Quantum Calculations on a Ring II

In this activity, your group will carry out calculations on the following quantum state on a ring:

$$|\Phi\rangle = \sqrt{\frac{2}{3}}|-3\rangle + \frac{1}{\sqrt{6}}|-1\rangle + \frac{i}{\sqrt{6}}|3\rangle$$

1. You carry out a measurement to determine the z-component of the angular momentum of the particle at time, t. Calculate the probability that you measure the z-component of the angular momentum to be $3\hbar$. What representation/basis did you use to do this calculation and why did you use this representation?

2. You carry out a measurement to determine the energy of the particle at time, t. Calculate the probability that you measure the energy to be $\frac{9\hbar^2}{2I}$. What representation/basis did you use to do this calculation and why did you use this representation?

3. Calculate the probability that the particle can be found in the region $0 < \phi < \frac{\pi}{3}$ at some time, t. What representation/basis did you use to do this calculation and why did you use this representation?

4. Under what circumstances do measurement probabilities change with time?