Lecture 18

Questions

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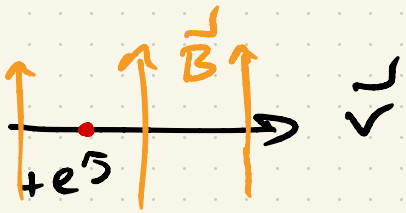
Q1 DRAW THE FORCE VECTORS

(USE RIGHT HAND RULE!)

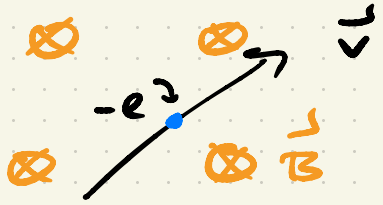
(FLIP $\vec{F}$ IF $q < 0$!)

[⊙ ≡ OUT OF PAGE,
⊗ ≡ INTO PAGE]

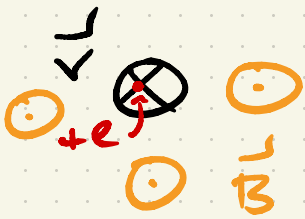
a)



b)



c)



L²

Q2:

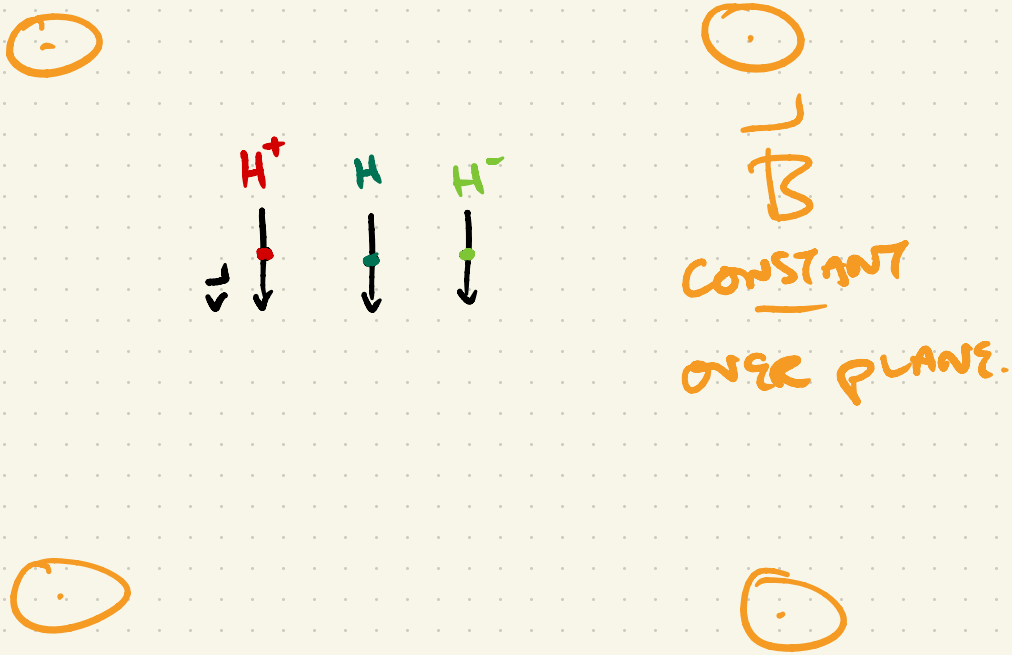
(ok if messy)

a) On the same picture, draw the trajectories for the following particles:

- H^+, H^-, H

Assume they all start near the same point with the same initial velocity $\vec{v}$

