PHY820 Homework Set 6

1. [10 pts] Goldstein, Problem 1.22.

2. [5 pts] Goldstein, Problem 3.14.

3. [10 pts] Goldstein, Problem 3-12. Refrain from following the book's advice of $m = +1$; for convergence, the potential must vanish faster with the distance.

4. [5 pts] 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) $\delta V = \gamma/r^3$.

5. [10 pts] An exam problem: 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.)

6. [5 pts] Goldstein, Problem 3.18. Use of the Runge-Lenz vector can be beneficial.