1. Problem Goldstein 9-31 (Goldstein, 2nd edition, Problem 9-29)

2. (a) Write down the Hamiltonian for a spherical pendulum in spherical coordinates \((r, \theta, \phi)\).
   
   (b) Evaluate explicitly the Poisson bracket
   \[
   [L_x, L_y], [L_y, L_z], [L_z, L_x]
   \]
   in terms of the spherical coordinates and verify directly the relation given by Eq. (9-128) in Goldstein.

3. A particle of mass \(m\) is subject to a one-dimensional potential
   \[V = -ax + \frac{1}{2}kx^2\]
   where \(a\) and \(k\) are positive constants.
   
   (a) Find the Hamiltonian and the equation of motion. Find the position \(x\) and the momentum \(p\) as functions of time \(t\) with initial conditions \(x_0 = 0\) and \(p_0 = mv_0\).
   
   (b) Find \(x\) and \(p\) by using the Poisson bracket form of the equation of motion with the same initial conditions given in a).

4. A particle of mass \(m\) is subject to a one-dimensional potential
   \[V = \alpha x\dot{x} - kx\]
   where \(\alpha\) and \(k\) are both positive constants.
   
   (a) Find \(x\) and \(p\) as functions of time \(t\), by using the formal solution to the equation of motion in terms of the Poisson brackets. Assume initially at a time \(t = 0\), \(x = x_0\) and \(\dot{x} = \dot{x}_0\). Find the value of \(p\) at \(t = 0\) in terms of \(m, \alpha, x_0,\) and \(\dot{x}_0\).
   
   (b) Solve this problem by using the Hamilton-Jacobi equation and compare your results with the solutions from part a).

5. Problem Goldstein 10-5 (Goldstein, 2nd edition, Problem 10-5)

6. Problem Goldstein 10-8 (Goldstein, 2nd edition, Problem 10-8)