The following are 2 different representations for the **same** state on a quantum ring

$$|\Phi\rangle = \sqrt{\frac{1}{2}}\,|2\rangle - \sqrt{\frac{1}{4}}\,|0\rangle + i\sqrt{\frac{1}{4}}\,|-2\rangle \tag{1}$$

$$\Phi(\phi) \doteq \sqrt{\frac{1}{8\pi r_0}}\left(\sqrt{2}e^{i2\phi} - 1 + ie^{-i2\phi}\right) \tag{2}$$

1. Write down the matrix representation for the same state.

2. In each of the three representations, write the expressions you would use to evaluate the probabilities that a measurement of L_z will yield $0\hbar$, $-2\hbar$, and $2\hbar$. Then choose one of the representations and carry out the probability calculations.

3. If you measured the z-component of angular momentum to be $2\hbar$, write down the full resultant state immediately after the measurement.

4. If an energy measurement is performed on the state $\Phi(\phi)$, what is the probability that the energy measurement will yield each of the following values: $0\frac{\hbar^2}{I}$?,$2\frac{\hbar^2}{I}$?,$4\frac{\hbar^2}{I}$?

5. If you measured the energy of the state to be $2\frac{\hbar^2}{I}$, write down the full resultant state immediately after the measurement.