Name: _____ DISC: _____ Score: _____ / 20

Instructions:

- Do your own work.
- Answer the questions below in the space provided.
- Make sure you show all your work and any equations that you use.
- Please place a box around your answers.
- Remember to give the correct units with all numerical answers

Q1	Q2	Q3	Q4
10	10	5	5

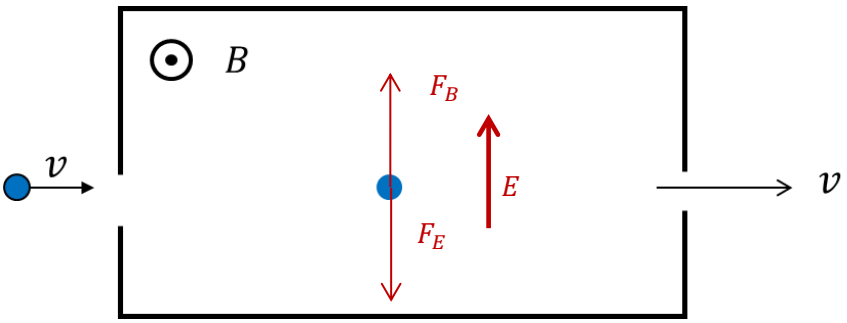
FORCE	$F = qvB\sin\theta$
	$F = qE$
	$F = IBL\sin\theta$
TORQUE	$\tau = FR\sin\theta$
	$\tau = IAB\sin\theta$
RADIUS OF CURVATURE	$R = \frac{mv}{qB}$

Useful Information for All Problems

CHARGE (q)	$-5\mu C$
MAGNETIC FIELD (B)	$0.05\ T$
VELOCITY	$2\times10^5\ m/s$

Information for Problem 1

1. Consider the velocity selector below where B is directed out of the page:



Force (2 pt):

a. On the diagram draw the direction in which the *force from the magnetic field* is pushing the particle when it moves into the box. Use the information in the table to help you.

Field (2 pt):

b. On the diagram, draw the direction of the *Electric Field* required for the particle to travel straight through to the other side. Use the information in the table to help you.

Force (2 pt):

c. Using the information in the table what is the magnitude of the *force* the particle experiences *from the magnetic* field B?

$$F_B = qvB\sin\theta = (5\times10^{-6}C)(2\times10^5 m/s)(5\times10^{-2}T) = 5\times2\times5\times10^{-3}N = 5\times10^{-2}N$$

E-Field (2 pt):

d. What is the magnitude of the *electric field* needed to keep the particle going in a straight line?

$$qE = F_E = F_B$$

$$E = \frac{F_E}{q} = \frac{5\times10^{-2}N}{5\times10^{-6}C} = 1\times10^4 N/C$$

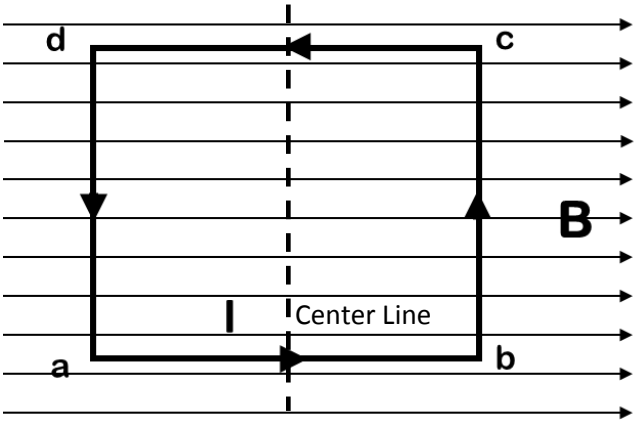
The electric force must have the same magnitude (although opposite direction) as the magnetic field to keep the particle moving in a straight line.

Mass (2 pt):

e. If the electric field is removed, the particle travels a circular path of radius $R = 0.2\ m$. What is the particle mass?

$$R = \frac{mv}{qB} \rightarrow m = \frac{qBR}{v} = \frac{(5\times10^{-6}\ C)(5\times10^{-2}\ T)(0.2\ m)}{2\times10^5 m/s} = 25\times10^{-14}\ kg = 2.5\times10^{-13}\ kg$$

2. Consider the current loop shown below:



I	$10\mu A$
B	$5\ mT$
L	$0.25\ m$

Useful Information

Fill in the following table:

Table (10 pts):
1 pt for each force
1pt for each direction
2 pts for the torque

WIRE SEGMENT	FORCE	DIRECTION (choose one)	TORQUE ON LOOP
ab	$0\ N$ (I lies along B)	Into page Out of page Neither	$3.125\ nN\ m$
bc	$12.5\ nN$	Into page Out of page Neither	
cd	$0\ N$ (I lies along B)	Into page Out of page Neither	
da	$12.5\ nN$	Into page Out of page Neither	

$$F = IBL\sin\theta = (10\times10^{-6}A)(2.5\times10^{-1}m)(5\times10^{-3}T)$$
$$= 10\times2.5\times5\times10^{-10}N = 125\times10^{-10}$$
$$= 12.5\ nN$$

$$\tau = FR\sin\theta = 2\left(12.5\times10^{-9}N\right)(0.125\ m)$$
$$= 3.125\ nN\ m$$

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