5.73

Quiz 22

$$\left[\mathbf{L}_i, \mathbf{p}_j\right] = i\hbar \sum_k \varepsilon_{ijk} \mathbf{p}_k$$

$$\left[\mathbf{L}_i, \mathbf{p}_j\right] = i\hbar \sum \varepsilon_{ijk} \mathbf{p}_k$$

ε_{ijk} = +1 if ijk are in cyclic order (i.e. xyz, yzx, or zxy)
–1 if ijk are in anti-cyclic order
0 if any index is repeated.

$$\mathbf{L} = (\mathbf{q} \times \mathbf{p}) = \begin{pmatrix} \hat{i} & \hat{j} & \hat{k} \\ \mathbf{x} & \mathbf{y} & \mathbf{z} \\ \mathbf{p}_x & \mathbf{p}_y & \mathbf{p}_z \end{pmatrix}$$

A. What are $\mathbf{L}_y$ and $\mathbf{L}_z$ in terms of (**x,y,z**) and ($\mathbf{p}_x$, $\mathbf{p}_y$, $\mathbf{p}_z$)?

B. Use ε_{ijk} notation to evaluate [$\mathbf{L}_x$, **x**], [$\mathbf{L}_x$, **z**], [$\mathbf{L}_x$, $\mathbf{p}_x$], and [$\mathbf{L}_x$, $\mathbf{p}_z$].
[$\mathbf{L}_x$, **x**] =

[$\mathbf{L}_x$, **z**] =

[$\mathbf{L}_x$, $\mathbf{p}_x$] =

[$\mathbf{L}_z$, $\mathbf{p}_z$] =

C. Use the results of part B to show that [$\mathbf{L}_x$, $\mathbf{L}_y$] = i$\hbar\mathbf{L}_z$. Recall that [**A,BC**] = **B**[**A,C**] + [**A,B**]**C**.

5.73 Quantum Mechanics I
Fall 2018