

Physics 505 - Autumn 2010

HW IV

Due 10/27/10

NOTE: The Midterm Exam is Friday 11/5/10

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. Again we have exercises similar to past Qual problems.

- 1) Fetter & Walecka – 3.6 (6 pts) Same idea as the last problem in HW III. Be certain to work out the details.
- 2) Fetter & Walecka – 3.17 (6 pts) This problem illustrates the usefulness of the method of Lagrange multipliers, *i.e.*, we can easily evaluate when the constraint force goes to zero.
- 3) Fetter & Walecka – 3.18 (7 pts) Similar to the previous problem, but with a bit more complexity. Be certain to answer all of the parts of the question.
- 4) (6 pts) 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 $t \rightarrow \infty$?