

HW4 Due, at start of class Oct. 6/2010

Note Title

1. Consider the step potential

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

For a free particle fired from left with $E < V_0$

(a) Solve the time independent Schrödinger Eq. as we did in class, and sketch

$|\Psi(x,t)|^2$ as a function of x .

(b) Express R and T as a function of E .

(c) What values does $\frac{|\Psi(x=0,t)|^2}{|A|^2}$

approach for $\frac{E}{V_0} \ll 1$

and for $\frac{E}{V_0} \approx 1$, respectively?

Here, "A" represents the amplitude of the incoming wave.

2. Now consider

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

A free particle is again fired from left with $E > V_0$

Do (a) and (b) of Prob. 1 for this problem as well

3. Griffiths, Prob. 2.26.

4. Griffiths, Prob. 2.37.

5. A free particle has the initial wave function

$$\Psi(x,0) = \begin{cases} \frac{1}{\sqrt{2a}}, & \text{if } -a < x < a \\ 0, & \text{otherwise} \end{cases}$$

(a) Rewrite this function using $\Theta(x-a)$ and $\Theta(x+a)$

(b) Using $\frac{d\Theta(x)}{dx} = \delta(x)$ and $\int_{-\infty}^{\infty} \delta'(x) f(x) dx = -f'(0)$ find the expectation values

$\langle p \rangle$ and $\langle p^2 \rangle$ at $t=0$

(c) Find the expectation values $\langle x \rangle$ and $\langle x^2 \rangle$ at $t=0$

(d) Check the uncertainty principle