PHY 6/75101 September 1998

Classical Mechanics — Homework II

Pass 1 for this homework is tentatively due Wednesday September 16, 1998.

A. Use Lagrange's eq. to obtain the equation of motion for a particle constrained to move (a) vertically and (b) horizontally near the surface of the earth, assuming a dissipation function bv^2, where b is a constant In each case, assume an initial velocity v_0 and integrate to find $v(t)$.

B. Consider a system of mass m with just one generalized coordinate q having a Lagrangian

$$L = e^{bt}(\tfrac{1}{2}m\dot{q}^2 - \tfrac{1}{2}kq^2)$$

where b and k are each positive constants. Find the equation of motion. What, if any, are the constants of the motion? Describe the possible motion of this system.

C. Consider a massless spring with spring constant k, fixed at one end, located in a gravitational field $\mathbf{g}$ with a mass m attached to the other end. This is normally called a *spring pendulum*. Let the equilibrium length of the spring without any mass attached be ℓ, and assume that the mass is constrained to move in a vertical plane. Write down the Lagrangian for this system and find the equations of motion. Indicate solutions in the limit of small displacements from equilibrium.

D. A bead of mass m is threaded on a circular hoop of radius R. The hoop rotates with angular velocity ω about a vertical axis through its diameter. Write down the Lagrangian and find the equations of motion. What is the maximum angular velocity that still allows the bead to maintain a stable equilibrium position?