

Solution

Name:

Quiz 2

1. What is the commutator, $[x, p]$? (Write it down - no proof needed.) (3 pts.)

$$[x, p] = i\hbar$$

2. Evaluate the commutator $[x, px]$. (3 pts.)

$$\begin{aligned} [x, px] &= [x, p]x + p[x, x] \\ &= i\hbar x \end{aligned}$$

3. Evaluate the commutator $[x, p^2]$. (4 pts.)

$$\begin{aligned} [x, p^2] &= \underbrace{[x, p]}_{i\hbar} p + p \underbrace{[x, x]}_0 + p^2 \underbrace{[x, p]}_{i\hbar} \\ &= i\hbar (xp + px) \end{aligned}$$

Some students use $xp - px = i\hbar$ to write this as

$$\begin{aligned} &= i\hbar (2px + i\hbar) = 2i\hbar px - \hbar^2 \\ &= i\hbar (2xp - i\hbar) = \frac{2i\hbar xp}{2\hbar^2 x \frac{d}{dx}} + \hbar^2 \end{aligned}$$