Central Forces Quantum Calculations on a Ring I

Your group will be given one of the following normalized abstract quantum states on a ring:

$$|\Phi_a\rangle = \frac{\sqrt{8}}{3}|0\rangle + \frac{1}{3}|2\rangle \qquad |\Phi_b\rangle = \frac{\sqrt{8}}{3}|2\rangle + \frac{1}{3}|-3\rangle$$

$$|\Phi_c\rangle = \frac{\sqrt{7}}{3}|2\rangle + \frac{\sqrt{2}}{3}|-2\rangle \qquad |\Phi_d\rangle = \frac{\sqrt{7}}{3}|0\rangle + \frac{\sqrt{2}}{3}|-3\rangle$$

$$|\Phi_e\rangle = \frac{\sqrt{6}}{3}|0\rangle + \frac{\sqrt{3}}{3}|2\rangle \qquad |\Phi_f\rangle = \frac{\sqrt{6}}{3}|2\rangle + \frac{\sqrt{3}}{3}|-3\rangle$$

$$|\Phi_g\rangle = \frac{\sqrt{5}}{3}|2\rangle + \frac{\sqrt{4}}{3}|-2\rangle \qquad |\Phi_h\rangle = \frac{\sqrt{5}}{3}|0\rangle + \frac{\sqrt{4}}{3}|-3\rangle$$

1) If you measured the z-component of angular momentum, what is the probability that you would obtain $2\hbar$? $-3\hbar$?

2) If you measured the z-component of angular momentum, what other possible values could you obtain with non-zero probability?

3) If you measured the energy, what possible values could you obtain with non-zero probability?

4) What is the expectation value of $\hat{L}_z$ in this state? the expectation value of energy?

by Corinne Manogue