PHYS 451: Quantum Mechanics I
Homework #6, due Thursday October 9, in class

1. Show that for a particle of mass m moving in 1D potential $V(x)$ the following relation takes place:
$$m\frac{d^2\langle x\rangle}{dt^2} = -\left\langle \frac{\partial V}{\partial x} \right\rangle.$$
Hint: you might want to use the identity that we derived in lecture
$$\frac{d\langle \hat{Q}\rangle}{dt} = \left\langle \frac{\partial \hat{Q}}{\partial t} \right\rangle + \frac{1}{i\hbar}\langle [\hat{Q}, \hat{H}]\rangle$$
one or more times.

2. Verify the energy-time uncertainty principle for a particle in an infinite square well of length a assuming that the initial wave function is given by
$$\Psi(x, t = 0) = \frac{1}{\sqrt{2}}[\psi_1(x) + \psi_2(x)],$$
where $\psi_1(x)$ and $\psi_2(x)$ are the ground and first excited stationary states respectively. To define Δt as
$$\Delta t = \frac{\Delta Q}{\left|\frac{d\langle Q\rangle}{dt}\right|}$$
you need to pick some observable, Q. Use the position for this purpose, i.e. assume that $Q \equiv x$.

3. Problem 3.31 in Griffiths.

4. Problem 3.37 in Griffiths.

Found an error or need a clarification? Email the instructor at sergiy.bubin@nu.edu.kz