Physics 214 Fall 98—Problem Set 12—[Total Points: 9] Due Before 9:00 am November 19 1998
Handout November 10 1998

Homework [4 Points]

1. Reading Assignments from Serway

   Week Beginning November 10: 41.8 - 41.10; 42.0 - 42.6
   Week Beginning November 17: 42.6 - 42.8; 43.3, 43.5

2. Serway, Chapter 41, pg 1248, Problem 44

   Hint:
   \[ \psi(x) = \begin{cases} \ A e^{ik_1 x} + B e^{-ik_1 x} & \text{Region 1} \\ \ C e^{ik_2 x} & \text{Region 2} \end{cases} \]

   and the reflection coefficient R is given by \( R = \frac{n^2}{A^2} \).

3. Serway, Chapter 41, pg 1250, Problem 67

4. Alpha Decay

   Read about Alpha Decay in Serway, Chapter 45, Section 6 - Decay Processes, pgs 1363 - 1336. If we model the potential energy curve of Figure 45.16 as that of a barrier of height \( U = 30 \text{ MeV} \) and width \( L = 10^{-12} \text{ m} \) determine the transmission coefficient for alpha particles of energy \( E = 5 \text{ MeV} \) and mass \( m = 6 \times 10^{-27} \text{ kg} \).

5. Spinless Fermions

   Consider six noninteracting spinless fermions of mass \( m \) in a one-dimensional box of length \( L \).
   
   a) Draw an energy level diagram for the
      
      \( \bullet \) Ground State Energy
      \( \bullet \) First Excited State Energy

   b) What is the Ground State and First Excited State Energy in terms of the parameters \( m, L \) and \( h \)?

6. Bosons

   Consider six noninteracting bosons of mass \( m \) in a one-dimensional box of length \( L \).
   
   a) Draw an energy level diagram for the
      
      \( \bullet \) Ground State Energy
      \( \bullet \) First Excited State Energy

   b) What is the Ground State and First Excited State Energy in terms of the parameters \( m, L \) and \( h \)?

7. Fermions – Spin \( \frac{1}{2} \)

   Consider six noninteracting fermions of mass \( m \) and spin \( \frac{1}{2} \) in a one-dimensional box of length \( L \).
   
   a) Draw an energy level diagram for the
      
      \( \bullet \) Ground State Energy
      \( \bullet \) First Excited State Energy

   b) What is the Ground State and First Excited State Energy in terms of the parameters \( m, L \) and \( h \)?

Five non-interacting fermions of mass $m$ and spin $\frac{3}{2}$ are confined in a one-dimensional box of length $L$ with infinitely high walls. The total energy of the ground state of this system is

(A) $\frac{h^2}{8mL^2}$
(B) $\frac{5h^2}{8mL^2}$
(C) $\frac{3h^2}{16mL^2}$
(D) $\frac{h^2}{mL^2}$
(E) $\frac{h^2}{2mL^2}$

**Computing** [5 Points]

1. Schröd Gr

The following sections from the lab manual for *schrdgr* needs to be completed and handed in:

- Section S2: Square Shelf
- Section S3: The Hydrogen Atom

Before starting please read the Introduction and Introduction to the Simulation sections.