1 A particle of mass m movers in plane under the influence of a central force $\vec{F}(\rho) = -\vec{\nabla}V(\rho)$, where V is a scalar function and (ρ, φ) are polar coordinates.

a (2 points) Compute the angular momentum of the particle with respect to the center of the coordinate system in polar coordinates.

b (3 points) Use Euler-Lagrange equations to obtain a differential equation for $\rho(t)$, show that its implicit solution can be given in the form $t = \int g(\rho)d\rho$ for some function g, and determine the expression for $g(\rho)$.

c (5 points) Use conservation of energy to determine $g(\rho)$.

2 (10 points) Do Exercise 2.1.3 on Page 83 of Shankar's book.

3 (10 points) Do Exercise 2.3.1 on Page 86 of Shankar's book.

4 (10 points) Do Exercise 2.5.2 on Page 90 of Shankar's book.

5 (10 points) Do Exercise 2.5.4 on Page 90 of Shankar's book.

6 (10 points) Do Exercise 2.7.2 on Page 92 of Shankar's book.

7 (10 points) Do Exercise 2.7.5 on Page 95 of Shankar's book.

8 (10 points) Do Exercise 2.7.6 on Page 97 of Shankar's book.

9 (10 points) Do Exercise 2.7.9 on Page 97 of Shankar's book.

10 (10 points) Show that the Poisson bracket satisfies the Jacobi identity and the Leibnitz rule.