KLUB NAUKOWY FENIX

Problems 9

20 November, 2020

Physics problems

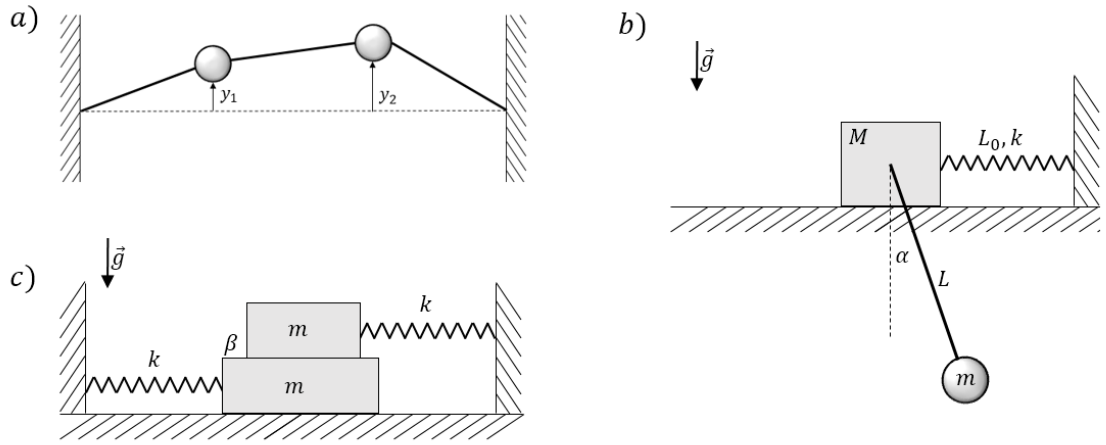

Figure 1

1. Two equal masses m move on a frictionless horizontal table. They are held by three identical taut strings (each of length L and tension T), as shown in Figure 1a, so that their equilibrium position is a straight line between the anchors. The two masses move in the transverse (y) direction, but not in the longitudinal (x) direction. Write down the equations of motion for the two masses, assuming small displacements from the equilibrium find the normal modes of vibrations for the system [1].

2. A simple pendulum (mass m and length L) is suspended from a cart (mass M) that can oscillate on the end of a spring of force constant k, as shown in Figure 1b. Assuming that the angle α remains small, write down the equations of motion for x and α. Assuming that $M = m = 1\,\mathrm{kg}$, $L = 1\,\mathrm{m}$, $g = 9.81\,\mathrm{m/s^2}$ and $k = 2\,\mathrm{N/m}$ find the normal frequencies, and for each normal frequency find and describe the motion of the corresponding normal mode [1].

3. The two carts in Figure 1c have equal masses m (though different shapes). They are joined by identical but separate springs (force constant k) to separate walls. Cart 2 rides on cart 1, as shown, and cart 1 is covered with molasses, whose viscous drag supplies the coupling between the carts. Assuming that the drag force has magnitude βmv where v is the relative velocity of the two carts, write down the equations of motion of the two carts using as coordinates x_1 and x_2, the displacements of the carts from their equilibrium positions. Solve the equations. Describe the corresponding motions. Explain why one of these modes is damped but the other is not [1].

Reference

[1] J.R.Taylor "Classical Mechanics" USB 2005, ISBN: 1-891389-22-X