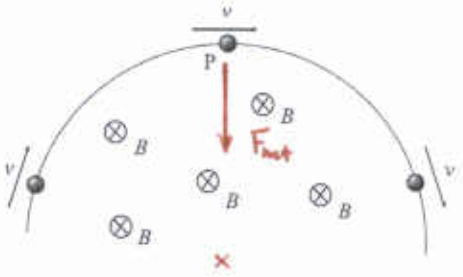
Units? Units?

Name_____

Phys 2020, Section 1
Quiz #3 — Fall 2003

1. An ion moves in a circular path in a plane perpendicular to a uniform magnetic field. The direction of motion of the ion is as shown; the B field points into the page.



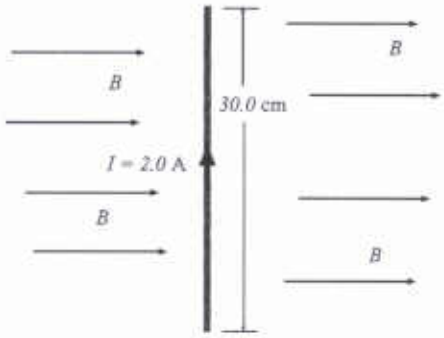
a) What is the direction of the net force on the ion when it is at the position marked P? (Draw it on the page for clarity.)

The net force goes as shown, toward the center of the circular path.

b) Is the ion positively charged or negatively charged? *Give your reasoning for this answer.*

It is negatively charged. If it were positively charged, the right-hand rule (Thumb: $\vec{v}$ Fingers $\vec{B}$ Palm $\vec{F}$) would give an outward force at P (or at other points). So a negative charge gives the correct inward force.

2. A straight wire segment of length 30.0 cm carries a current of 2.00 A in the direction shown, there is also a uniform B field of magnitude 0.150 T in the plane of the page pointing to the right.



Give the direction and magnitude of the force on this portion of the wire.

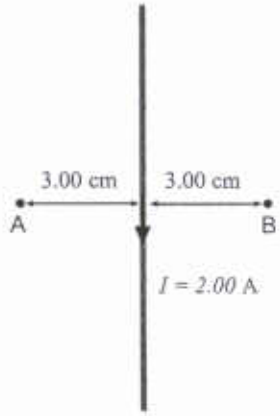
Magnitude of the force is

$F = ILB \cdot (\sin 90°)$

$= (2.00\,A)(0.300\,m)(0.150\,T) = \boxed{9.00 \times 10^{-2}\,N}$

By RHR-1, direction of the force is into the page.

3. A long wire carries a current of 2.00 A in the direction shown at the right.



a) Point A is 3.00 cm from the wire (as shown, in the plane of the page). What is the magnitude and direction of the magnetic field at A?

Magnitude of the $\vec{B}$ field from the wire at A is:

$$B = \frac{\mu_0 I}{2\pi r} = \frac{(4\pi \times 10^{-7}\ \frac{T\cdot m}{A})(2.00\ A)}{2\pi(0.0300\ m)}$$

$$= 1.33 \times 10^{-5}\ T$$

Using RHR-2 the magnetic field goes **into the page** at point A.

b) Point B is also 3.00 cm from the wire (also in the plane of the page), as shown. What is the magnitude and direction of the magnetic field at B?

Magnitude of the field at B is the same as at A, namely

$$B = 1.33 \times 10^{-5}\ T$$

But by RHR-2 the direction of the field at B is **out of the page**.

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

$$k = \frac{1}{4\pi\epsilon_0} = 8.99 \times 10^9\ \frac{N\cdot m^2}{C^2} \qquad \epsilon_0 = 8.85 \times 10^{-12}\ \frac{C^2}{N\cdot m^2} \qquad e = 1.602 \times 10^{-19}\ C$$

$$F = qvB\sin\theta \qquad \frac{mv}{r} = qB \qquad F = ILB\sin\theta \qquad \tau = NIAB\sin\phi$$

$$\mu_0 = 4\pi \times 10^{-7}\ \frac{T\cdot m}{A} \qquad B = \frac{\mu_0 I}{2\pi r} \qquad B_{loop} = N\frac{\mu_0 I}{2R} \qquad B_{sol} = \mu_0 nI$$

Force on charges and currents: RHR–1 B around wire: RHR–2