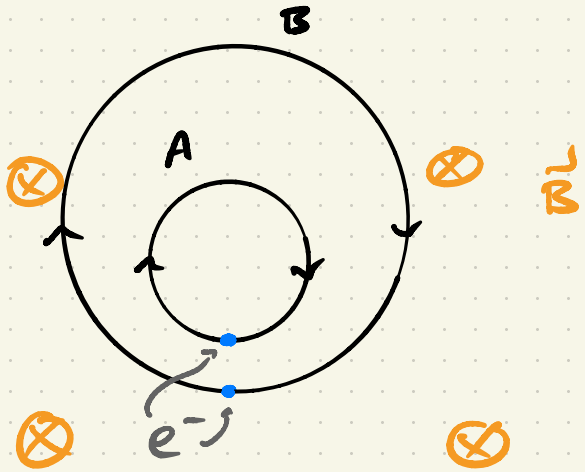
(Ignore attraction / repulsion between the particles)



b) Why would it be hard to draw an electron's trajectory on the same graph as part a) ?

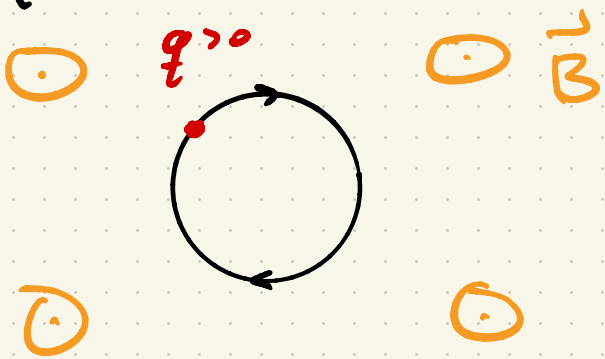
Assume it has the same initial velocity $\vec{v}$ as the particles in a).

c)



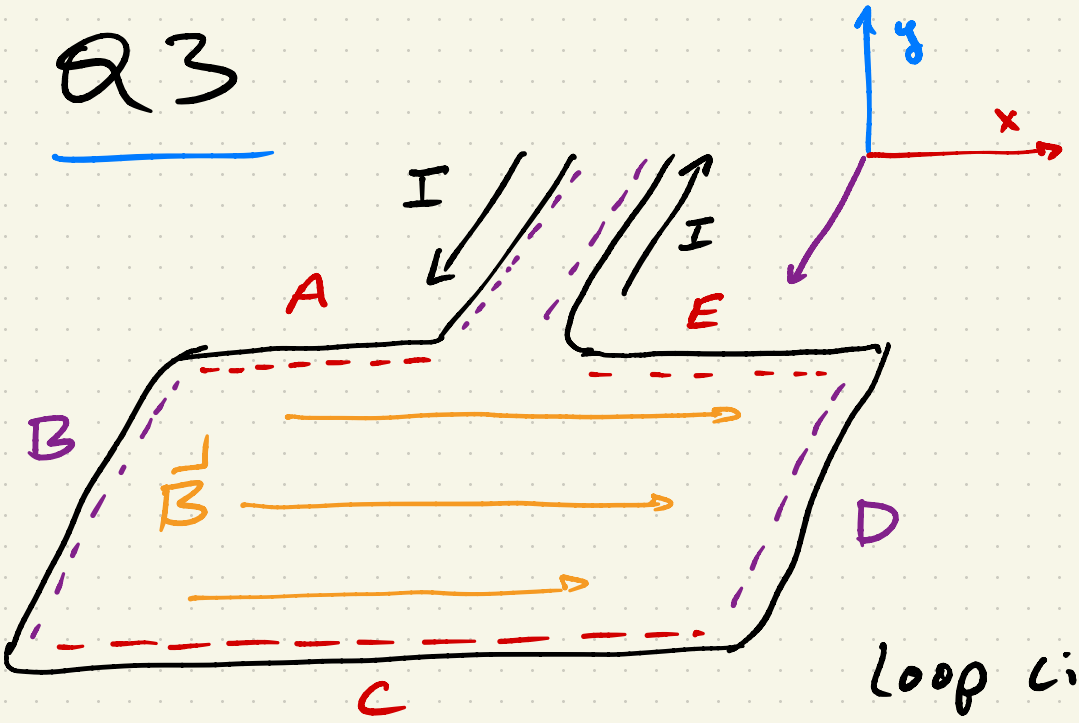
$v_A > v_B$ OR $v_B > v_A$?

d) Suppose:



- Now we double the strength of the magnetic field. Draw the new trajectory.

