Problem 29.19

The cosmic ray's energy is: $E = \left(\frac{1}{2}\right)mv^2$

$$\left[\left(10\text{x}10^{6}\ \text{eV}\right)\left(1.6\text{x}10^{-19}\ \text{joules/eV}\right)\right] = \left(\frac{1}{2}\right)\left(1.67\text{x}10^{-27}\ \text{kg}\right)v^2$$

$$\Rightarrow \quad v = 4.38\text{x}10^{7}\ \text{m/s}$$

From our magnetic force relationship, we can write:

$$qvB\sin 90^{\circ} = ma$$

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

$$\Rightarrow \quad B = \frac{mv}{er}$$

$$= \frac{\left(1.67\text{x}10^{-27}\ \text{kg}\right)\left(4.38\text{x}10^{7}\ \text{m/s}\right)}{\left(1.6\text{x}10^{-19}\ \text{C}\right)\left(5.8\text{x}10^{10}\ \text{m}\right)}$$

$$= 7.88\text{x}10^{-12}\ \text{T}$$