8.25) a) DRAW AN ANGULAR MOMENTUM DIAGRAM SIMILAR TO 8.14 FOR $\ell = 3$

b) HOW MANY ORIENTATIONS ARE THERE?

c) WHAT IS θ_{MIN} BETWEEN $\vec{L}$ AND $\hat{z}$?

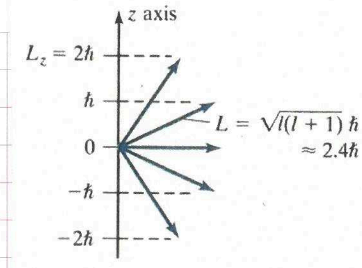


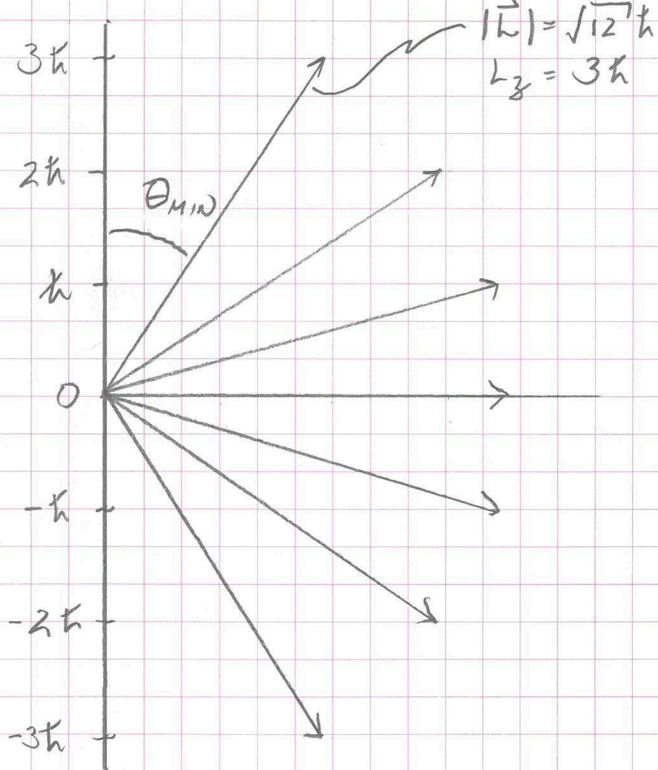
FIGURE 8.14

Classical representation of the quantized values of angular momentum **L** for the case $l = 2$. The z component has $(2l + 1) = 5$ possible values, $L_z = m\hbar$ with $m = 2, 1, 0, -1, -2$. The magnitude of **L** is $L = \sqrt{l(l+1)}\hbar = \sqrt{2 \times 3}\hbar \approx 2.4\hbar$ in all five cases.

a) FOR $\ell = 3$: $|\vec{L}| = \sqrt{\ell(\ell+1)}\,\hbar = \sqrt{12}\,\hbar \approx 3.5\hbar$

$L_z = m\hbar = \pm 3\hbar, \pm 2\hbar, \pm\hbar, 0$

DRAW THESE POSSIBILITIES



b) SINCE m CAN BE $\pm$ ALL VALUES OF ℓ AND ZERO, THE NUMBER OF ORIENTATIONS IS

$\# = 2\ell + 1 = 7$

$\Rightarrow$ 7 ORIENTATIONS

c) THE MINIMUM ANGLE IS

$$\cos\theta = \frac{\text{ADJACENT}}{\text{HYPOTENUSE}}$$

$$\cos\theta_{MIN} = \frac{3\hbar}{\sqrt{12}\,\hbar}$$

$$\cos\theta_{MIN} = \frac{3}{2\sqrt{3}}$$

$$\cos\theta_{MIN} = \frac{\sqrt{3}}{2}$$

$\theta_{MIN} = 30^\circ$ $\Leftarrow$