Q3



Electric current is sent in through the left side of the loop and returns through the right side. There is a magnetic field pointing in the +x direction.

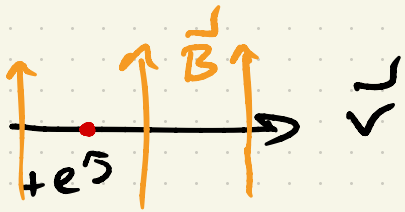
Draw the force vectors acting on segments A through E.

Draw the axis about which the loop will rotate. Will it rotate clockwise or counter-clockwise?

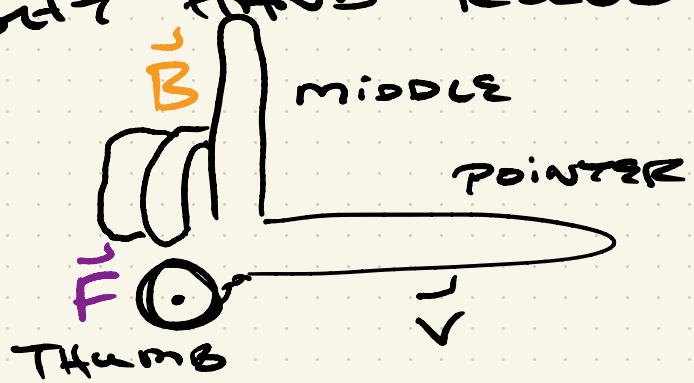
ANSWERS

Q1

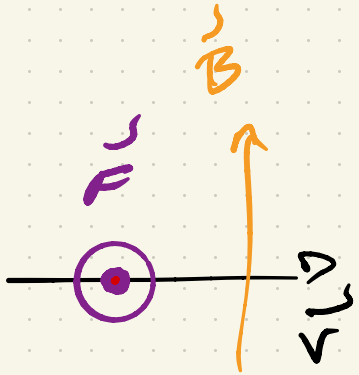
a)



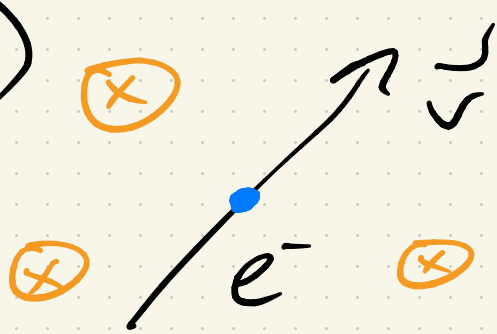
RIGHT HAND RULE:



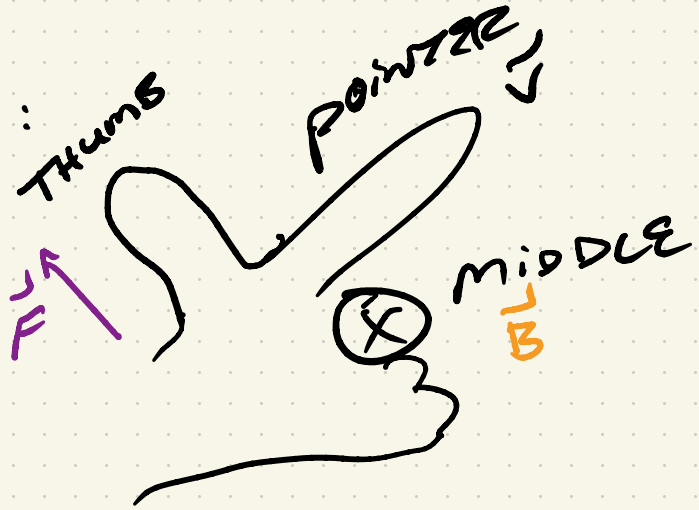
So:



