**Physical Chemistry Cume**
**Petr Král**
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*In this cume, you can show how you understand principles of quantum mechanics.*

1. a) How could you solve a wave equation of a string? $\frac{\partial^2 u}{\partial x^2} = \frac{1}{v^2}\frac{\partial^2 u}{\partial t^2}, \quad u(0,t) = u(l,t) = 0$

   b) Why do we use linear Hermitian operators in quantum mechanics? What is a complete basis set of a Hermitian operator?

   c) When does a momentum operator have the same eigenstates like the system Hamiltonian? Why? What are these states?

   d) Imagine that you prepare a wave packet (superposition state) of a quantum particle and you want to measure energy of the particle. What do you obtain? What do you obtain if you want to measure energy again on the resulting state? What if you want to measure something else in the second case?

2. a) How would you describe quantum mechanically the radiation coming out from a laser? How would a superposition state |1>+|2> of a double well evolve in time (sum of the ground and first excited states)? Why?

   b) Explain the concept of pure and mixed states in quantum mechanics. You can relate it to relaxation of a superposition state.

   c) How would you prepare a complete basis set of N electrons in 3D space? How could an exact solution of an N electron problem look like? (ground and excited states). How could it be approximated?