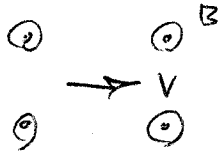


DERIVE THE CYCLOTRON FREQUENCY

Consider the effect of the (magnetic) Lorentz force on a charge q moving with a speed v perpendicular to a magnetic field B (out of the page)



Draw the force $\vec{F} = q\vec{v} \times \vec{B}$ on a positive charge q , for several successive positions.

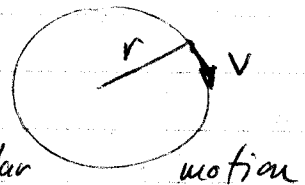
How does the charge move?

We can use Newton's 2nd law to figure out how fast it orbits the field line.

$$F = ma$$

$$qvB = m \frac{v^2}{r}$$

uniform circular



Solve for $r =$ _____

To find the angular frequency ω , recall:

$$\frac{r}{\theta} s = r\theta$$

$$\frac{ds}{dt} = r \frac{d\theta}{dt}$$

Solve for $\omega =$ _____

$$v = r\omega$$