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## Tutorial 2

T2.1 In class, you learned about Bohr's theory of Hydrogen atom. Before Bohr, Rutherford tried to explain hydrogen atomic structure by assuming a planetary model (which you are acquainted from your high school). Rutherford's model is a classical model and it predicts that light emitted by hydrogen atom is equal to the frequency of the moving electron in the orbits. According to Bohr, the frequency of light emitted is a result of electron making jumps between stationary states i.e.  $\nu = (E_{n_1} - E_{n_2})/h$ . At high values of  $n$ , show that Bohr and Rutherford models converge. This convergence is an example of a rule called "correspondence principle" which states that in the limit of large quantum numbers, quantum mechanics recovers classical mechanics.

T2.2 Somewhere in the universe, you are living in a place called "quantum land" where Planck's constant value is  $h = 10^{-1}$  Js. In that land, watermelons grow to a size of 20 cm with very hard shells and with seeds of mass 1.0 g. When you live in that land, and planning to eat watermelon, you have to be very careful while cutting open the melon. Explain why?

T2.3 At a certain instant of time, a one-particle, one-dimensional system has

$$\psi = (2/b^3)^{1/2} x e^{-|x|/b}, \text{ where } b = 3 \text{ nm.}$$

If a measurement of  $x$  is made at this time instant,

- find the probability for the particle to lie between 0.9 nm and 0.9001 nm (this interval can be treated as infinitesimal)
- find the probability for the particle to lie between 0 and 2 nm
- for what value of  $x$ , the probability density is a minimum?
- verify that  $\psi$  is normalized.