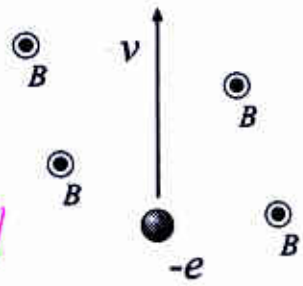
Units? Units?

Name_____

Mar. 10, 2004

Phys 2020
Quiz #3 — Spring 2004

1. An electron moves in the plane of the page with a speed of $1.50 \times 10^6 \frac{\text{m}}{\text{s}}$, as shown. It moves in a uniform magnetic field of magnitude 0.300 T directed out of the page.



a) What is the direction of the magnetic force on the electron?

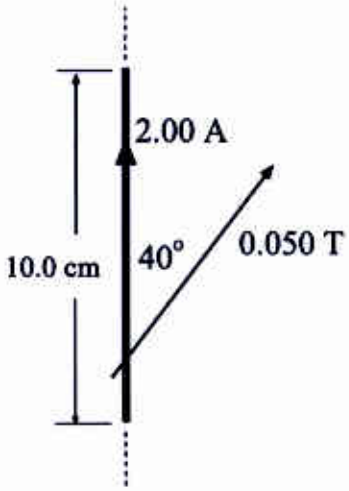
Using the RHR on the dir. of $\vec{v}$ and $\vec{B}$ gives a force to the right But this is a negative charge so the force points to the left.

b) What is the magnitude of the magnetic force on the electron?

Use $F = qvB\sin\theta = qvB$, get:

$F = (1.602\times10^{-19}\text{C})(1.50\times10^{6}\frac{\text{m}}{\text{s}})(0.300\text{T}) = 7.21\times10^{-14}\text{ N}$

2. A 10.0 cm (straight) length of wire carries a current of 2.00 A. A magnetic field of magnitude 0.050 T is directed at 40.0° from the direction of the current. See the picture at the right.



What is the direction and magnitude of the magnetic force on the segment of wire?

Using RHR on dir of current and B field gives a force (into the page)

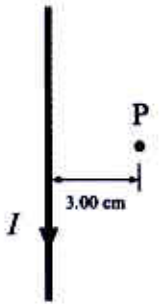
Find magnitude of the force from

$F = I L B \sin\theta$,

$F = (2.00\text{ A})(0.100\text{ m})(0.050\text{ T})\sin 40^\circ$

$= 6.4\times10^{-3}\text{ N}$

3. A long straight wire carries a current in the plane of the page, in the direction shown. The point P is also in the plane of the page and is 3.00 cm from the wire.



a) What is the direction of the magnetic field at point P?

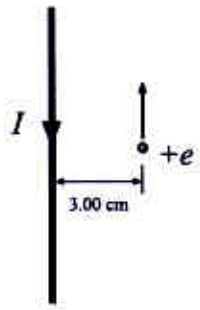
From RHR-2, mag. field at P comes **out of the page.**

b) If the magnitude of the field at P is 0.050 T, what is the current in the wire?

Use $B = \frac{\mu_0 I}{2\pi r}$, then

$$I = \frac{2\pi r B}{\mu_0} = \frac{2\pi (0.0300)(0.050)}{4\pi \times 10^{-7}} \text{ A}$$

$$= \boxed{7500 \text{ A}} \quad (!)$$



c) Now suppose there is a particle with charge $+e$ moving parallel to the same wire, in the plane of the page, as shown. The particle is 3.00 cm from the wire and has a speed of $4.2 \times 10^6 \frac{\text{m}}{\text{s}}$. What is the direction of the magnetic force on the particle?

Use RHR on dir of $\vec{v}$ (up) and $\vec{B}$ (out of page). Find that force is **to the right.**

d) What is the magnitude of the magnetic force on the particle?

Use $F = qvB\sin\theta = qvB$, so

$$F = (1.602 \times 10^{-19} \text{C})\left(4.2 \times 10^6 \tfrac{\text{m}}{\text{s}}\right)(0.050 \text{ T})$$

$$= \boxed{3.36 \times 10^{-14} \text{ N}}$$

You must show all your work and include the right units with your answers!

$e = 1.602 \times 10^{-19}$ C $\quad \mu_0 = 4\pi \times 10^{-7} \frac{\text{T}\cdot\text{m}}{\text{A}}$ $\quad F = qvB\sin\theta$ $\quad F = IBL\sin\theta$ $\quad B_{\text{wire}} = \frac{\mu_0 I}{2\pi r}$