INSA | INSTITUT NATIONAL DES SCIENCES APPLIQUÉES LYON

SCAN 1st

Mechanics test 2

Friday, 12th April 2019 – Duration: 1h30

Lecture Notes (booklet) authorised.

Exercise 1:

The homogeneous 15 m bar in Figure 1 is supported by a vertical cable (tension T) and by the contacts at A and B (frictionless). The mass of the bar is 150 kg.

Find the reaction forces at A and B. Find the tension in the cable

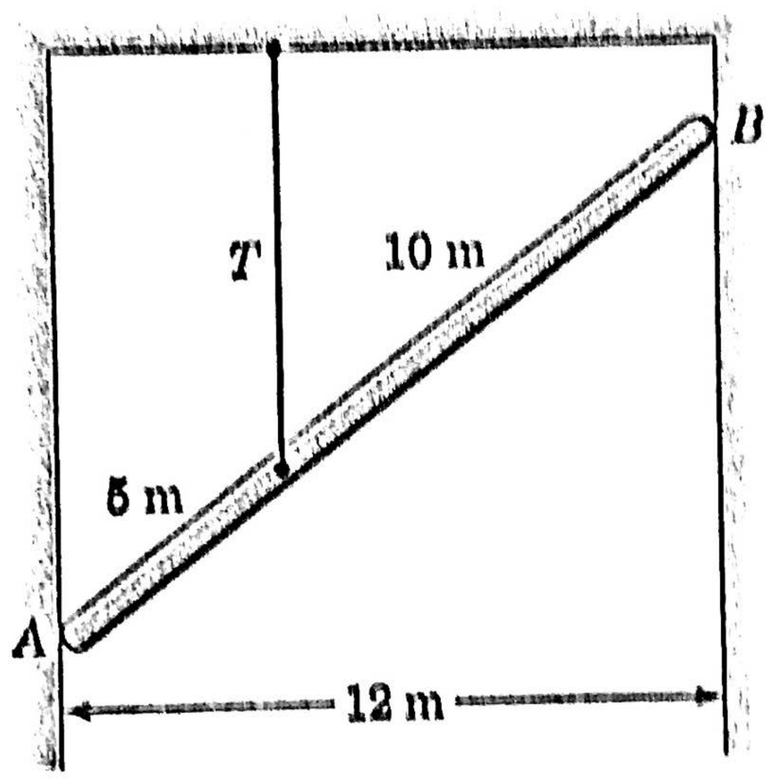


Figure 1.

Exercise 2:

The 1.2 kg slider shown in Figure 2 is released from rest at point A and slides without friction along the guide.

