Homework Problem 9 – Due April 4

Chapter 32

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When an electron makes a transition from its first excited quantum level to ground level, the energy difference is carried by the emitted photon. In comparison, how much energy is needed to move an electron at ground level to the first excited quantum level?

Q2

How can the electron "orbits" in a hydrogen atom be compared with the standing waves on a string? In particular, what "harmonics" correspond to the ground state, first excited state and so on? What is the relationship between the different frequencies at which standing waves can occur to the energy levels of an electron in a hydrogen atom?

Q3

We know waves can diffract around corners, create interference patterns, and refract (bend) or reflect when impinging on the surface between two different media (with different wave velocities). Which of these phenomena do you expect will also occur with quantum mechanical "matter waves", e.g. waves describing the behavior of electrons?

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If the electron in a hydrogen atom obeyed classical mechanics instead of quantum mechanics, would it emit a continuous spectrum or a line spectrum? Explain.

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If the world of the atom is so uncertain and subject to the laws of probabilities, how can we accurately measure such things as light intensity, electric current, and temperature?

Q6

What would happen to Chemistry if the Pauli exclusion principle didn't apply to the electrons in an atom? Explain what would happen, and give at least 2 qualitative differences from the world we actually live in.

Q7 – Bonus Question

We know that the size of a hydrogen atom is about 0.1 nm (= 1 Å = 10^{-10} m). This means that the position of the electron at any given time could be anywhere within the atom, making it "uncertain" within 0.1 nm. According to Heisenberg's uncertainty principle, how uncertain would the MOMENTUM of the electron inside a hydrogen atom have to be?