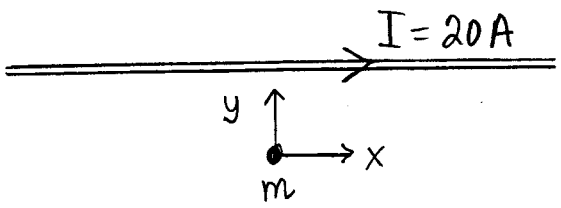
Physics 104 **QUIZ #3** **Fall 2006**



NAME: SOLUTIONS

SECTION # : _____

TA: _____

A long straight wire carries a current of 20 A. A particle of mass m and charge $q = 10\,\mu$C is 5 cm below the wire and traveling with a velocity of 3×10^4 m/s.

(a) Find the magnitude and direction of the magnetic field that the particle feels.

Right hand rule with thumb along the wire ⇒ field lines loop around and at m point into the paper.

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi\times10^{-7}\ \text{T·m/A})(20\ \text{A})}{2\pi\cdot(0.05\ \text{m})} = \boxed{8.0\times10^{-5}\ \text{T}}$$

$$\vec{F} = q\vec{E}$$
$$F = qvB\sin\theta$$
$$F = IBL\sin\theta$$
$$B = \frac{\mu_0 I}{2\pi r}$$
$$\mu_0 = 4\pi\times10^{-7}\ \text{T·m/A}$$

(b) Find the magnitude and direction of the force on the particle if it is moving in the $+x$ direction.

Direction: fingers along v, curl to $\vec{B}$ (into paper) ⇒ thumb points

upward (+y)

$F = qvB\sin\theta$ $\quad\theta = 90°,\ \sin\theta = 1$

$$F = (10^{-5}\ \text{C})(3\times10^4\ \text{m/s})(8\times10^{-5}\ \text{T}) = \boxed{2.4\times10^{-5}\ \text{N}}$$

(c) Find the magnitude and direction of the force on the particle if it is moving in the $+y$ direction.

Direction: fingers along +y, curl into paper ⇒ force is to the left (−x direction)

$F = qvB\sin\theta$ = same as (b) = $\boxed{2.4\times10^{-5}\ \text{N}}$

(d) Find the magnitude and direction of the force on the particle if it is moving into the paper.

Here $\vec{v}$ and $\vec{B}$ are parallel, $\theta = 0$, $\sin\theta = 0$

$\boxed{F = 0}$