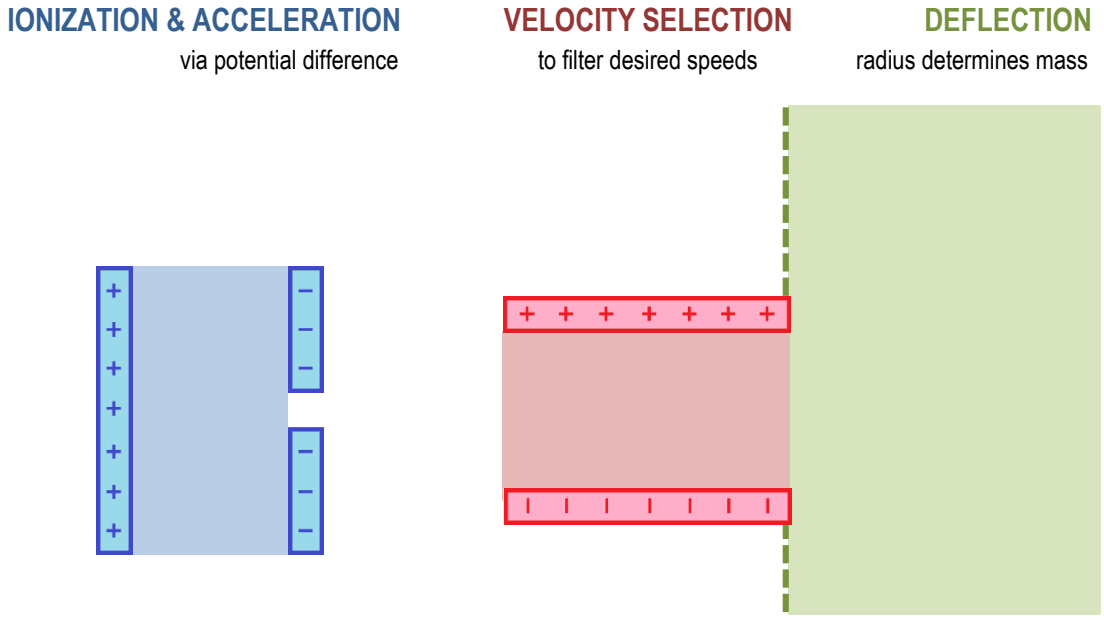
## CONCEPT: THE MASS SPECTROMETER

● MASS SPECTROMETERS are instruments used to measure the **MASS** of a known charge. They do this in 4 steps:




EXAMPLE: A +2 C charge is accelerated in the +x axis through an unknown potential difference $\Delta V$. It then passes through horizontal parallel plates that produce a electric field of 3 N/C that points vertically up. A magnetic field of magnitude 4 T also exists between the plates, which keeps charges at the desired speed from deflecting while in between the plates. This magnetic field also exists outside of the plates, and it causes the charge to deflect with a circular arc of radius 5 cm.

**(a)** What must be the direction of the magnetic field?

**(b)** Sketch the deflection that the charge will experience after leaving the parallel plates.

**(c)** Calculate the mass of the charge.

**(d)** Through what potential difference must the charge have been accelerated?

## PRACTICE: FIND DIRECTION OF FIELDS IN SPECTROMETER

A negative charge in a spectrometer is accelerated in the negative x-axis. It is later deflected and collides some distance ABOVE velocity selector. What are the orientations of the electric and magnetic fields, respectively, inside the selector**?**

**(a)** up and out of the page
**(b)** up and into the page
**(c)** down and out of the page
**(d)** down and into the page

## PRACTICE: FIND COLLISION DISTANCE IN SPECTROMETER

A 2 kg, – 3 C charge is accelerated through a potential difference of 4 V. The velocity selector has an electric field of magnitude 5 N/C. How far from the velocity selector will the charge collide against the spectrometer **"**wall**"?**

## EXAMPLE: FIND MASS TO CHARGE RATIO IN SPECTROMETER

A mass spectrometer has a velocity selector electric field of magnitude 20 N/C. When a certain charge is accelerated to a constant 30 m/s, it collides 40 m away from the velocity selector. What is this charge's mass-to-charge ratio, m / q**?**