9.8) WRITE THE ELECTRON'S SPIN ANGULAR MOMENTUM FOR A MASS m_e WITH A RADIUS OF $R_e = 10^{-18}$ m. FIND THE EQUATORIAL VELOCITY AND COMPARE IT TO c.

FOR A SPINNING BALL

$$|\vec{S}| = I\omega = \left(\frac{2}{5}MR^2\right)\frac{v}{R} = \frac{2}{5}MRv$$

TAKING THE e^-'s SPIN ANGULAR MOMENTUM

$$|\vec{S}| = \frac{\sqrt{3}}{2}\hbar$$

GIVES AN EXPRESSION FOR THE EQUATORIAL VELOCITY

$$v = \frac{5|\vec{S}|}{2MR} = \frac{5}{2m_eR_e}\frac{\sqrt{3}}{2}\hbar$$

EVALUATING THIS IN MKS UNITS

$$v = \frac{5\sqrt{3}}{4}\frac{1.05\times10^{-34}}{(9.11\times10^{-31})(10^{-18})} \qquad \frac{J\cdot s}{kg\cdot m} \sim \left(\frac{kg\cdot m^2}{s^2}\right)\frac{s}{kg\,m} \sim \frac{m}{s}$$

$$\boxed{v_{eq} = 2.495\times10^{14}\ \frac{m}{s}}$$ ZIPPY!

COMPARE TO THE SPEED OF LIGHT

$$\frac{v_{EQ}}{c} = \frac{2.495\times10^{14}}{2.997\times10^{8}} = 8.33\times10^{5}$$

$$\Rightarrow \boxed{v_{EQ} = 8.33\times10^{5}\,c}$$ RIDICULOUS!

THUS, A SPINNING BALL OF CHARGE IS NOT A GOOD MODEL!