

Chem. 542
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Time Evolution Basics – Problem 1

For a particle in one dimension with Hamiltonian

$$\hat{H} = \frac{\hat{p}^2}{2m} + V(\hat{x})$$

show that the equations of motion for the expectation values of the position and of the momentum follow Newton's laws; i.e.,

$$\frac{d}{dt}\langle x_t \rangle = \frac{\langle p_t \rangle}{m}, \quad \frac{d}{dt}\langle p_t \rangle = \langle f_t \rangle$$

where $f = -dV/dx$ is the force acting on the system. This is known as Ehrenfest's theorem.