Exercise 9 - TFY4345 Classical Mechanics

2020

1 Coupled pendula

(FIGUR)
Consider the system of two pendula of length b, with masses m and coupled by a spring with spring constant k. The spring is unstretched in the equilibrium position $\theta_1 = \theta_2 = 0$. Start by writing down the kinetic and potential energy of the system in generalized coordinates. Determine the eigenfrequencies and describe the normal mode motion of the system. Assume small oscillations.

2 Two coupled oscillators

(FIGUR)
Evaluate the eigenfrequencies of the system of two masses m, attached to each other by and a fixed point A by two springs with spring constant k as shown in the figure. Determine the associated eigenfrequencies, and describe the vibrational modes qualitatively. Assume the masses glide without friction.

3 Oscillating body with two attached pendula

(FIGUR)
Consider a block of mass M, attached by two springs of equal spring constants k on opposite sides to a wall. The mass has two pendula of mass m and length ℓ attached to the underside. Assume small oscillations, and evaluate the eigenfrequencies of the system. You will need three generalized coordinates.

4 Double pendulum

(FIGUR)
Consider a double pendulum with equal masses m and of equal lengths ℓ. Assume small oscillation, and determine the eigenfrequencies and eigenvectors based on the theory of couple oscillations.