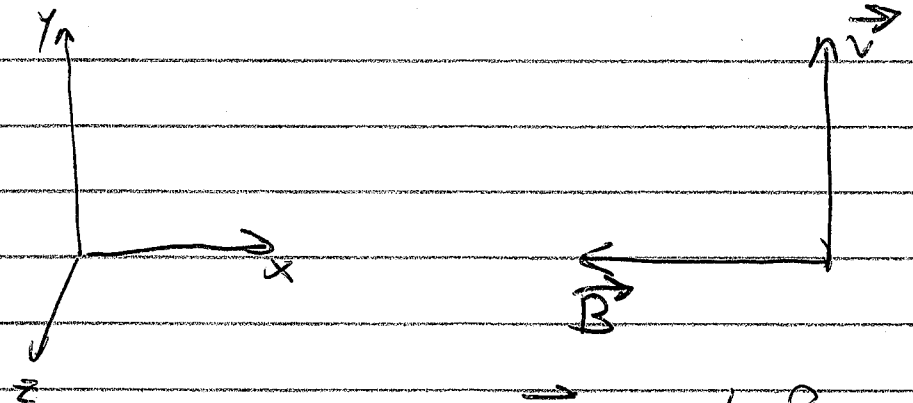
- Index Finger points along $\vec{v}$
- Middle Finger bent inward along $\vec{B}$
- Thumb extends in dir of $\vec{F}$ (on ⊕)

Describing Directions



$\pm x$	$\pm y$	$\pm z$
Right/Left	Up/Down	Out of page/Into Page
→/←	↑/↓	⊙/×
		Toward/Away
~~B~~E/W	N/S	Up/Down

Ex: A ⊕ charge is moving in $+\hat{y}$.
It goes into a mag field pointing in $-\hat{x}$.
What dir is the force?



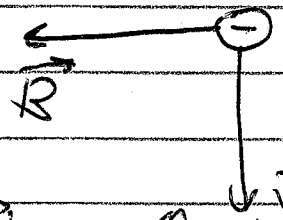
$\vec{F}$ is out of page $= +\hat{z}$

Ex: ⊕ charge moving in $+\hat{y}$.
How could the Force point in $-\hat{x}$?

$\vec{B}$ could point into page $= -\hat{z}$

If the charge is ⊖, the force flips opposite to your thumb.

Ex: ⊖ charge moving in $-\hat{y}$
$\vec{B}$ points in $-\hat{x}$



Thumb points "in"
q is ⊖, so
Force is "out"

If $\vec{B}$ points Left, ⊕↑ has same force as ⊖↓. Both are I↑.

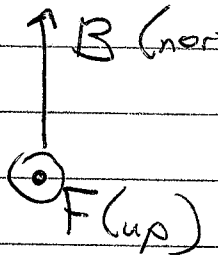
(4)

Force on a current

- Maximum $F = I \ell B$ (when $I \perp B$)

Thumb ↑ Pointer ↑ middle ↑

Ex: B points North.
Want to Levitate a wire,
⇒ The magnetic force is up. (not North)



Quick Conclusions:
- Current can't be up/down
  (Force is ⊥ to motion of charges).
- Current can't be N/S
  (Force is tiny when motion "near" B)
- Choose from East/West.