Quantum Mechanics Fall 2003- Homework Set 7

Wave Mechanics

Due 5:00pm Monday November 10, 2003 in physics office or under my door.

2.22 Gaussian Wave Packet (Parts(a), (b), and (c) only.)

2.28 Finite Square Well

2.32 Reflection from finite boundary

2.33 Reflection from step, Part (a) and (b).

5.4

Problem A1 A particle begins to behave quantum mechanically when its de Broglie wavelength is of the same order as the size of the object with which the particle interacts. A good test is when the de Broglie wavelength is the same order as the size of the object. What mass does a spit ball with the density of water ($1000 kg/m^3$) moving at $10m/s$ become quantum mechanical? How many atoms is this?

Problem A2 If this room is $5m$ cubed and your mass is $50kg$, what is your minimum energy? If all this energy is kinetic, what is your minimum speed?

Problem A3 What are your odds of jumping to the moon? Assume you have mass 75kg and can jump at 10m/s. Treat the earth's gravity as a square barrier such that the height of the barrier is your total gravitational potential energy and the width of the barrier is the distance it takes for earth's gravity to fall by a factor of 1/2. This may, hopefully, be a very small number.

Problem A4 (Altered from CT1.1) A beam of neutrons with energy $E = 1.3 \times 10^{-20}$J is incident on a linear array of molecules of unknown spacing ℓ. If the first diffraction maximum occurs at an angle of $\theta = 30°$, what is the spacing of the molecules.