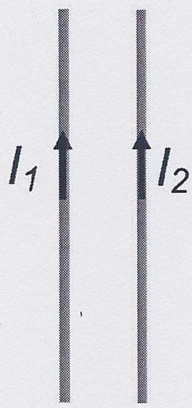
EE 135 Winter 2015 **Quiz #7**

NAME ______________________

Total :100 (Bonus) Points

1. (25 pts) Consider two parallel current carrying wires. With the currents running in the same direction, the wires are



a) attracted (like attract)

b) repelled (likes repel)

c) pushed in another direction

d) not pushed – no net force

2. (25 pts)

Can a charged particle move through a uniform magnetic field without experiencing any force?

Suppose a charged particle is moving under the influence of both electric and magnetic fields. How can the effect of the two fields on the motion of the particle be distinguished?

$$\vec{F}_{magnetic} = q\,\vec{v} \times \vec{B}.$$

Yes. When a charged particle moves parallel with the magnetic field.

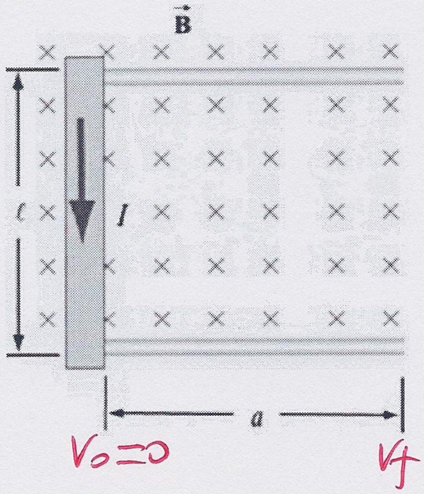
$$\vec{F} = q\vec{E} + q\,\vec{v} \times \vec{B},$$

If $\vec{v}$ is particle's velocity.

$$m\frac{d\vec{v}}{dt} = q\vec{E} + q\,\vec{v} \times \vec{B}.$$

So the effect of electric field will be along the velocity direction. and the effect of magnetic field will be perpendicular to the velocity direction.

3. (25 pts) A rod with a mass m and a radius R is mounted on two parallel rails of length a separated by a distance , as shown in the Figure below. The rod carries a current I and slides in uniform magnetic field



What is the speed of the rod as it leaves the rails?

$$F \cdot a = \frac{1}{2} m V_f^2 - \frac{1}{2} m V_0^2 = \frac{1}{2} m V_f^2$$

$$F = ILB$$

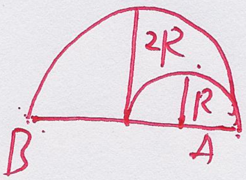
$$\Rightarrow V_f^2 = \frac{2Fa}{m} = \frac{2ILB \cdot a}{m}.$$

$$V_f = \sqrt{\frac{2ILB \cdot a}{m}}.$$

$Q_A = q$ $Q_B = 2q$.

~~3~~ 4. (25 pts) Particle A with charge q and mass m_A and particle B with charge 2q and mass m_B, are accelerated from rest by a potential difference ΔV, and subsequently deflected by a uniform magnetic field into semicircular paths. The radii of the trajectories by particle A and B are R and 2R, respectively. The direction of the magnetic field is perpendicular to the velocity of the particle. Show that their mass ratio is

$$\frac{m_A}{m_B} = \frac{1}{8}$$



$\frac{1}{2} m v^2 = \Delta V \cdot q$, v is velocity. ΔV is potential difference

$$v = \sqrt{\frac{2\Delta V \cdot q}{m}}$$

$$\Rightarrow v_A = \sqrt{\frac{2\Delta V \cdot q}{m_A}} \qquad v_B = \sqrt{\frac{2\Delta V \cdot 2q}{m_B}} = \sqrt{\frac{4\Delta V q}{m_B}}$$

Centripital force $\frac{m v^2}{r} = q v B$, $(\vec{B} \perp \vec{v})$

$$v = \frac{r q B}{m}$$

$$\Rightarrow v_A = \frac{R q B}{m_A}, \qquad v_B = \frac{2R\,2qB}{m_B} = \frac{4RqB}{m_B}$$

$$\frac{v_A}{v_B} = \frac{\sqrt{\frac{2\Delta V \cdot q}{m_A}}}{\sqrt{\frac{4\Delta V \cdot q}{m_B}}} = \frac{\frac{RqB}{m_A}}{\frac{4RqB}{m_B}}$$

$$\Rightarrow \sqrt{\frac{\frac{2}{m_A}}{\frac{4}{m_B}}} = \frac{\frac{1}{m_A}}{\frac{4}{m_B}}$$

$$\Rightarrow \sqrt{\frac{m_B}{2m_A}} = \frac{m_B}{4m_A} \Rightarrow \frac{m_A}{m_B} = \frac{1}{8}.$$

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