

PHYSICS 633

Home Work Assignment # 5

04/25/2008

Due: Friday, May 2, 2008

All problem numbers are from the text book by Griffiths.

• **The WKB Approximation**

- 1) Finding bound states: Problem 8.1
- 2) Quantum tunneling of a macroscopic object: Problem 8.17

• **Time dependent phenomena**

3) Consider a particle in a double well potential (such as the ammonia molecule) whose low-energy properties can be described by a two-state system. In the basis of states describing the particle in the right ($|\psi_R\rangle$) and left ($|\psi_L\rangle$) wells, the Hamiltonian is

$$\begin{pmatrix} \epsilon_0 & -\Delta \\ -\Delta & \epsilon_0 \end{pmatrix}.$$

If the particle starts off in the right well at time $t = 0$, calculate and plot the probability of finding the particle in the left well as a function of time.

• **Time dependent perturbation theory**

4) Consider a one-dimensional harmonic oscillator in its (unperturbed) ground state at $t = -\infty$. Let a perturbation

$$H'(t) = -e\mathcal{E} X e^{-t^2/\tau^2}$$

be applied between $t = -\infty$ and $t = +\infty$. What is probability that the oscillator is in state $|n\rangle$ at time $t = +\infty$ for all n ?