

PHYSICS 633

Home Work Assignment # 1

03/27/2008

Due: Thursday, April 3, 2008

All problem numbers are from the text book by Griffiths.

• **Particle in a 1D box with a repulsive delta-function perturbation**
(If you don't remember the Dirac delta-function, see p. 70 of the textbook).

- 1) First order perturbation theory: Problem 6.1 (a),(b)
- 2) Second order perturbation theory: Problem 6.4 (a). (If you find it hard to sum the series explicitly in general, at the very least you should sum it for the simplest case of $n = 1$).

• **Perturbing the harmonic oscillator**

- 3) Linear perturbation: Problem 6.5 (a),(b). For part (a) you need to use the result of Problem 3.33; please include the solution as part of your homework.
- 4) Quadratic perturbation: Problem 6.2 (a),(b) and Problem 6.4 (b). Hint: Use a and a^\dagger to evaluate the matrix elements needed for part 6.2(b) and 6.4(b). [An alternate method for 6.2(b) is to use the virial theorem of Problem 3.31, but if you use this approach, please derive the required results of that Problem.]

Cubic Perturbation: This anharmonic problem is *not* exactly solvable, unlike the two problems above. Its perturbation theory was developed in class; please review your class notes after completing the above problems.

• **Degenerate perturbation theory**

- 5) Problem 6.7 (a),(b),(c),(d)

In part (b) you need to evaluate a "Gaussian integral": see Problem 2.22 (b). Such integrals are used extensively in many areas of physics like statistical mechanics and quantum field theory, so its a good idea to master them.