Tutorial Sheet (Wave-Mechanics)

1 Calculate the wave length associated with an electron accelerated to a potential difference of 1.25 keV. (3.46×10^{-11}m).

2. A proton is moving with a speed of 2×10^8 m/s. Find the wave length of the matter wave associated with it. (1.47×10^{-5}Å).

3. Calculate the wave length associated with a 1 MeV electron, 1 MeV proton.

(8.75×10^{-13}m, 1.24×10^{-12}m).

4. Calculate the smallest possible uncertainty in the position of an electron moving with velocity 3×10^7m/s. (3.88×10^{-12}m).

5. The speed of an electron is measured to be 5×10^3m/s to an accuracy of 0.003%. Find the uncertainty in determining the position of electron. (7.82×10^4m).

6. The position and momentum of a 1kev electron are simultaneously determined. If its position is located within 10^{-10} m, what is the percentage of uncertainty in its momentum.? (6.2%).

7. A certain excited state of hydrogen atom is known to have a life time of 2.5×10^{-14}sec, what is the minimum error which the energy of this state can be measured?(4.22×10^{-21} J).

8. The life time of an excited state of nucleus is 10^{-12}sec. What is the uncertainty in energy of x-ray photon emitted. (0.527×10^{-22} J or 3.3×10^{-4} eV).

9. An electron is bound in one dimensional potential box which has width 2.5×10^{-10}m and height infinite. Calculate the least permitted energy value of the electron. (6.04 ev).

10. A particle is in motion along a line between x = 0 and x = 2 with zero potential energy. The potential energy is infinite at $x < 0$ and $x > 2$. The wave function for the particle in n^{th} state is given by $\varphi = A\left(sin\frac{n\pi x}{L}\right)$. Find the expression for the normalized wave function applicable in least energy state.

11. Find the probability of finding a particle trapped in a box of length 1Å in the region from 0.45Å to 0.55Å for the ground state. (19.8%).