Problem 29.9

The velocity of a charge moving in a B-field is:

$$\vec{v} = 10^7 \hat{k} \ \left(\text{m/s}\right)$$

The force on the charge is:

$$\begin{aligned}\vec{F} &= m\vec{a} \\ &= \left(1.67\text{x}10^{-27}\ \text{kg}\right)\left(1\text{x}10^{13}\ \text{m/s}^2\right)\hat{i} \\ &= \left(3.34\text{x}10^{-14}\ \text{N}\right)\hat{i}\end{aligned}$$

So what must B's direction be to get this force?
What we need is to evaluate the directional components of the relationship:

$$\begin{aligned}\vec{F} &= q\vec{v}\text{x}\vec{B} \\ \Rightarrow \quad \hat{i} &= \left(-\hat{k}\right)\text{x}\left(?\right) \\ \Rightarrow \quad ? &= \left(-\hat{j}\right)\end{aligned}$$

The B-fld magnitude will be:

$$\begin{aligned}\left|\vec{F}\right| &= q\left|\vec{v}\right|\left|\vec{B}\right|\sin\theta = m\left|\vec{a}\right| \\ \Rightarrow \quad B &= \frac{m\left|\vec{a}\right|}{q\left|\vec{v}\right|\sin 90^\circ} \\ \Rightarrow \quad B &= \frac{\left(1.67\text{x}10^{-27}\ \text{kg}\right)\left(2\text{x}10^{13}\ \text{m/s}^2\right)}{\left(1.6\text{x}10^{-19}\ \text{C}\right)\left(1\text{x}10^{7}\ \text{m/s}\right)\sin 90^\circ} \\ \Rightarrow \quad &= 2.09\text{x}10^{-2}\ \text{T}\end{aligned}$$

In short:

$$\vec{F} = \left(2.09\text{x}10^{-2}\ \text{T}\right)\left(-\hat{j}\right)$$