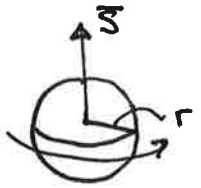
TL 7-31

If the electron is a sphere of radius

$$r = 10^{-15} \text{ meters}$$

and uniform mass density, then what is the speed of a point on it's equator?



$S = \sqrt{s(s+1)}\,\hbar$, $s = \frac{1}{2}$ so

$S = \sqrt{\frac{3}{4}}\,\hbar$

$S = I\omega$ ← relation between angular momentum S, moment of inertia I & angular velocity ω.

- I use $I = \frac{2}{5}mr^2$ for a sphere

  or $v = \omega r \Rightarrow \omega = v/r$ ← relationship between v at distance r for object spinning at ω.

$$\sqrt{\frac{3}{4}}\,\hbar = \left(\frac{2}{5}mr^2\right)\left(\frac{v}{r}\right)$$

- So $$v = \frac{5\sqrt{3/4}\,\hbar}{2mr}$$

- Plugging in numbers...

$$\boxed{v = 836c} = 2.5\times10^{11} \text{ m/s}$$

- This is impossible, since it is greater than the speed of light. So "electron spin" cannot be described as a classical spinning sphere of charge e.