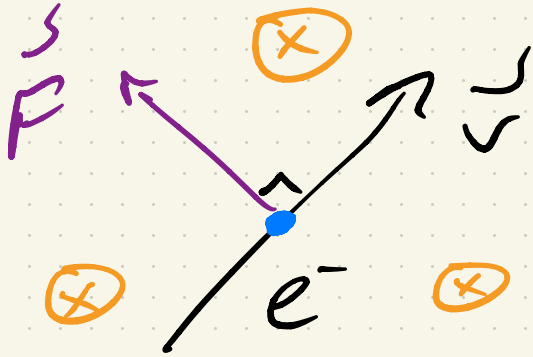
5)



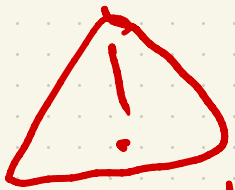
RHR:



So:



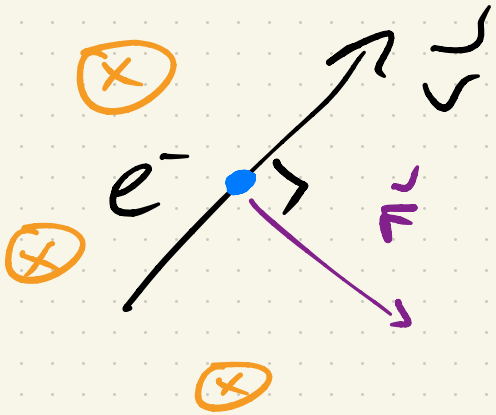
WRONG!



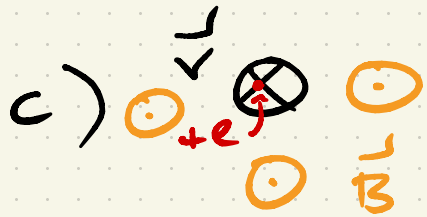
BUT!

SEE NEXT PAGE

- FOR e^- $q<0$ SO WE FLIP $\vec{F}$ UPSIDE DOWN:



CORRECT NOW!

c) 

$\vec{F} = 0$!

[$\vec{v}$ & $\vec{B}$ ARE (ANTI) PARALLEL, i.e. $\theta = 180^\circ$, SO $\sin\theta = 0$]

Q2 a)

- LARMOR RADIUS:

$$R = \frac{mv}{B} \times \frac{1}{q}$$

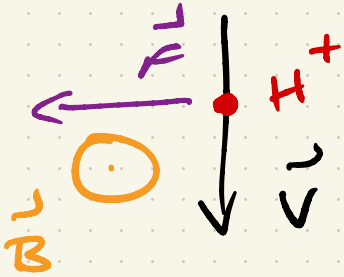
SAME FOR ALL PARTICLES

DIFFERENT FOR DIFFERENT PARTICLES

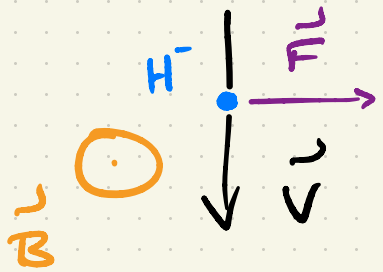
	q
• H^+	$+e$
• H:	0
• H^-:	$-e$

Direction:

