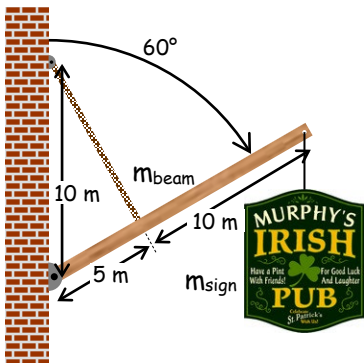## HOMEWORK SET 6: STATIC EQUILIBRIUM
Due Monday, September 18, 2023

1) A pub sign hangs supported by a beam and cable as shown.

    a) Find expressions for T, the tension in the cable and forces, F_H and F_V, exerted by the wall on the beam.

    b) Evaluate these for beam and sign masses of m_{beam} = 8 kg and m_{sign} = 35 kg.   T = 992 N, F_{horiz} = 496 N (right), F_{vert} = 436 (down)

2) A cylinder rolls against a step. When a horizontal force is applied to the top of the cylinder, the cylinder remains at rest.

    a) Show that the normal force exerted by the floor on the cylinder is

$$N_{floor} = Mg - F\sqrt{\frac{2R - h}{h}}$$
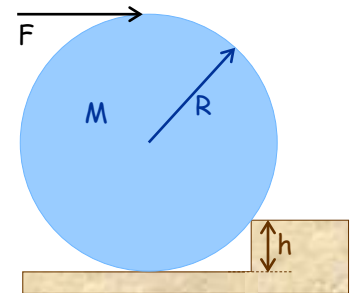
    b) Find an expression for the horizontal force exerted by the edge of the step on the cylinder.

    c) Find an expression for the vertical force exerted by the edge of the step on the cylinder.

    d) Find an expression for the minimum force that will roll the cylinder over the step.

   **e)** Evaluate F_{min} for R = 10 cm, h = 3 cm and M = 2 kg.

3) A beam is supported by a post through its center where it pivots on a frictionless bearing. One end of the beam is attached to a spring that is unstressed when the beam is horizontal. When a mass is hung from the other end, the beam settles into an equilibrium position at θ.

    a) Show that the mass of the object is

$$m = \frac{\frac{1}{2}kL\left(\sqrt{3 - 2\left(\cos\theta - \sin\theta\right)} - 1\right)\cos\left[\theta - \tan^{-1}\left(\frac{1 - \cos\theta}{1 + \sin\theta}\right)\right]}{g\cos\theta}$$

    b) Evaluate this for L = 2.5 m, k = 1250 N/m and θ = 17.5°.   m = 48.6 kg

To help you figure out the angles in this problem, an expanded diagram is on the next page with the upper perpendicular to the beam and the vertical indicated..
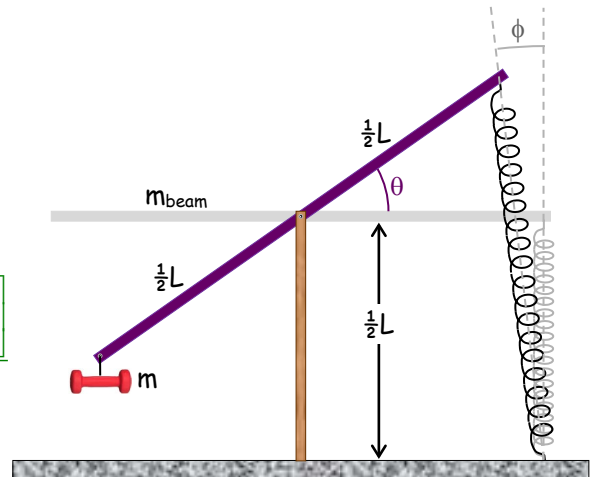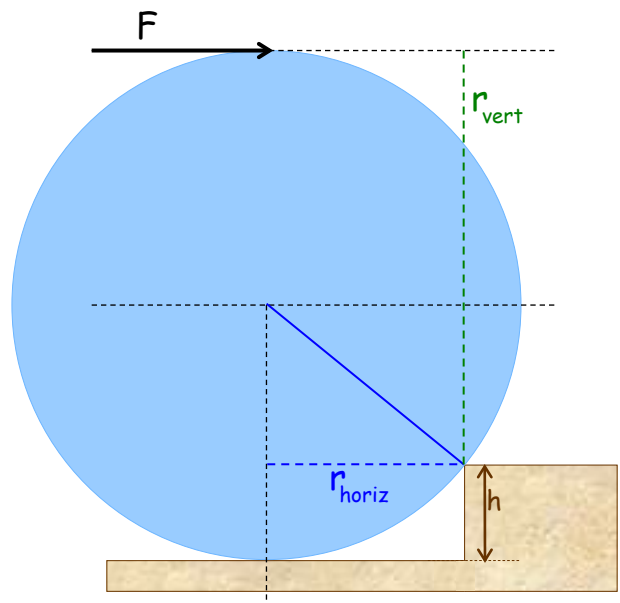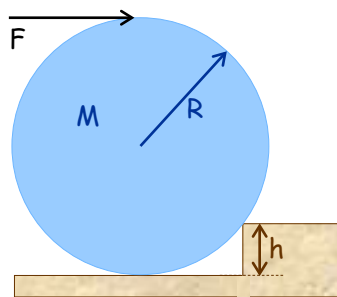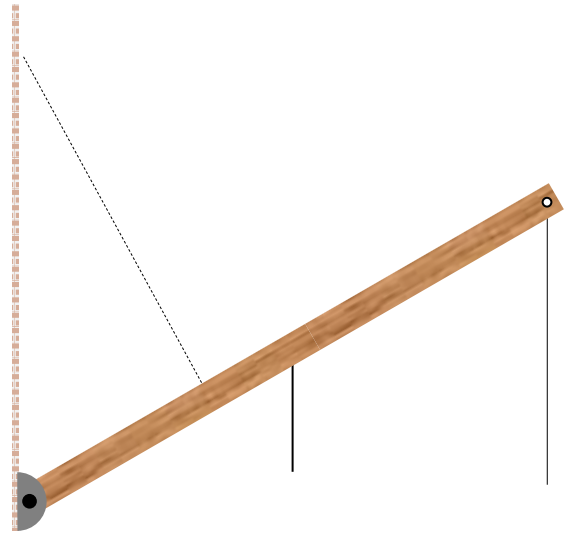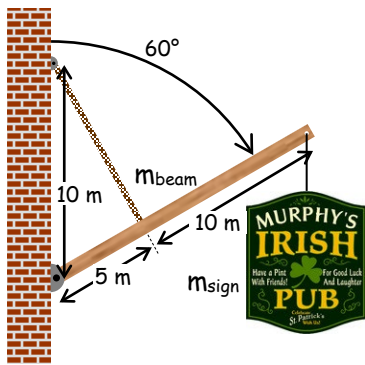
Give me a lever and a place to stand and I will move the world!
~ Archimedes

North entrance to *Old Main*, Clarkson University, Main Street, Potsdam, NY.

Schematics for problems 1 & 2

60°

m_{beam}

10 m

10 m

5 m

m_{sign}

MURPHY'S
IRISH
Have a Pint   For Good Luck
With Friends!   And Laughter
PUB
Celebrate
St. Patrick's

F

M

R

h

F

r_{vert}

r_{horiz}

h

Schematic for problem 3