Moving charges in a magnetic field

1. Force on an electric charge moving in a magnetic field

The force acting upon a current of electrons perpendicular to a magnetic field is $F = B \cdot I \cdot s$. Substitute $I = \frac{q}{t}$ and $s = v \cdot t$:

$$F = \qquad\qquad\qquad\qquad =$$

Hence, the force acting upon a charge moving perpendicular to a magnetic field is:

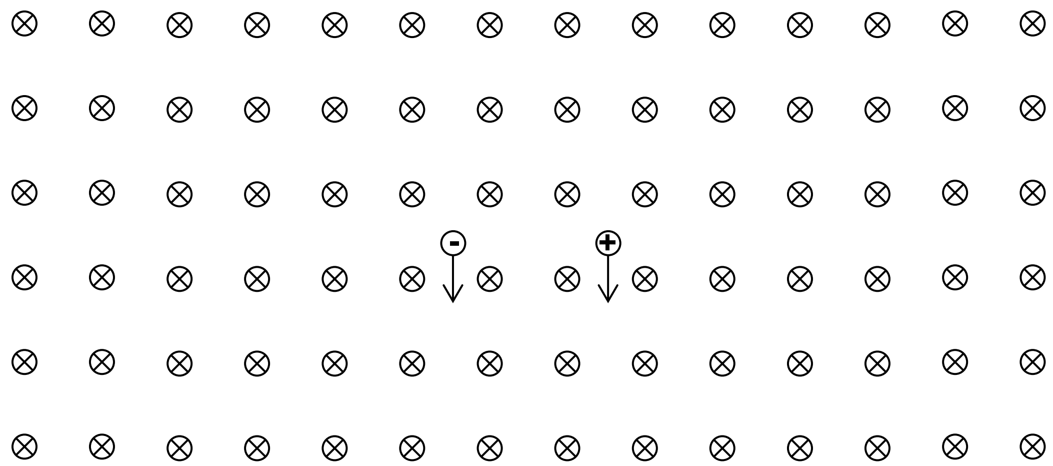
$F =$

Written as a vector product: $\vec{F} =$ where q is a positive charge.

If a charge is moving parallel to the magnetic field lines, the magnetic force acting upon it is ....

2. Path of a charged particle moving perpendicular to a uniform magnetic field

Here are two charges moving perpendicular to a uniform magnetic field:



a) Draw the magnetic force acting on the negative charge, and try to figure in what direction it will continue.
b) Draw the next position of the negative charge (approximately). Draw also the direction of motion with an arrow.
c) Draw the magnetic force acting on the negative charge at the new position, and try to figure out in what direction it will continue.
d) Repeat b) and c), how you find out what the particle's path looks like. What does it resemble?

....

e) Apply a) to d) to the positive charge. What is different?

....

3. The magnetic force provides the centripetal force

Given: A charged particle (charge q, mass m) is moving at velocity v perpendicular to the magnetic field lines of a field B.

Wanted: Formula for r (radius of the circle)

Procedure:

1. The magnetic force provides the centripetal force: $F_{magnetic} = F_{centripetal}$
2. $F_{magnetic} = q \cdot v \cdot B$
3. $F_{centripetal} = \frac{m \cdot v^2}{r}$
4. Substitute 2. and 3. into 1.
5. Solve for r:

Task: Complete the following sentences (applying to charged particles moving in a circular path perpendicular to the field lines of a magnetic field) with either *smaller* or *greater*.

The greater the mass of the particle is, the .... is the radius of its circular path.

The greater the speed of the particle is, the .... is the radius of its circular path.

The greater the charge of the particle is, the .... is the radius of its circular path.

The greater the strength of the magnetic field is, the .... is the radius of its circular path.