1 – Determine the speed of the slider as it passes position B

2 – Calculate the maximum deflection of the spring

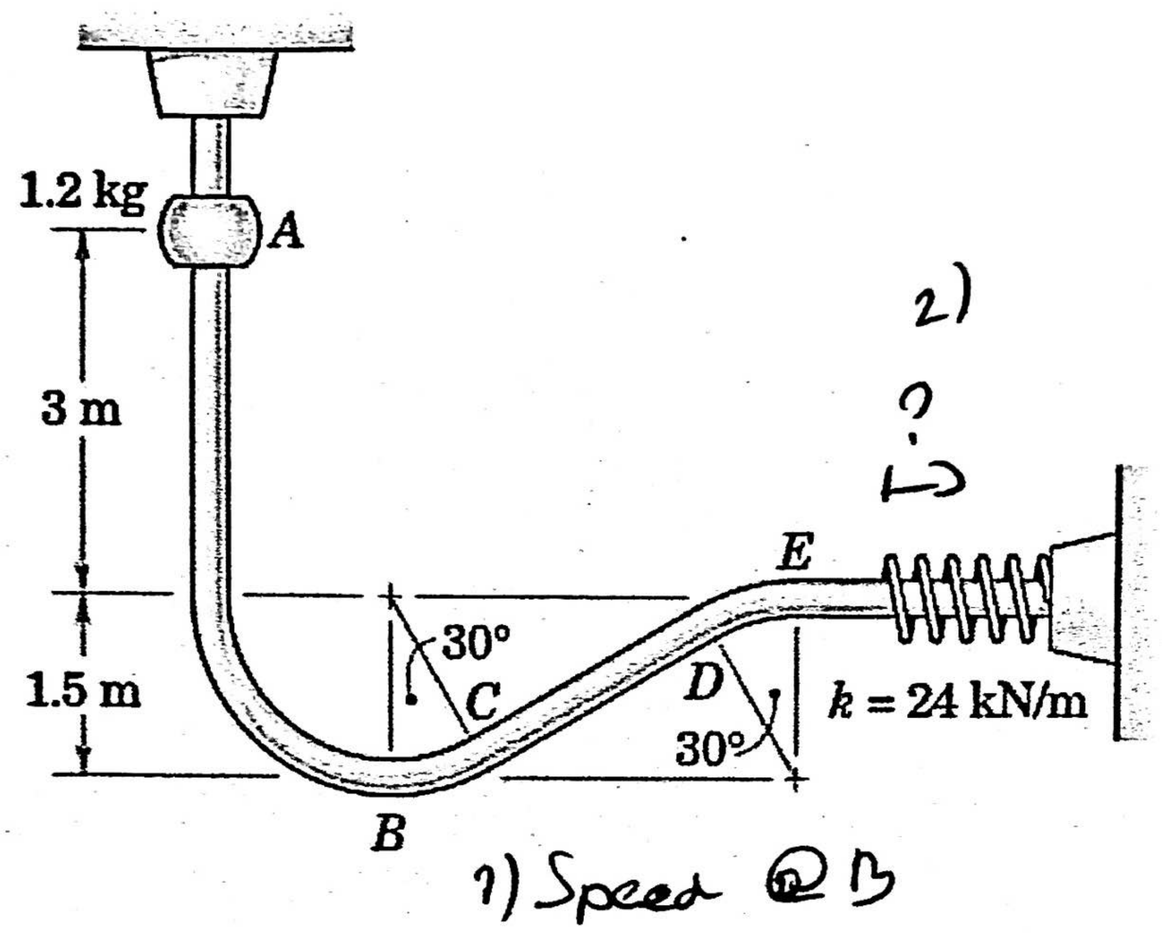


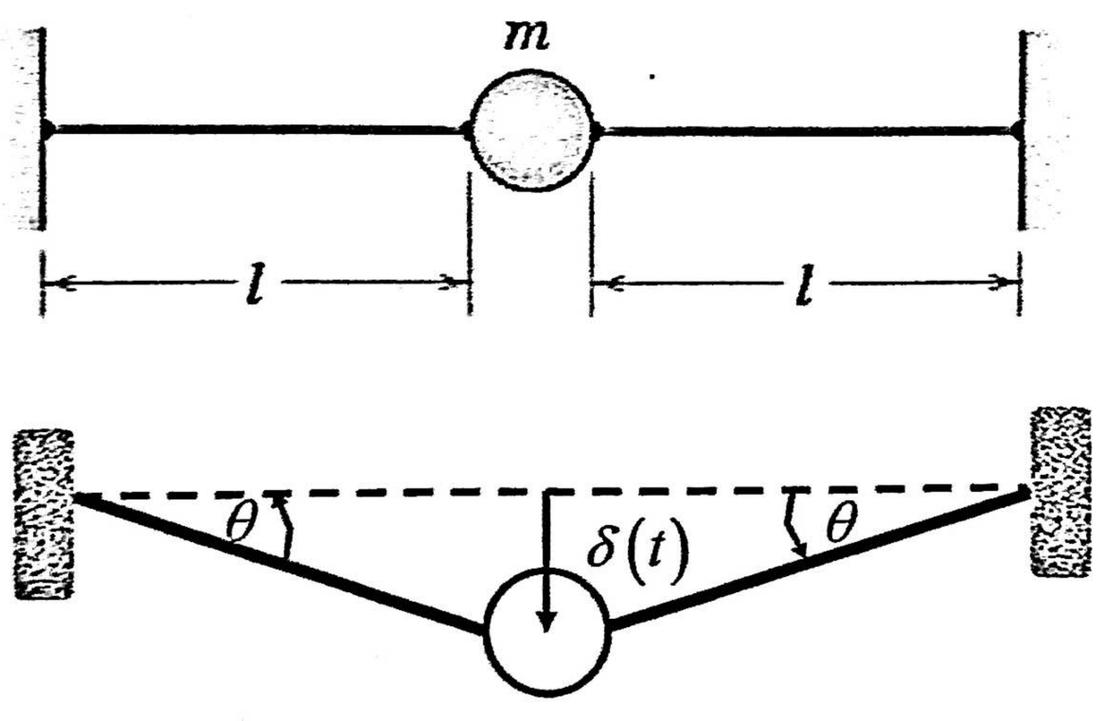
Figure 2.

