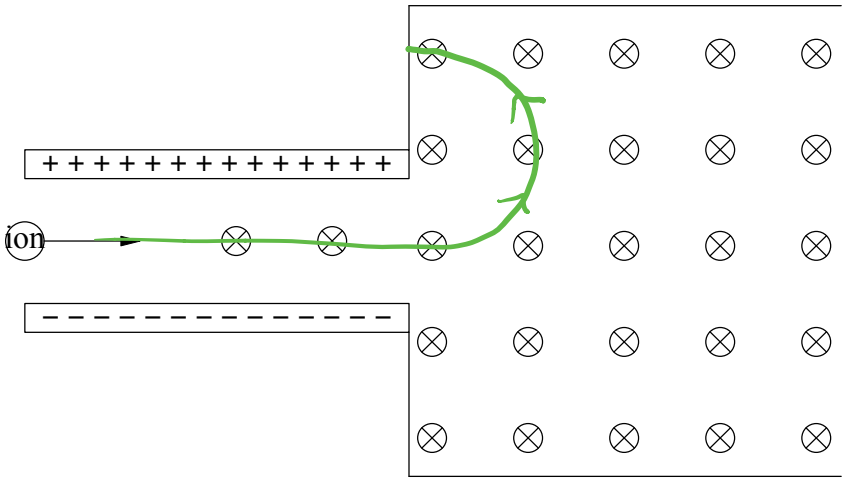
2. (25 pts.) A singly charged ion with mass 2.18×10^{-26}kg is sent through the velocity selector and mass spectrometer shown schematically in the figure. The electric field between the plates of the velocity selector is 950 V/m, and the magnetic fields in both the velocity selector and the deflection chamber have magnitudes of 0.93 T.

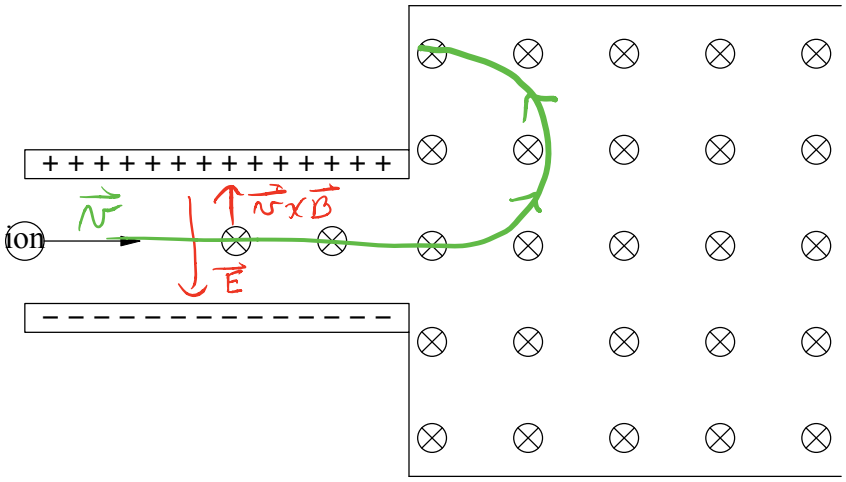


a. (10 pts.) What is the speed of an ion which passes through the velocity selector undeflected?

b. (5 pts.) What is the sign of the charge on the ion?

c. (10 pts.) What is the radius of the path of the ion?

2. (25 pts.) A singly charged ion with mass 2.18×10^{-26}kg is sent through the velocity selector and mass spectrometer shown schematically in the figure. The electric field between the plates of the velocity selector is 950 V/m, and the magnetic fields in both the velocity selector and the deflection chamber have magnitudes of 0.93 T.



a. (10 pts.) What is the speed of an ion which passes through the velocity selector undeflected?

undeflected $\Rightarrow$ $\Sigma \vec{F} = 0$

$qvB - qE = 0$, where $E = \frac{\Delta V}{d} = 950$ V/m

$v = E/B$

$v = \frac{950 \text{ V/m}}{0.93 \text{ T}} = 1022$ m/s

b. Sign? Positive. (use $\vec{F} = q\vec{v} \times \vec{B}$ on circular arc.)

c. Radius? $F = ma$

$qvB = \frac{mv^2}{R} \Rightarrow R = \frac{mv}{qB}$

$R = \frac{(2.18 \times 10^{-26} \text{ kg})(1022 \text{ m/s})}{(1.602 \times 10^{-19} \text{ C})(0.93 \text{ T})} = 1.5 \times 10^{-4}$ m