Answer on Question #85009 Physics / Quantum Mechanics

For the operator $\hat{A} = a\hat{x} + ib\hat{p}$ where a and b are constants, calculate $[\hat{A}, \hat{x}]$ and $[\hat{A}, \hat{A}]$.

Solution:

The commutation relation between position and momentum operators is as follows

$$[\hat{p}, \hat{x}] = -i\hbar$$

So

$$\left[\hat{A}, \hat{x}\right] = [a\hat{x} + ib\hat{p}, \hat{x}] = a\underbrace{[\hat{x}, \hat{x}]}_{0} + ib\underbrace{[\hat{p}, \hat{x}]}_{-i\hbar} = b\hbar$$

For any operator $\hat{A}$

$$\left[\hat{A}, \hat{A}\right] = 0$$

Answer: $\left[\hat{A}, \hat{x}\right] = b\hbar$, $\left[\hat{A}, \hat{A}\right] = 0$.