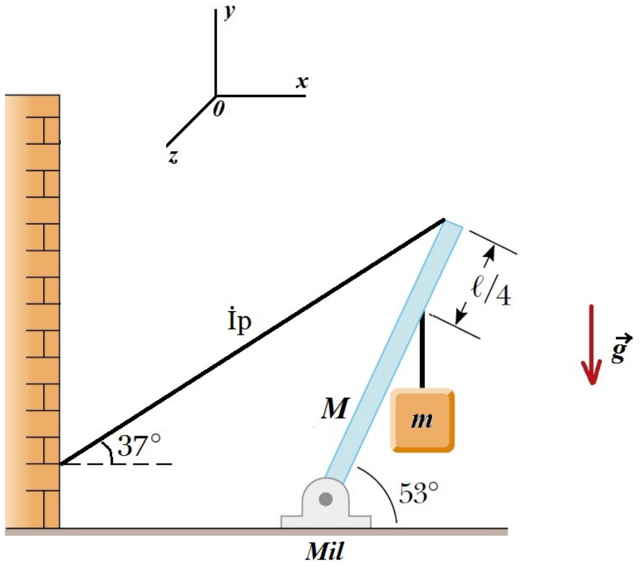
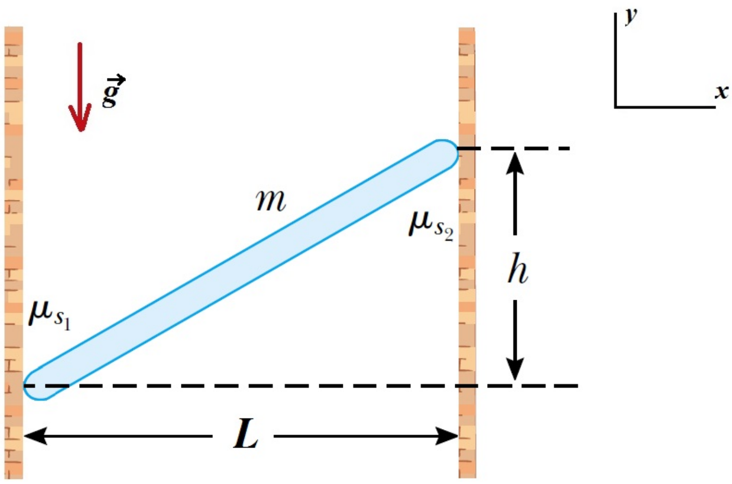
RECITATION 7

1)



A uniform beam of mass $M = 20\,kg$ and length l is supported by a cable as shown in figure. The beam is pivoted at the bottom, and a box of mass $m = 80\,kg$ hangs from it. Draw a free-body diagram and find the tension in the cable.

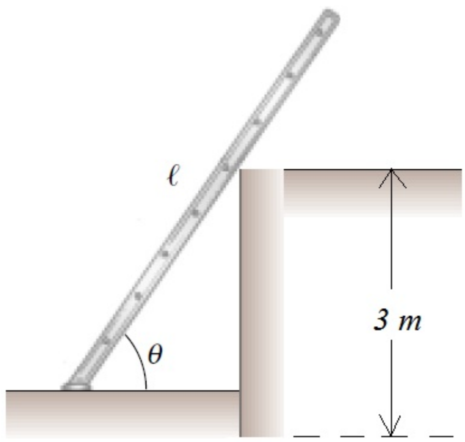
2)



A thin uniform rod of mass $m = 0.6\,kg$ is balanced between two vertical walls that are separated by a distance $L = 0.9\,m$. The static coefficients of friction between the rod and the left wall, and the right wall, are $\mu_{s_1} = 1.2$ and $\mu_{s_2} = 0.8$, respectively. Assume that the friction forces are both at a maximum and the rod is just to slide down.

- **a)** Find the magnitudes of the horizontal and vertical components of the forces exerted by each wall on the rod.
- **b)** Find the vertical distance h between the support points.

