Quiz 1

Chemistry 3BB3; Winter 2005

Name/PID:

1. **Write the Schrödinger Equation for the Hydrogen atom in atomic units. You may use the Born-Oppenheimer approximation.**

2. **In order to solve the Hydrogen atom, we used the solution of the following exactly solvable system**
   (a) particle in a box
   (b) harmonic oscillator
   (c) rigid rotor
   (d) Hückel Hamiltonian

3. **Which of the following phrases correctly describe the Born-Oppenheimer approximation (there may be more than one correct answer)**
   (a) The electronic state is perfectly coupled to the nuclear positions and is independent of the motion of the atomic nuclei
   (b) The nuclear state is perfectly coupled to the electronic positions and is independent of the motion of the electrons.
   (c) The nuclei move independently of the electronic motions.
   (d) The electronic wave function does not depend on the nuclear positions.
   (e) There is no transfer of momentum between nuclei and electrons.

4. **The mass of the antimuon, μ^+, is about $\frac{1}{9}^{\text{th}}$ the mass of the proton. The Born-Oppenheimer approximation will be more accurate for:**
   (a) A system that consists of antimuons and electrons.
   (b) A system that consists of protons and electrons.

5. **Which of the following is *not* an approximations used in the electronic Hamiltonian we wrote in class?**
   (a) The effects of relativity are ignored.
   (b) Nuclear forces are ignored.
   (c) Interactions between electrons are ignored altogether.
   (d) Atomic nuclei are assumed to be a point charges.
   (e) The effects of gravity are ignored.

Quiz 1 Key

Chemistry 3BB3; Winter 2005

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1. **Write the Schrödinger Equation for the Hydrogen atom in atomic units. You may use the Born-Oppenheimer approximation.**

$$\left(\frac{-\nabla_r^2}{2} - \frac{Z}{r}\right)\Psi(\boldsymbol{r}) = E\Psi(\boldsymbol{r}) \qquad \text{for Hydrogen, } Z = 1.$$

2. **In order to solve the Hydrogen atom, we used the solution of the following exactly solvable system**
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   (b) harmonic oscillator
   (c) rigid rotor
   (d) Hückel Hamiltonian

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