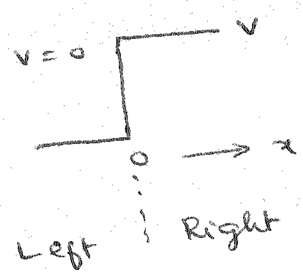
Tutorial Notes # 5   One dimensional barrier



Left $\psi^{(l)} = A_l e^{i k_l x} + B_l e^{-i k_l x}$

$k_l^2 = 2mE/\hbar^2$

Right $\psi^{(r)} = A_r e^{i k_r x}$

(We have arbitrarily kept $B_r = 0$, so that we can interpret $R = |B_l|^2 / |A_l|^2$ as a reflection coeft at the barrier.

(classically $R = 1$ if $E < V$ and $R = 0$ if $E > V$)

From continuity relations: $A_l + B_l = A_r$

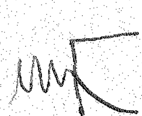
$k_l A_l - k_l B_l = k_r A_r$

$\therefore B_l = \dfrac{k_l - k_r}{k_l + k_r} A_l \qquad R = \dfrac{|k_l - k_r|^2}{|k_l + k_r|^2}$

If $E < V$ k_r is imaginary $\therefore R = 1$ (to see this put $k_r = i\zeta$ to get $R = \dfrac{(k_l - i\zeta)(k_l + i\zeta)}{(k_l + i\zeta)(k_l - i\zeta)}$

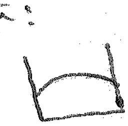
$\therefore R = 1$ when $E < V$ as for a classical case. But $R < 1$ (not zero) when $E > V$ - ie, every barrier reflects!

Within the barrier $\psi^{(r)} = A_r e^{-\zeta x}$ an exponentially decaying function:



Compare with:

Finite potential well



Infinite potential well