

1. Consider a step of potential defined as

$$V(x) = \begin{cases} 0 & \text{if } x \leq 0 \\ V_0 & \text{if } x > 0 \end{cases}$$

Calculate the reflection coefficient, R , for $E < V_0$ and for $E > V_0$. Given that $R = \frac{|B|^2}{|A|^2}$, where A and B are amplitudes of the incident and reflected waves, respectively.

2. A particular mass m and kinetic energy E approaches an abrupt potential step given as

$$V(x) = \begin{cases} 0 & \text{if } x \leq 0 \\ -V_0 & \text{if } x > 0 \end{cases}$$

What is the probability that it will reflect back, if $E = \frac{V_0}{3}$.

3. Electrons with energies of 0.400 eV are incident on a barrier 3.00 eV high and 0.1 nm wide. Find the approximate probability for these electrons to penetrate the barrier.
 4. Compute $\langle x \rangle$, $\langle x^2 \rangle$, $\langle p \rangle$, $\langle p^2 \rangle$ for the states ψ_0 and ψ_1 of a harmonic oscillator and check the uncertainty principle for these states.
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