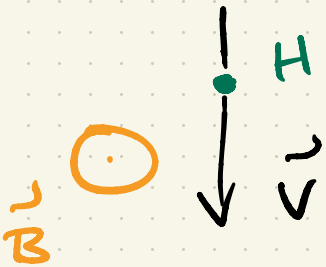
$q > 0$



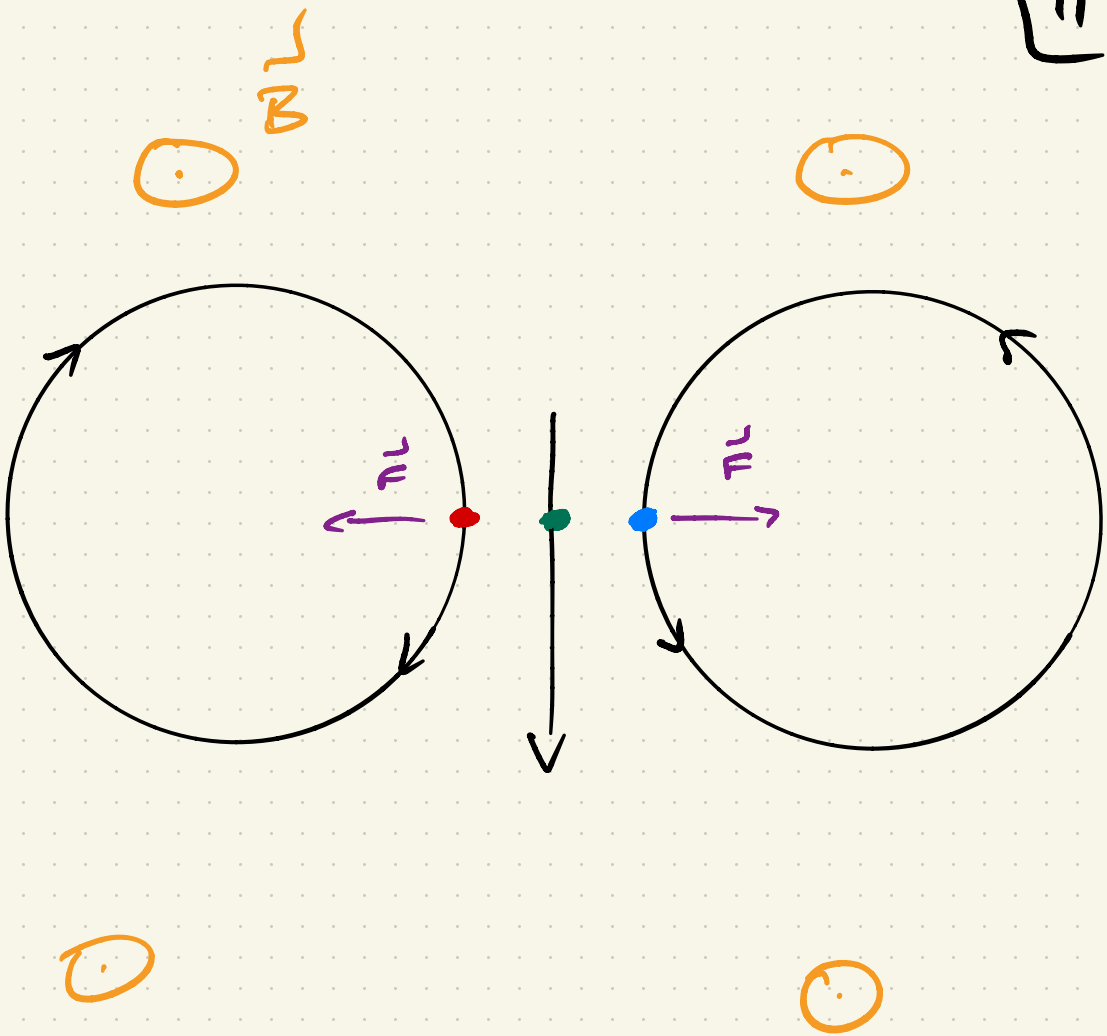
$q < 0$



$q = 0$



$\vec{F} = 0$!


B
F
F

b) $R \propto m$,

$m_H = 1$ amu BUT

$m_e \approx \frac{1}{2000}$ amu,

SO ELECTRON'S TRAJECTORY WOULD BE TINY!

