

Physics 505 - Autumn 2005

HW V

Due 11/2/05

NOTE: The MidTerm Exam is also Wednesday 11/2/05

Overview: Recall that solving physics problems is not (just) about solving differential equations. Use physical reasoning to help solve the following exercises and be certain to show your work. It is also important that you practice completely solving these exercises, checking for errors as you go along.

- 1) Fetter & Walecka – 3.7 Let's consider the pendulum problem but with a slight refinement. Again we want to consider the form of small oscillations around equilibrium. Take the length of the pendulum to be l with the mass m at the end.
- 2) Lets consider a different sort of problem where we start with the Lagrangian,

$$L = \frac{1}{2}m(\dot{x}^2 - \omega^2 x^2)e^{\gamma t},$$

describing the motion of a particle of mass m in one dimension (x). The constants m , γ and ω are real and positive.

- a) Find the equation of motion for the particle.
- b) You have seen this system before? What is it, and what kinds of forces act on the particle?
- c) Find the canonical momentum, and from this construct the Hamiltonian function.
- d) Is the Hamiltonian a constant of the motion? Is the energy conserved? Explain.
- e) For the initial conditions $x(0) = 0$ and $\dot{x}(0) = v_0$, what is $x(t)$ asymptotically as $t \rightarrow \infty$?

Since we are having the Midterm Exam on Wednesday and did not cover normal modes last week, the following exercise will be delayed until HW VI, which is due on 11/9/05.

3) Fetter & Walecka – 4.1 Here we expand our study of small oscillations to include the full normal mode formalism.