Chem. 540
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FORMALISM - PROBLEM 20

Consider a particle described by the following Gaussian wavefunction:

$$\Psi(x) = \left(\frac{\alpha}{\pi}\right)^{\frac{1}{4}} e^{-\frac{\alpha}{2}x^2} .$$

a) Calculate the expectation values of $\hat{x}$ and of $\hat{x}^2$ for this system.

b) Find the wavefunction that describes this state in momentum space.

c) Using this result, find the expectation values of $\hat{p}$ and of $\hat{p}^2$ for the same system. Check your answer by calculating the same quantities directly in the position representation.