Einführung in die Physik I: Mechanik und Thermodynamik
Universität Basel
Herbstsemester 2022
Due to Friday 18.11.2022, 1 pm

Exercise Sheet 7

Remember to specify your name, the number of your group and the name of the assistants in your group on the sheet that you hand in.

Question 1 (4 points)

A body moves upward along an inclined plane (starting from the lowest point) with a velocity $v_1 = 5$ m/s. The angle that the inclined plane forms with the horizontal is $\alpha = 60°$. After reaching the maximum height on the inclined plane, the body turns back, following the same path, and reaches the starting point with speed $v_2 = 4$ m/s.
Calculate the dynamic friction coefficient relative to the contact between the body and the inclined plane.

Question 2 (3 points)

A box characterized by a weight force of 50N lies on a horizontal floor. The coefficient of static friction between the box and the floor is 0.5. A 20 N force is applied to the box acting to the right.
What is the resulting static friction force acting on the box? Is the applied force big enough to induce an acceleration to the box?

Question 3 (3 points)

A body of mass $m = 0.2$ kg is attached to two springs of elastic constants $k_1 = 3$ N/m and $k_2 = 5$ N/m respectively (Figure 1). The body can move on a frictionless horizontal plane under the action of the two springs. The equilibrium position is achieved with the two springs at their respective rest conditions. Calculate the period of oscillation.

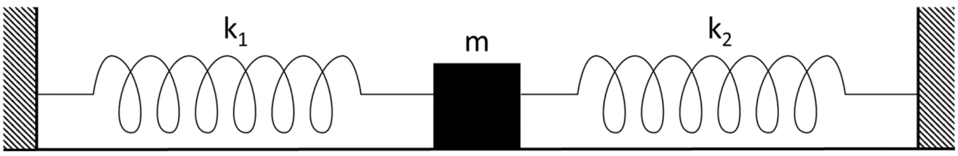

Figure 1: Schematic of question 3.

Problem 1 (10 points)

In the device shown in Figure 2, the mass M = 1 kg rests on a horizontal plane. The coefficient of static friction relative to the contact between the body and the plane is $\mu_s = 0.5$. An inextensible wire of negligible mass, connects the mass M to the mass m = 0.3 kg, suspended in vacuum. The pulley C rotates without friction and has negligible mass. Calculate the maximum value of the angle θ_0 between the mass m and the vertical axis, that does not produce the displacement of mass M.
Hint: Notice that the tension in the wire cannot be neglected.

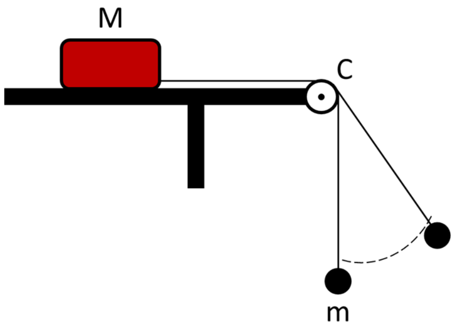

Figure 2: Schematic of problem 1.

Problem 2 (10 points)

A person pushes a 14 kg lawn mower at constant speed with a force F = 88 N directed along the handle, which is at an angle of 45° to the horizontal (Figure 3).

(a) Draw a diagram showing all the relevant forces acting on the mower.

(b) Calculate the horizontal friction force on the mower.

(c) Evaluate the normal force exerted vertically upward on the mower by the ground.

(d) What force must the person exert on the lawn mower to accelerate it from rest to 1.5 m/s in 2.5 s, assuming the same friction force?

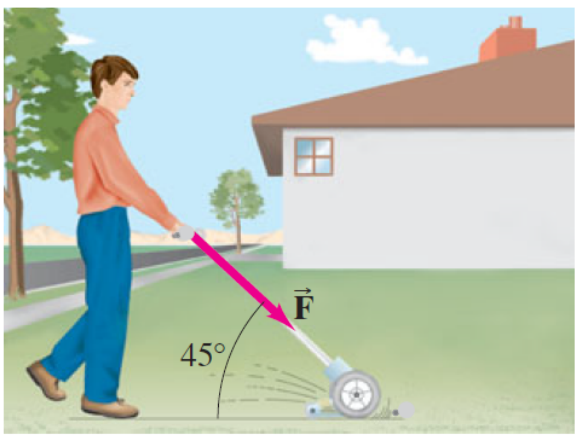

Figure 3: Schematic of problem 2.