Exercise 3:

A small particle of mass m is attached to two highly tensioned wires as shown in Figure 3. The particle is displaced slightly in the vertical direction and released so that its vertical small displacement is $\delta(t)$ ($\delta(t) \ll \ell$). There is no horizontal displacement.

1 – Explain why the tension in both wires is the same at all times.

2 – Assuming that: a) the tension in both wires T is constant and, b) that the weight of the particle can be neglected compared with the tension intensity, determine the natural frequency ω_n of the system.



Exercise 4:

A cylinder of mass m rests in a supporting carriage on an incline as shown in Figure 4. Friction is neglected.

1 – Introduce unit vectors along all the privileged directions and draw the corresponding change of basis diagrams.

2 – Draw the free-body diagram for the cylinder and list all the external forces acting on it as vectors.

3 – Using Newton's second law, find the maximum acceleration which, the carriage may be given up the incline so that the cylinder does not lose contact at point B. Express the result in terms of g (acceleration of the gravity field) and angle θ .

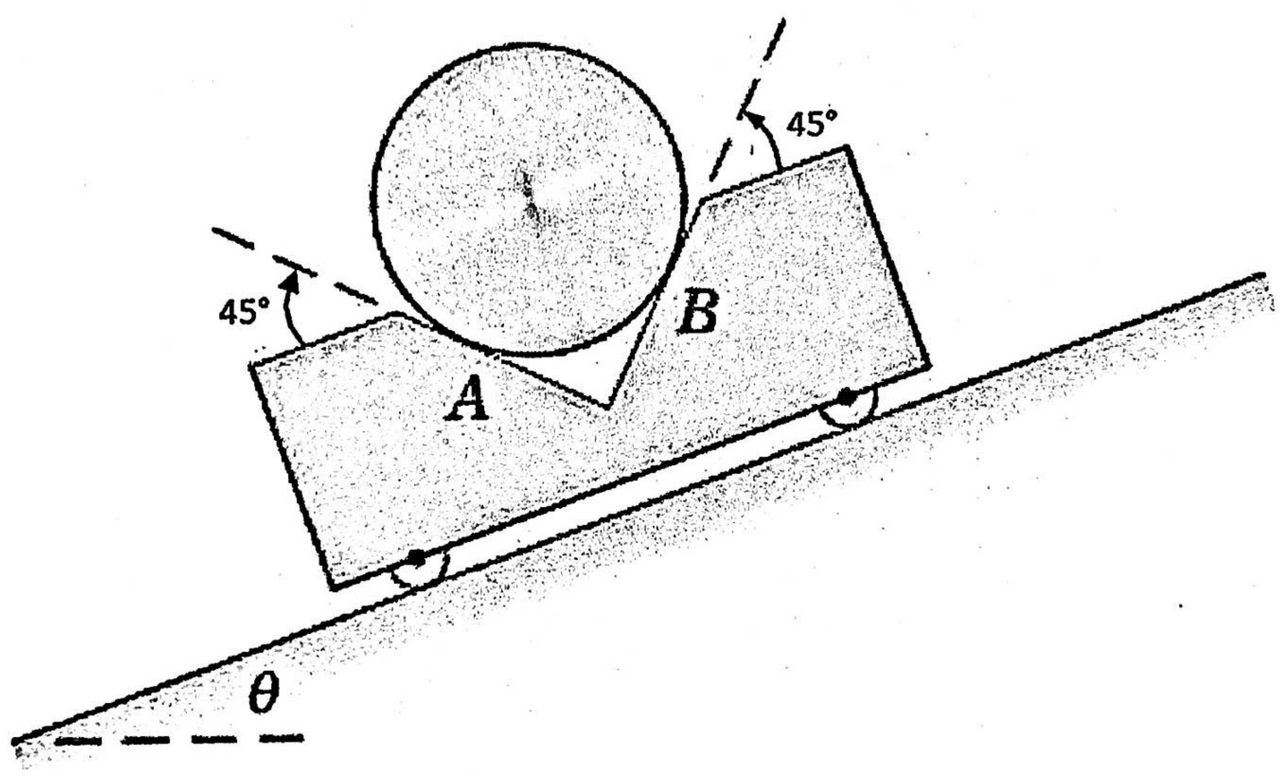


Figure 4.