Arab Academy for Science & Technology & Maritime Transport

(AASTMT – Cairo Branch)

College of Engineering & technology

Electronics & Communication Engineering Department

Course : Solid State Electronics
Course Code : EC210
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Sheet # 4

Schrodinger Equation

Physical Constants:

Charge of electron (e) =1.6x10^{-19} C **Mass of electron (m_e) = 9.1x10^{-31} kg**
Mass of proton (m_p) = 1.672x10^{-27} kg **Plank's constant (h) = 6.63x10^{-34} J.s**
Speed of light (C) = 3x10^{8} m/s
1 eV = 1.6×10-19 J

Put (T) for the true statement or (F) for the false statement:

1. Quantum mechanics is valid only for particles moving with high speed.
2. For an electron in an infinite potential well, the difference between two successive energy levels is the same for all levels.
3. The value of the wave function ψ is the probability of finding the particle.
4. The wave function of a matter wave can be positive, negative or even complex quantity.
5. If an electron in a region is free, its potential energy in this region must be zero.
6. A single traveling wave could represent the associated matter wave of the particle.

Solve the following Problems:

1. Which of the following wave functions cannot be solutions of Schrodinger's eq. for all values of x? Why not?
   (a) ψ = A tan x
   (b) $\psi = e^{x^2}$
   (c) $\psi = e^{-x^2}$

2. A particle is confined in a one dimensional box of length a. The form of the wave function in the box can be written as y = A sin(πx/a), where 0 < x < a.
   (a) Use the normalization condition to determine the value of A
   (b) What is the probability of finding the particle at x = a/4
   (c) What is the most likely point of finding the particle?
   (d) What is the probability of finding the particle in the region a/4 < x < 3a/4

3. A particle of mass 2.00 × 10-28 kg is confined in a one dimensional infinite potential well of width 1.00 × 10-10 m.

   (a) What is the maximum wavelength of the radiation produced in order for the particle to return to n = 3?

   (b) Find the possible wavelengths of radiation produced in order for the particle to return from n = 3 to n = 1.

   (c) For n = 2, what are the particle's wavelength and its velocity?