PHYS 451: Quantum Mechanics I – Spring 2016
Quiz #4

1. Consider a particle in a 1D potential $V(x)$ (assume $V(x) \neq 0$).

(a) Can the particle's position and momentum be measured precisely at the same time?

(b) Can the particle's position and kinetic energy be measured precisely at the same time?

(c) Can the particle's position and potential energy be measured precisely at the same time?

(d) Can the particle's position and total energy be measured precisely at the same time?

2. Consider the uncertainty principle that relates the position (x) and energy (E) of a particle in a *stationary* state of the Hamiltonian $\hat{H} = \frac{p^2}{2m} + V(x)$. Based on this uncertainty principle determine the expectation value of the momentum, $\langle p \rangle$, in that state.

Appendix: Heisenberg uncertainty principle

Position-momentum: $\Delta x \, \Delta p_x \geq \frac{\hbar}{2}$ Energy-time: $\Delta E \, \Delta t \geq \frac{\hbar}{2}$ General: $\Delta A \Delta B \geq \frac{1}{2} |\langle [\hat{A}, \hat{B}] \rangle|$