

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  $\Delta x = \frac{1}{\alpha} = \frac{\hbar}{\sqrt{2m(V_0 - E)}}$ , 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 :  $V_0 = 2K.E = 2 \times 2.1 \times 10^{-15} J$

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