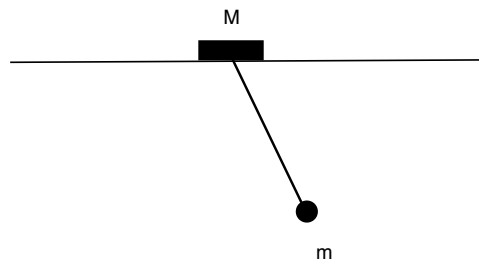


Physics 5300, Theoretical Mechanics Spring 2015

Midterm 1

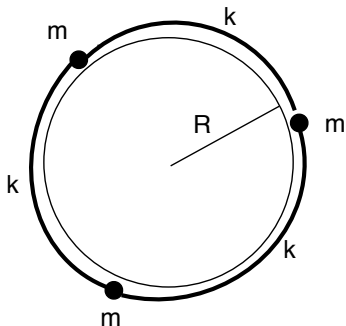
Given: Wed Feb 25

Problem 1 (20 points) A mass M can slide without friction on a horizontal surface in the x direction. A mass m is suspended from M by a massless rod of length L , and can swing freely in the vertical plane.



- (a) Find the Lagrangian. (10 points)
- (b) Is there a cyclic coordinate? If so find the corresponding conserved momentum. (5 points)
- (c) Find the Lagrange equations of motion (you do not have to solve these equations). (5 points)

Problem 2 (20 points) Three point masses, each of mass m , can slide on a circle of radius R . They are connected by springs of spring constant k . When the masses are evenly spaced around the circles, the springs are at their relaxed lengths.



(a) Use the angular positions $\theta_1, \theta_2, \theta_3$ as variables. Find the frequencies of small oscillations and the normal modes. (15 points)

(b) Suppose at $t = 0$ the displacements were (ϵ is a small number)

$$\theta_1 = \epsilon, \quad \theta_2 = 0, \quad \theta_3 = 0 \quad (1)$$

and $\dot{\theta}_1 = 0, \dot{\theta}_2 = 0, \dot{\theta}_3 = 0$. Find the evolution of the oscillations for later times. (5 points)