Central Forces Quantum Calculations on a Ring

Keep in your notebook

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

$$\Phi_a(\phi) = \frac{1}{\sqrt{4\pi r_0}}\left(1 + e^{2i\phi}\right) \qquad \Phi_b(\phi) = \frac{1}{\sqrt{4\pi r_0}}\left(e^{i\phi} + e^{2i\phi}\right)$$

$$\Phi_c(\phi) = \frac{1}{\sqrt{8\pi r_0}}\left(\sqrt{3}e^{i\phi} + e^{2i\phi}\right) \qquad \Phi_d(\phi) = \frac{1}{\sqrt{4\pi r_0}}\left(e^{2i\phi} + e^{-2i\phi}\right)$$

$$\Phi_e(\phi) = \frac{1}{\sqrt{4\pi r_0}}\left(e^{2i\phi} + e^{-3i\phi}\right) \qquad \Phi_f(\phi) = \frac{1}{\sqrt{8\pi r_0}}\left(\sqrt{3}e^{2i\phi} + e^{-2i\phi}\right)$$

1) If you measured the z-component of angular momentum, what possible values could you obtain?

2) If you measured the energy, what possible values could you obtain?

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

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

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