

$$7.37) \quad l=3 \Rightarrow L = \sqrt{3(3+1)} \hbar = \sqrt{12} \hbar \approx 3.46 \hbar$$

$$l=3 \Rightarrow m = -3, -2, -1, 0, 1, 2, 3$$

$$\Rightarrow L_z = -3\hbar, -2\hbar, -\hbar, 0, \hbar, 2\hbar, 3\hbar$$

* L_z is strictly less than $|L|$, so L cannot be along the z-axis.

$$L_z = L \cos \theta = \sqrt{12} \hbar \cos \theta \quad \rightarrow \quad \theta = \cos^{-1} \left(\frac{L_z}{\sqrt{12} \hbar} \right)$$

$$L_z = -3\hbar : \theta = 150^\circ$$

$$L_z = -2\hbar : \theta = 125.3^\circ$$

$$L_z = -\hbar : \theta = 106.8^\circ$$

$$L_z = 0 : \theta = 90^\circ$$

$$L_z = \hbar : \theta = 73.2^\circ$$

$$L_z = 2\hbar : \theta = 54.7^\circ$$

$$L_z = 3\hbar : \theta = 30^\circ$$

$$7.38) \quad 1.00 \cdot 10^{-33} \text{ kg m/s} = \sqrt{l(l+1)} \hbar \quad \rightarrow \quad \hbar = 1.055 \cdot 10^{-34} \text{ Js}$$

$$\left(\frac{1 \cdot 10^{-33}}{\hbar} \right)^2 = l(l+1)$$

$$0 = l^2 + l - \left(\frac{1.00 \cdot 10^{-33}}{\hbar} \right)^2$$

$$0 = l^2 + l - 89.845$$

$$l = \frac{-1 \pm \sqrt{1 - 4(-89.845)}}{2} = 8.99, -9.99 \quad \Rightarrow \quad l = +9$$

$$L_z = m_l \hbar \quad \text{where} \quad m_l = 0, \pm 1, \pm 2, \dots, \pm 9$$

$$L_z = 0, \pm \hbar, \pm 2\hbar, \pm 3\hbar, \pm 4\hbar, \pm 5\hbar, \pm 6\hbar, \pm 7\hbar, \pm 8\hbar, \pm 9\hbar$$

$$\text{ep37) a) } |S| = \sqrt{s(s+1)} \hbar = \sqrt{\frac{1}{2}(\frac{1}{2}+1)} \hbar = \sqrt{\frac{1}{2}(\frac{3}{2})} \hbar = \sqrt{\frac{3}{4}} \hbar = \frac{\sqrt{3}}{2} \hbar$$

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

$$\text{b) } m_s = -s, -s+1, -s+2, \dots, +s-1, +s$$

$$m_s = -\frac{1}{2}, +\frac{1}{2}$$

$$\text{c) } S_z = m_s \hbar$$

$$S_z = \pm \frac{\hbar}{2}$$