PH 105 – Quantum Mechanics

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69)

In the region where ($V=V_0>0$)

$\psi(x) = Ae^{kx}$

$k=[2m(V_0-E)/\hbar^2]^{1/2}$

(a) $|\psi(0)|^2/|\psi(x_0)|^2 = 1/e$

$-2k\, x_0 = -1$

$x_0 = 1/2k = \hbar/[8m(V_0-E)]^{1/2}$

$\mathbf{x_0 = \hbar/[8m(V_0-E)]^{1/2}}$

(b)

$\Delta p.\ \Delta x \sim \hbar$

$\Delta p= \hbar/ \Delta x = [8m(V_0-E)]^{1/2}$

$\Delta E = \Delta p^2/2m = 4(V_0-E)$

$E' = E \pm \Delta E$

$\mathbf{E' = V_0 + 3(V_0-E) > V_0}$

Due to the uncertainty in energy, E may exceed V_0 . This explains why the particle is able to penetrate the potential barrier even though it is classically forbidden.