Physics 820 homework V, due Mon Sep 29

Reading: Chapter 3

Problems:

1. By considering the respective Lagrangian, determine the integrals of motion for a particle moving in a uniform field $V = -\vec{F} \cdot \vec{r}$.

2. Goldstein, Problem 2-21 (a) and (c). You do not need to consider the laboratory coordinates.

3. The addition to the potential energy $V = -k/r$ of a small correction $\delta V(r)$ makes the bounded orbits deviate from closed; after each turn, the perihelion shifts by a small angle $\delta\phi$. Find $\delta\phi$ for (a) $\delta V = \beta/r^2$ and (b) $\delta V = \gamma/r^3$.

4. Goldstein, Problem 3-12.

5. A problem from the Aug '02 subject exam: Discuss the 2-dimensional motion of a particle moving in an attractive central-force described by the force law $f(r) = -k/r^\alpha$, where k is positive and $3 > \alpha > 2$.
(a) Write down the equations of motion in polar coordinates;
(b) Show how conservation laws can be used to derive the formal equation for the orbit of motion;
(c) Describe the nature of the orbits for various possible initial energies and angular momenta. (Graphical methods can be very useful.)