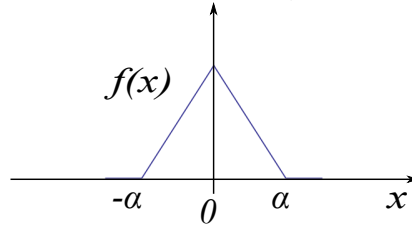


PHYS4702 Atomic, Nuclear, & Particle Physics Fall 2015 HW #3

Due at the start of class on Thursday 10 Sept 2015

(1) Consider a triangular function $f(x)$ that forms a straight line from the point at $x = 0$ to the x -axis at both $x = \pm\alpha$ and is zero otherwise, that is



What might you call the “width” Δx of $f(x)$? Now determine the Fourier Transform $a(k)$ of $f(x)$, and recommend a value Δk for the width of $a(k)$. Show that the product $\Delta x \Delta k$ is consistent with the Uncertainty Principle from quantum mechanics.

(2) A particle with mass m moves under the influence of an attractive δ -function potential energy $V(x) = -aV_0\delta(x)$ where a and V_0 are both positive constants and a has dimensions of length. Find the wave function and binding energy of the ground state.

(3) Consider a particle of mass m subject to a one-dimensional potential of the form

$$V = \begin{cases} \frac{1}{2}m\omega^2x^2 & \text{for } x > 0 \\ \infty & \text{for } x < 0. \end{cases}$$

Find the energy eigenvalues and wave functions for the ground state and the first two excited states.