Classical Mechanics - Problem Set 7

Problem 1)

Solve Problem 1.(a) on page 362 in Goldstein (skip part b).

Problem 2)

Reconsider the system from Problem 3 in Problem Set 2 (two masses moving under their mutual gravitational attraction in an external gravitational field). Write down the Hamiltonian of the system. Is energy conserved? Write out Hamilton's equations of motion (all 12). Find the solutions for all Cartesian CoM coordinates (X,Y,Z) and their conjugate momenta.

Problem 3)

A constant magnetic field $\vec{B}(\vec{r},t) = B_0\hat{k}$ pointing in the z-direction can be described (using cartesian coordinates) with a magnetic vector potential $\vec{A}(x,y,z) = xB_0\hat{y}$. Set up the Lagrangian for a particle of charge q moving in this magnetic field. Derive the generalized momenta and write down the Hamiltonian for this problem. Write down Hamilton's equations of motion. Is the Hamiltonian equal to the energy? Is it conserved? What other quantities are conserved? Describe the resulting motion qualitatively.