Einführung in die Physik I: Mechanik und Thermodynamik
Universität Basel
Herbstsemester 2022
Due to Friday 11.11.2022, 1 pm

Exercise Sheet 6

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 having mass m = 1 kg is subjected at the same time to the action of an elastic force characterized by elastic constant k = 40 N/m and of a frictional force due to the medium, F = -bv, with b = 2 kg/s. The initial amplitude of the oscillation is $A_0 = 20$ cm. Evaluate the amplitude of the oscillations A after 3 periods.

Question 2 (3 points)

A 25 kg object is being lifted by two people pulling on the ends of a 1.15 mm diameter nylon cord (UTS = 500 x 10^6 N/m^2) that goes over two 3 m high poles placed at a distance of 4 m from each other, as shown in Figure 1.
How high above the floor will the object be when the cord breaks?

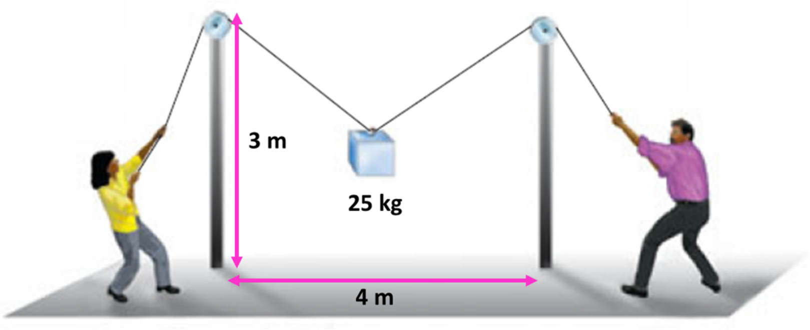

Figure 1: Schematic of question 2.

Question 3 (3 points)

Two springs of spring constants and rest lengths of $k_1 = 10$ N/m, $k_2 = 20$ N/m, $l_1 = 10$ cm and $l_2 = 20$ cm respectively are connected in series, as shown in Figure 2. A pulling force is applied at point A in a direction parallel to the springs. Due to this force, the total length of the two-spring system becomes L = 40 cm. Calculate the length of each spring in the deformation situation produced by the force F.

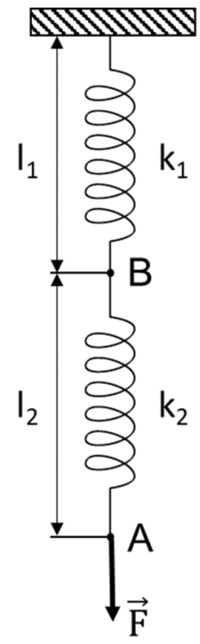

Figure 2: Schematic of question 3.

Problem 1 (10 points)

A point mass of mass m is released from the top of a frictionless cylindrical surface of radius R (Figure 3). The rotation axis of the mass is parallel to the floor.

(a) Find the expression for the normal reaction N, when the angle α in the figure is smaller than the angle at which the detachment of the mass from the cylinder occurs.

(b) Calculate the angle α at which the mass detaches from the cylinder.
Hint: the detachment of the mass occurs when $N = 0$.

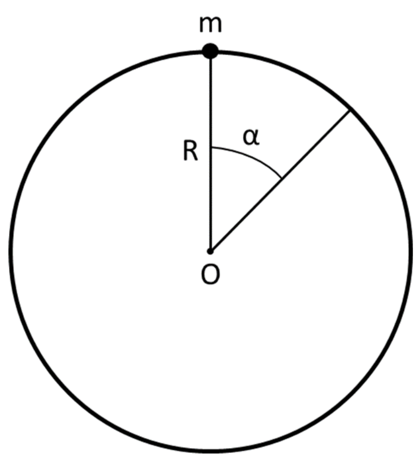

Figure 3: Schematic of problem 1.

Problem 2 (10 points)

A 7180 kg helicopter accelerates upward at 0.80 m/s^2 while lifting a 1080 kg frame through a metallic cable (Figure 4).

(a) What is the lift force exerted by the air on the helicopter rotors?

(b) What is the tension in the cable (ignore its mass) which connects the frame to the helicopter?

(c) What force does the cable exert on the helicopter?

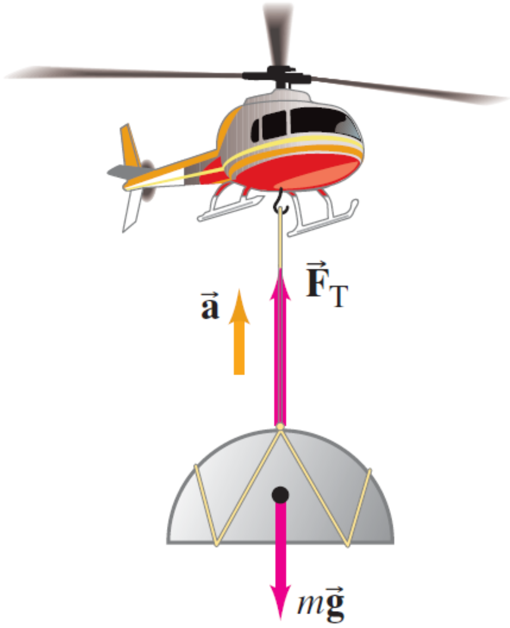

Figure 4: Schematic of problem 2.