5-27

(a) According to Problem 5.8 in the text eigen values are $0$ & $\pm\hbar$ also we have $\theta = \frac{\pi}{2}$ , $\varphi = 0$ thus

$$|1, m_x = -1\rangle = \frac{1}{2}\begin{pmatrix} 1 - \cos\frac{\pi}{2} \\ -\frac{2}{\sqrt{2}}\sin\frac{\pi}{2} \\ 1 + \cos\frac{\pi}{2} \end{pmatrix} = \frac{1}{2}\begin{pmatrix} 1 \\ -\sqrt{2} \\ 1 \end{pmatrix}$$

$$|1, m_x = 0\rangle = \frac{1}{\sqrt{2}}\begin{pmatrix} -\sin\frac{\pi}{2} \\ \sqrt{2}\cos\frac{\pi}{2} \\ \sin\frac{\pi}{2} \end{pmatrix} = \frac{1}{\sqrt{2}}\begin{pmatrix} -1 \\ 0 \\ 1 \end{pmatrix}$$

$$|1, m_x = 1\rangle = \frac{1}{2}\begin{pmatrix} 1 + \cos\frac{\pi}{2} \\ \frac{2}{\sqrt{2}}\sin\frac{\pi}{2} \\ 1 - \cos\frac{\pi}{2} \end{pmatrix} = \frac{1}{2}\begin{pmatrix} 1 \\ \sqrt{2} \\ 1 \end{pmatrix}$$

(b)

$$|1, m_x = 1\rangle = \frac{1}{2}|1,1\rangle + \frac{1}{\sqrt{2}}|1,0\rangle + \frac{1}{2}|1,-1\rangle$$

(c)

$$P_{+1} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

$$P_0 = \left(\frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2}$$

(d) By measuring $m_z$ one of these values occur $0$ & $\pm\hbar$ and probability for each of them can be obtain

$$P_0 = \frac{1}{2}, P_{\pm 1} = \frac{1}{4}$$

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Translated by: @PhysicsDirectory