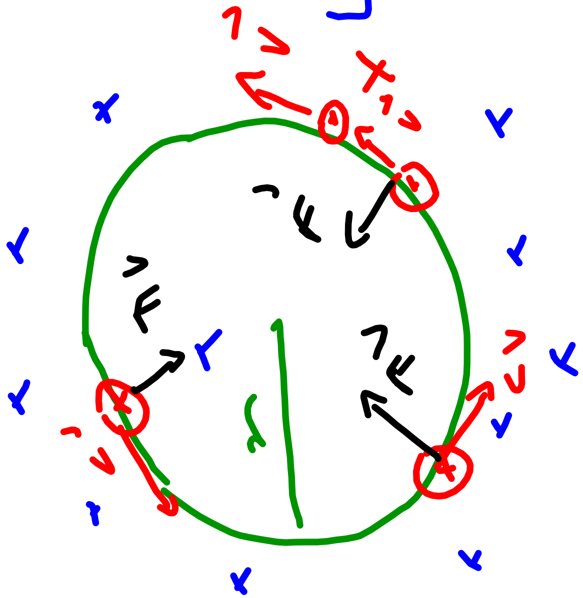
Cyclotrone motion



Newton law

centipetal acceleration

$$q\cancel{v}B = ma_r$$

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

$$r_{cyclotrone} = \frac{mv}{qB}$$

cyclotrone frequency

$$f_{cyc} = \frac{v}{2\pi r} = \frac{v}{2\pi \frac{mv}{qB}} = \frac{qB}{2\pi m}$$

$$T = \frac{1}{f}$$

$$\vec{F} = I \vec{\ell} \times \vec{B}$$

!

$$\vec{F} = q \vec{v} \times \vec{B}$$

An electron experiences a force

$$\vec{F} = (\underbrace{3.8}_{F_x}\,\hat{i} - \underbrace{2.7}_{F_y}\,\hat{j}) \cdot 10^{-13}\ N$$ when

passing through a magnetic field

$\vec{B} = 0.85\,T\,\hat{k}$. What is $\vec{v}_e = ?$

$$\vec{F} = q\vec{v} \times \vec{B} \qquad q = -e$$

$$\vec{F} = q\,\vec{v} \times \vec{B} \qquad \vec{B} = \underbrace{0.85}_{B_z}\,\hat{k}\ \mathrm{T}$$

$$F_x\hat{i} + F_y\hat{j} = -e \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ v_x & v_y & v_z \\ 0 & 0 & B_z \end{vmatrix} =$$

$$= -e\left[\hat{i}\,(v_y B_z) - \hat{j}\,(v_x B_z)\right]$$

$$F_y = e v_x B_z$$

$$v_x = \frac{F_y}{e B_z}$$

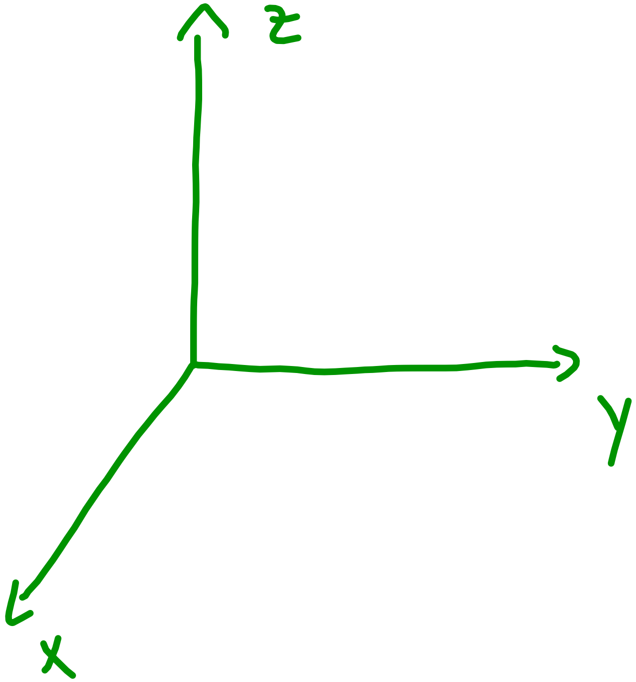
$$F_x = -e v_y B_z \qquad v_y = -\frac{F_x}{e B_z}$$

$$V_x = -2 \cdot 10^6 \ m/s$$

$$V_y = -2.8 \cdot 10^6 \ m/s$$

$$\vec{V} = -(2\hat{i} + 2.8\hat{j}) \cdot 10^6 \ m/s$$

Determine the magnitude & direction of the magnetic force on an electron traveling $8.75 \cdot 10^5$ m/s horizontally to the east in a vertically upward magnetic field of strength 0.45 T.



$$\vec{F} = q\,\vec{v} \times \vec{B}$$

$$q = - e$$

$$\vec{v} = v_x\,\hat{i}$$

$$\vec{B} = B_z\,\hat{k}$$

$$\hat{i} \times \hat{k} = - \hat{j}$$

$$\vec{F} = 6.3 \cdot 10^{-14}\,\hat{j}\,N \quad \text{to } N$$

Determine the currents in each resistor of figure: