

Physics 212 – Quiz #6  
Chapter 7

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Name: Key Id#: \_\_\_\_\_

Consider an atomic electron in the  $l=4$  state.

(a) Calculate the magnitude of the angular momentum.

$$|\vec{L}| = \sqrt{l(l+1)} \hbar = \sqrt{20} \hbar = 4.72 \times 10^{-34} \text{ J}\cdot\text{s}$$

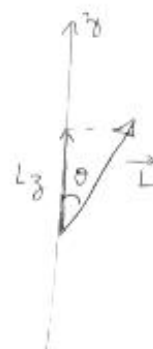
(b) What are the possible values of the magnetic quantum number?

$$m_l = 4, 3, 2, 1, 0, -1, -2, -3, -4$$

$$L = mvr = r p = m \frac{h v}{\lambda} \\ = \frac{h m v}{\lambda}$$

(c) What are the possible orientations of  $\vec{L}$  with the z-axis?

$$\cos \theta = \frac{|\vec{L}_z|}{|\vec{L}|} = \frac{m_l \hbar}{\sqrt{l(l+1)} \hbar} \\ = \frac{m_l}{\sqrt{l(l+1)}}$$



$$m_l = 4 \Rightarrow \theta = \cos^{-1} \left( \frac{4}{\sqrt{20}} \right) = 26.6^\circ$$

$$m_l = 3 \Rightarrow \theta = \cos^{-1} \left( \frac{3}{\sqrt{20}} \right) = 47.9^\circ$$

$$m_l = 2 \Rightarrow \theta = \cos^{-1} \left( \frac{2}{\sqrt{20}} \right) = 63.4^\circ$$

$$m_l = 1 \Rightarrow \theta = \cos^{-1} \left( \frac{1}{\sqrt{20}} \right) = 77.1^\circ$$

$$m_l = 0 \Rightarrow \theta = \cos^{-1}(0) = \pi/2 = 90^\circ$$

$$m_l = -4 \Rightarrow \theta = 153.4^\circ, \quad m_l = -3 \Rightarrow \theta = 132.1^\circ$$

$$m_l = -2 \Rightarrow \theta = 116.6^\circ, \quad m_l = -1 \Rightarrow \theta = 102.9^\circ$$