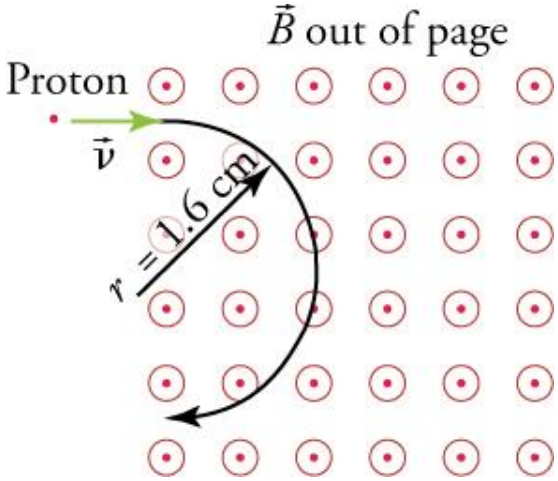
Path of a Charged Particle in a Magnetic Field

As seen in the diagram to the right the path of a charged particle as it travels through a magnetic field is **circular**. How does this work?

- Note that the Right Hand Rule dictates that: the direction of force on the particle depends on the direction of its motion.
- The force on the particle will *change the direction of the particle's motion.*
- This change in direction of the particle changes the direction of the force that the particle feels.



You can use the right hand rule and the diagram above to confirm that the path of the particle shown make sense. Also make sure you see the intro video posted.

You should see that the direction of force on the particle keeps changing and in fact is always directed **towards the centre of the curve** shown above.

Constant force towards center of rotation is called a **centripetal force** and is characteristic of **uniform circular motion**

Result: The Path of the particle is circular!

Magnetic Force on a moving charged particle:

$$\mathbf{F} = q(\mathbf{v} \times \mathbf{B})$$

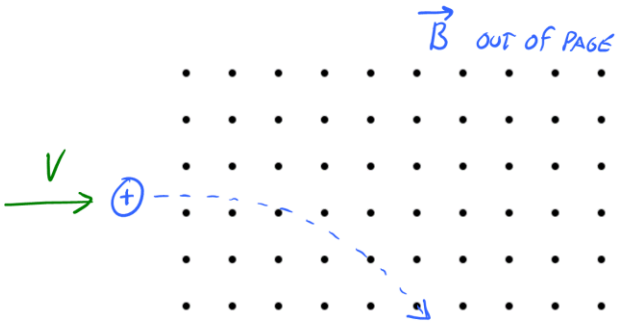
Centripetal Force:

$$F_c = \frac{mv^2}{r}$$

Centripetal Force $=$ Magnetic Force

$$\therefore \frac{mv^2}{r} = qvB$$

Motion of Particles in a **Magnetic Field**



RIGHT HAND RULE

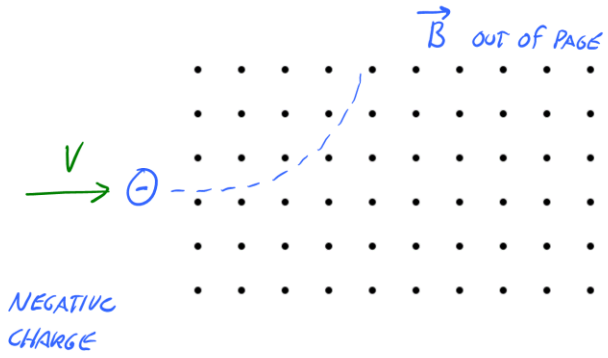
V - TO THE RIGHT

B - OUT OF PAGE

F - DOWN

$F = BVQ$

Motion of Particles in a **Magnetic Field**



RIGHT HAND RULE

V - TO THE LEFT

B - OUT OF PAGE

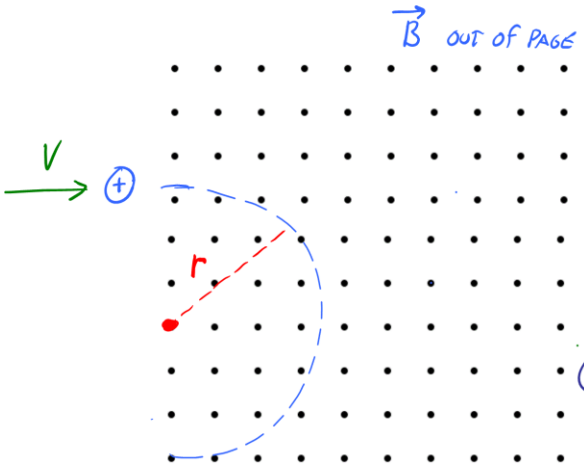
F - UP

$F = BVQ$

NEGATIVE CHARGE

(I - CONVENTIONAL CURRENT TO THE LEFT

Motion of Particles in a **Magnetic Field**



- FORCE ON PARTICLE
- DIRECTION OF V CHANGES
- DIRECTION OF F CHANGES

(FORCE DIRECTED TOWARDS A CENTER OF A CIRCULAR PATH)

① $F = BVQ$ ← CENTRIPITAL FORCE

② $F_c = \frac{mV^2}{r}$ CIRCULAR MOTION

③ $BVQ = \frac{mV^2}{r}$

☺ $\boxed{BQ = \frac{mV}{r}}$ TRUE FOR CHARGED PARTICLES IN A MAGNETIC FIELD

Mass Spectrometer

Using the device below (called a mass spectrometer) we can determine the mass of particles or even what identify what the particle is by seeing how much it is deflected.

The formula used to do this is the one discussed on the previous page:

$$BQ = \frac{mV}{r}$$