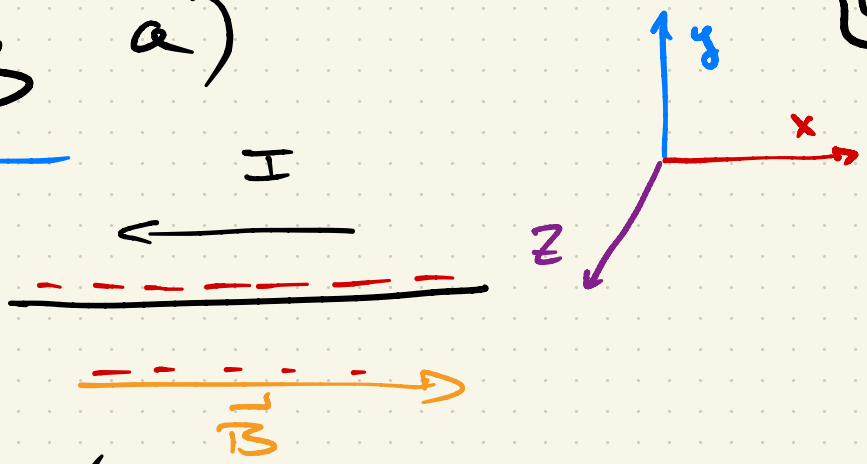
c) B, m, + q ARE THE SAME, SO $R \propto V$

SO $R_A < R_B \rightarrow V_A < V_B$

d) SIMILARLY, $R \propto \frac{1}{B}$

SO IF B INCREASES, R DECREASES

Q3 a)

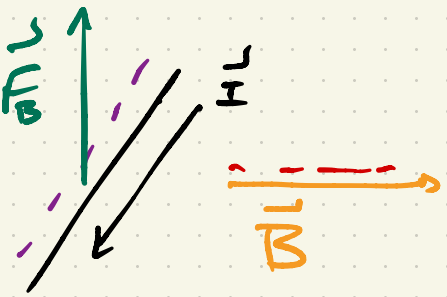


A:

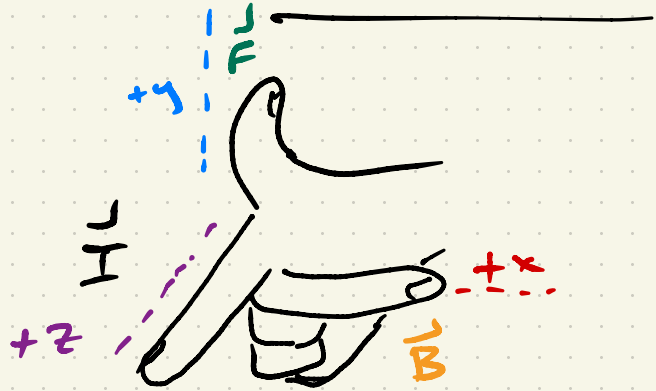
- $\vec{I}$ (ANTI) PARALLEL TO $\vec{B}$ (i.e. $\theta = 180^\circ$)

$$\vec{F}_A = 0$$

B:



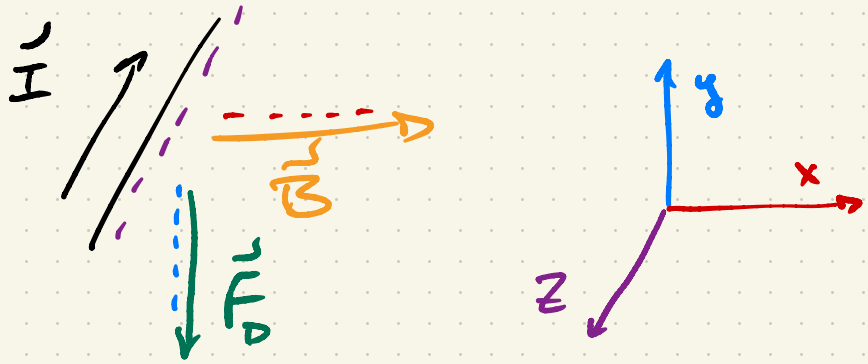
RIGHT-HAND RULE:



C: $\vec{F}_C = 0$ (SEE SEGMENT A)

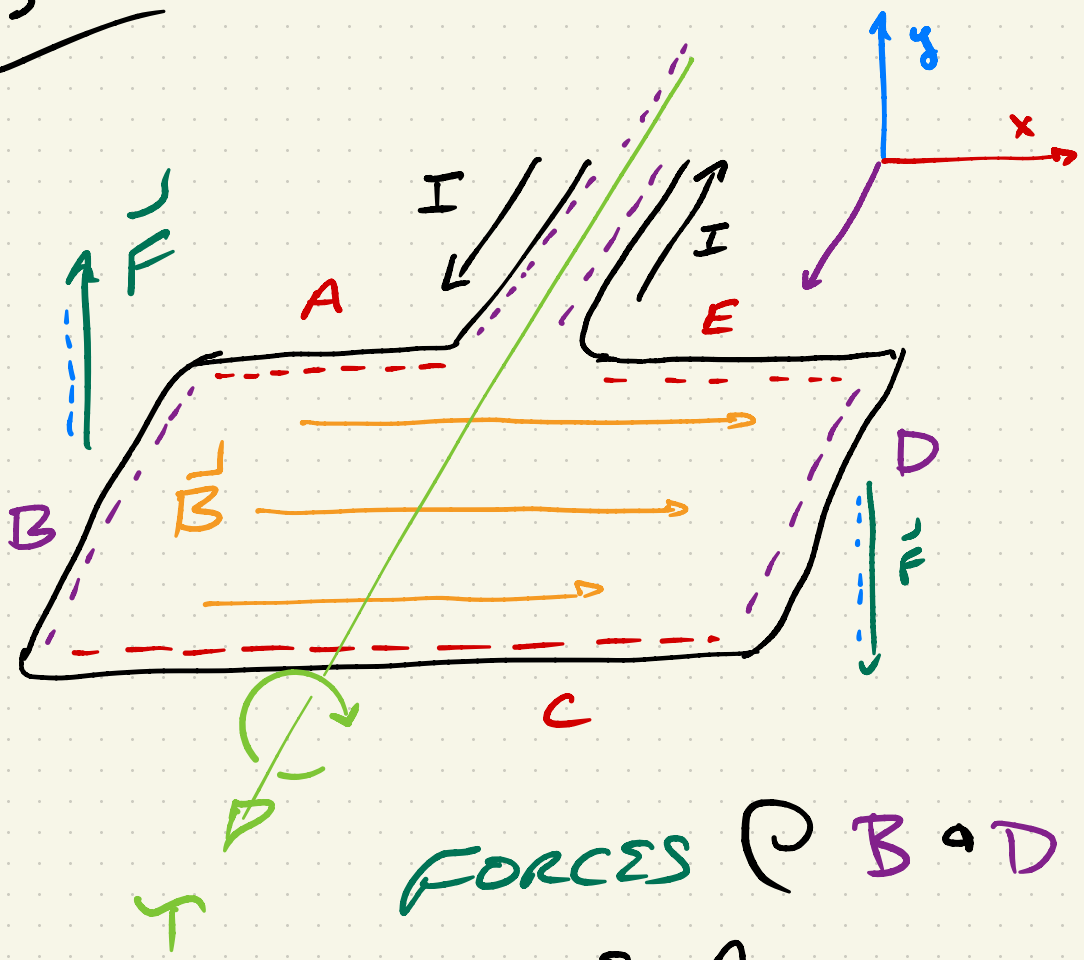
D: CURRENT RUNS OPPOSITE TO CURRENT @ SEGMENT B:

- $\vec{F}_D = -\vec{F}_B$



E: $\vec{F}_E = 0$ (SEE SEGMENT A)

SO:



FORCES ⊂ B & D

PRODUCE A

TORQUE (τ)

WHICH WILL TURN THE LOOP CLOCKWISE.