

HW13-5 Soln)

S_z is the component of S in the z -direction, and as such, it equals $S \cos\theta$. So,

$$\theta = \arccos\left(\frac{S_z}{S}\right) = \arccos\left(\frac{m_s \hbar}{\sqrt{s(s+1)}\hbar}\right) = \arccos\left(\frac{m_s}{\sqrt{s(s+1)}}\right).$$

With $s = \frac{1}{2}$ and $m_s = \pm \frac{1}{2}$, there are two:

$$\theta = \arccos\left(\frac{-\frac{1}{2}}{\sqrt{\frac{1}{2}(\frac{1}{2} + 1)}}\right) = 125.3^\circ$$

$$\theta = \arccos\left(\frac{+\frac{1}{2}}{\sqrt{\frac{1}{2}(\frac{1}{2} + 1)}}\right) = 54.7^\circ$$