Set #6 - for Wednesday February 19

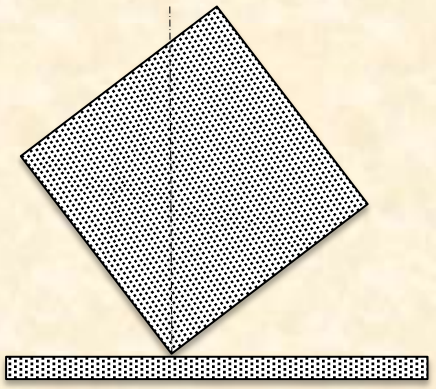
Read RHK Ch. 17
K&K Ch. 4: 4.7, 4.8; Ch. 5: 5.1 – 5.5

Solve

From RHK	**Ch. 12**	Problem 15	
	Ch. 17	Exercise 42	Problems 5, 22, 27
From K&K	**Ch. 6**	Problem 6.33, 6.35, Extra Credit: Use linear approximation to calculate the frequency of small oscillations in 6.35 about the stable equilibrium. Assume no slipping.)	

Problem 1. A homogeneous cube of mass M and edge length l is initially in a position of unstable equilibrium with one edge in contact with a horizontal plane. The cube is then given a small displacement and allowed to fall. Compute a formula for the angular velocity of the cube when one face strikes the plane under the following conditions:

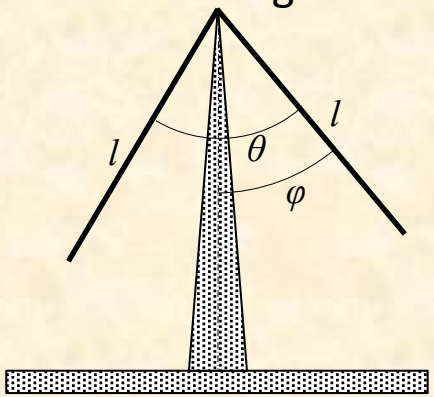
(a) The edge cannot slide on the table because of friction.
(b) Frictionless sliding occurs.
(c) Find the Lagrangian of this cube for parts (a) and (b) above and obtain the differential equation of motion in each case (*you need not solve them*).



Go to page 2

Set #6 - for Wednesday February 19

Problem 2. A uniform piece of wire is bent into a V-shape with angle θ between two legs of length l. The wire is placed over a pivot, as shown on the picture.

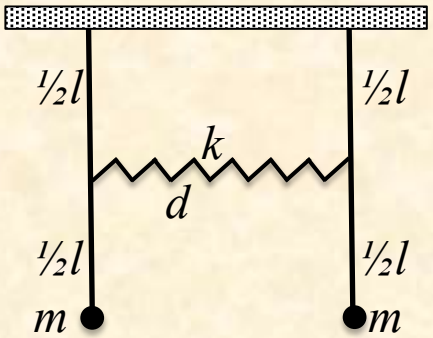


(a) Write a Lagrangian $L = T - U$ for this wire.

(b) Obtain the equation of motion (*2nd order differential equation*) to be satisfied by the instantaneous angle φ.

(c) Show that the angular frequency of small-amplitude oscillations about the equilibrium position is $\omega = \sqrt{\frac{3g\cos\frac{\theta}{2}}{2l}}$

Problem 3. Two pendulums with length l and and mass m are connected with a spring with the spring constant k. The spring is connected to the mid points of the pendulums. In equilibrium the pendulums are vertical and the spring has length d.

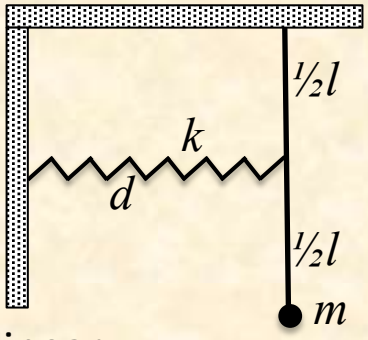


(a) Write a Lagrangian of the system in case if both pendulums move in the plane of the picture.

(b) Obtain the equation of motion in the linear approximation.

(c) Find normal frequencies of the system with g and in the case of zero gravity.

Problem 4. A pendulum with length l and mass m is connected to the wall with a spring. In equilibrium the spring has length d and it is horizontal. The pendulum is vertical in equilibrium . Pendulum can move only in the direction perpendicular to the picture



(a) Find the frequency of small oscillations of the pendulum.

(b) Show that without gravity even small oscillations of the system are not linear.

Good Luck, Dr. B