

Final Review - Answers

4.24 b) $\psi_{nm}(\theta, \varphi) = Y_n^m(\theta, \varphi)$, degeneracy $2n+1$.

4.28 $\langle S_x \rangle = \hbar \operatorname{Re}(ab^*)$ $\langle S_y \rangle = -\hbar \operatorname{Im}(ab^*)$

$\langle S_z \rangle = \frac{1}{2} \hbar (|a|^2 - |b|^2)$

$\langle S_x^2 \rangle = \langle S_y^2 \rangle = \langle S_z^2 \rangle = \frac{\hbar^2}{4}$

4.31

$$S_x = \frac{\hbar}{\sqrt{2}} \begin{pmatrix} 0 & 1 & 0 \\ 1 & 0 & 1 \\ 0 & 1 & 0 \end{pmatrix} \quad S_y = \frac{i\hbar}{\sqrt{2}} \begin{pmatrix} 0 & -1 & 0 \\ 1 & 0 & -1 \\ 0 & 1 & 0 \end{pmatrix} \quad S_z = \hbar \begin{pmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 0 & 0 & -1 \end{pmatrix}$$

4.35

a) baryons: spin $\frac{3}{2}$ and $\frac{1}{2}$

b) mesons: spin 1 and 0

4.49

a) $A = \frac{1}{3}$

b) $\frac{\hbar}{2}$ with prob. $\frac{5}{9}$, $-\frac{\hbar}{2}$ with prob. $\frac{4}{9}$, $\langle S_z \rangle = \frac{\hbar}{18}$

c) $\frac{\hbar}{2}$ with prob. $\frac{13}{18}$, $-\frac{\hbar}{2}$ with prob. $\frac{5}{18}$, $\langle S_x \rangle = \frac{2\hbar}{9}$

d) $\frac{\hbar}{2}$ with prob. $\frac{17}{18}$, $-\frac{\hbar}{2}$ with prob. $\frac{1}{18}$, $\langle S_y \rangle = \frac{4\hbar}{9}$