Homework Assignment #10

Chapter 4 The Wavelike Properties of Electromagnetic Radiation
Chapter 5 The Schrödinger Equation

Modern Physics (3rd Edition) by Kenneth Krane

Due Date: Tuesday, April 4, 2017

In these problems, when the problem asks for mass, energy, and momentum, please write your answers in units of:

Mass $\rightarrow MeV/c^2$ not kilograms !!

Momentum $\rightarrow MeV/c$ not kilograms·meters/sec !!

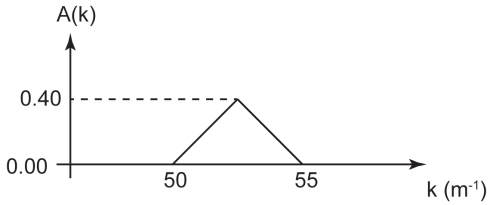
Energy $\rightarrow MeV$ not joules !!

unless otherwise specified.

When you are asked for velocities, always quote your answers in units of "c," the speed of light.

velocity = $\boldsymbol{\beta\, c}$

1. A particle is described by a distribution of wave numbers k as shown in the following diagram:



   a. Use equation 4.23 to determine the wavefunction $y(x)$ resulting from this distribution of wave numbers.

   b. Assume that the wavefunction describing this particle can be written as:

$$\psi(x) = A\, y(x)$$

   where A is the normalization constant for this wavefunction.

   Calculate the normalization for this wavefunction. $A =$ _____

   c. Using the normalization found in part (b), plot the probability density $\psi^*(x)\, \psi(x)$ in the range $\{-5 \leq x \leq 5\}$.

   d. What is the probability of finding the particle in the range $\{1 \leq x \leq 2\}$?

2. An electron is trapped in an infinitely deep potential well 0.20 nm wide. The electron makes a transition from the $n = 3$ state to the $n = 2$ state emitting a single photon. What is the wavelength of this photon?

$\lambda =$ _____ nm