

Physics 4261: Homework 2

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- 2.1. **Foot 2.2** (CP Note: Do not worry about the normalization constant in front, unless you want)
- 2.2. **Foot 2.4**
- 2.3. **Angular momentum commutators** Take the spherical coordinate operators

$$\begin{aligned}\hat{l}_x &= i\hbar \cot \theta \cos \phi \frac{\partial}{\partial \phi} + i\hbar \sin \phi \frac{\partial}{\partial \theta}, \\ \hat{l}_y &= i\hbar \cot \theta \sin \phi \frac{\partial}{\partial \phi} - i\hbar \cos \phi \frac{\partial}{\partial \theta}, \\ \hat{l}_z &= -i\hbar \frac{\partial}{\partial \phi}.\end{aligned}$$

- (a) Verify that $[\hat{l}_x, \hat{l}_y] = i\hbar \hat{l}_z$ (we did the other permutations in class).
- (b) Use the cyclic permutations to show that $\hat{\mathbf{l}}^2$ commutes with any particular \hat{l} operator.
- (c) Show that $[\hat{l}_z, \hat{l}_{\pm}] = \pm \hbar \hat{l}_{\pm}$.
- (d) (Bonus Q) Verify that $\hat{\mathbf{l}}^2$ takes the same form as derived from separation of variables.