A small mass m is tethered to the center of a smooth, horizontal surface via a spring of spring constant k. Assume the spring has zero length in its relaxed state (i.e., the force exerted by the spring on the mass is simply $F = -kr$, where r is the distance from the center). The mass can move around on the surface without any friction.

1. What are the proper generalized variables to describe the motion of the mass?

2. Write down the Hamiltonian for this system. Make sure you define all generalized momenta and coordinates.

3. Find the steady-state solution for Hamilton's equations of motion, i.e. the condition for $r = r_0 = const.$, using the Hamiltonian you found above.