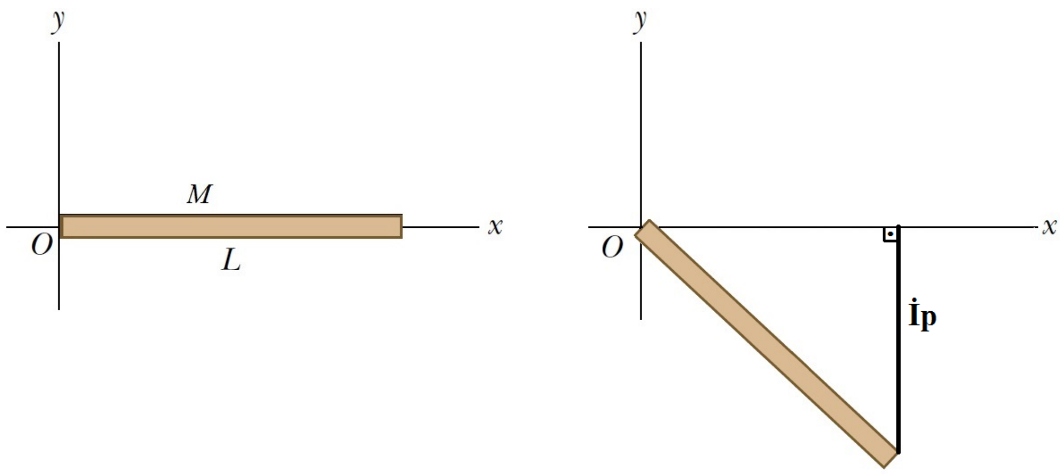
3) A uniform beam of weight 445 N and length 6 m is leaned on a frictionless wall of height 3 m as shown in figure. The beam is balanced at $\theta \geq 70°$ and starts to slip at $\theta < 70°$.



a) Find the normal forces that the horizontal floor and the wall exert on the beam.

b) Find the coefficient of static friction between the beam and the horizontal floor.

4)

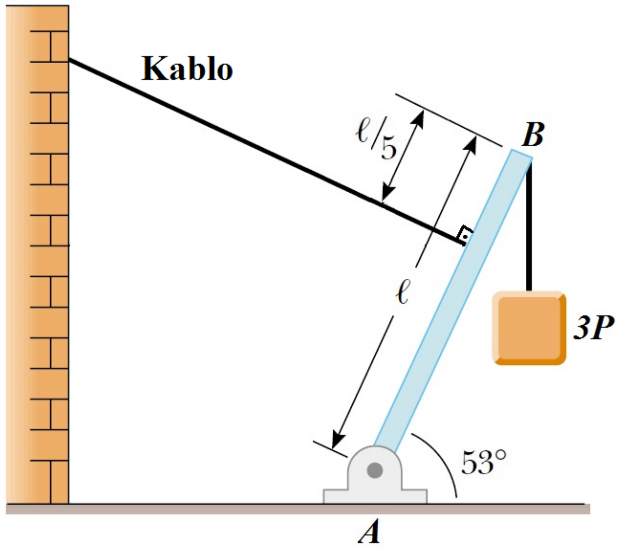


(a) **(b)**

A thin uniform rod of mass M and length L in figure (a) is balanced by a rope as shown in figure (b). The rod is free to rotate about a frictionless axle perpendicular to the figure plane.

- **a)** Calculate the moment of inertia of the rod about the perpendicular axis that passes through the centre of mass.
- **b)** Assume that the rod is uniform. Find the tension in the rope in terms of M and g.
- **c)** Assume that the rod is uniform. In the cases of the angle θ is small enough, if the rope breaks suddenly, find the period of simple harmonic motion of the rod in terms of g and L.
- **d)** Assume the rod in figure (a) is **non-uniform** and its linear mass density varies as $\lambda = x^3 / L$. Find the tension in the rope in the static equilibrium (figure (b)).

5)



A non-uniform rod of weight W is supported by a cable as in figure. The rod is hinged at the bottom, and an object of weight $3P$ hangs from its top. The linear mass density of the rod varies as $\lambda = r^2$, where r is the distance through the rod to the end A. Find the tension in the cable in terms of P.