CL15_Q1. Explain the term penetration depth?

Ans: It is the distance the particle penetrates in to the classically forbidden region (region of negative K.E) where the wave function drops to 1/e

Penetration is given by $\Delta x = \frac{1}{\alpha} = \frac{\hbar}{\sqrt{2m(V_o - E)}}$, Where V_0 is the depth of the potential and E is the energy state of the wave function.

The penetration depth increases as the energy of the particle increases.

CL15_Q2. A spherical dust particle of radius $10^{-5}m$ and density $10^4\ Kg/m^3$, moving at a speed of $10^{-2}m/s$ encounters a step potential of height equal to twice the K.E of the particle. Estimate the penetration depth of the particle inside the step.

Ans: Mass of the particle is $m = \frac{4}{3}\pi r^3 \rho = 4.2 \times 10^{-11}\ Kg$

K.E of the particle before impinging the barrier $E = \frac{1}{2}mv^2 = 2.1 \times 10^{-15}$ J

Given : $V_0 = 2K.E = 2 \times 2.1 \times 10^{-15}$J

$$\text{penetration depth} = \frac{\hbar}{\sqrt{2m(V_0 - E)}} = 2.5 \times 10^{-22}\ m$$