UNIVERSITY OF THE WEST INDIES
DEPARTMENT OF CHEMISTRY

C10J ATOMIC STRUCTURE (Tutorial #1)

1. The electron in the hydrogen atom (in its ground state) orbits the nucleus at a distance of 0.5292 Å. Calculate
   (a) the gravitational force and
   (b) the electrostatic force of attraction between the two.
   Comment on the magnitude and the importance of these two forces.
   (G, gravitational constant = 6.672×10^{-11} N m^2 kg^{-2}.)
   ($4\pi\varepsilon_o = 1.113 \times 10^{-10}$ C^2 m^{-1} J^{-1})

2. Is the assumption that the nucleus of the hydrogen atom is stationary while the electron is orbiting, a valid one? Explain your answer.

3. What do you understand by the Heisenberg Uncertainty Principle (HUP)? Express this in the form of an inequality.

4. Why is the Heisenberg Uncertainty Principle more meaningful for the hydrogen atom system than for the moon-earth system?

5 (a) If the position of an electron is known to within 10^{-12} m, what is the uncertainty in its momentum?
   (b) How does your figure compare with the momentum of an electron travelling with one-third the speed of light?

6. Two waveforms are described by the wavefunctions ψ_1 and ψ_2. Give expressions for the intensity at some region in space where both waveforms are interacting when
   (a) ψ_1 and ψ_2 are both positive
   (b) ψ_1 and ψ_2 are both negative
   (c) ψ_1 and ψ_2 are of opposite signs.

7. The Schrödinger wave equation can be written as $H\psi = E\psi$. Define and explain the significance of each term in the equation.

PTM