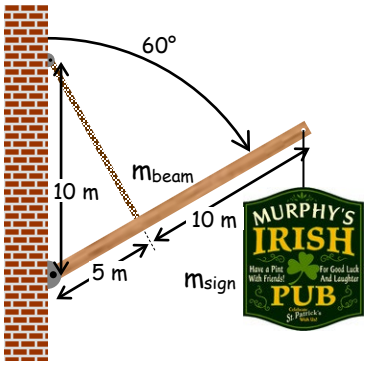
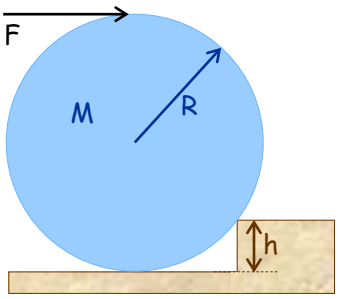
# Homework Set 6: Static Equilibrium
## Due Monday, September 23, 2024




**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

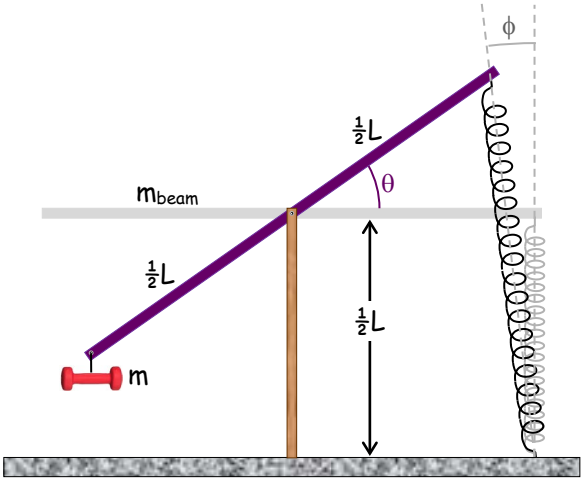
$$N_{floor} = Mg - F\sqrt{\frac{2R-h}{h}}$$

**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

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

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

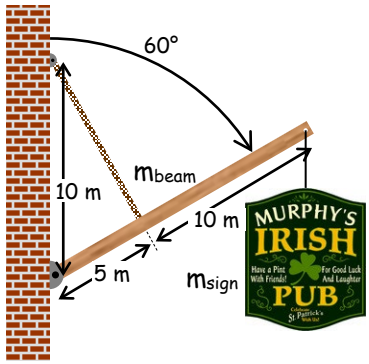
To help you figure out the angles in this problem, an expanded diagram is on the next page with the upper perpendicular to the beam and the vertical indicated..

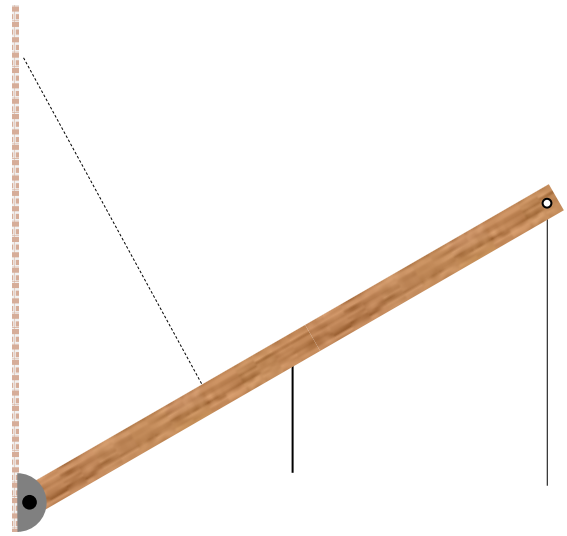
Give me a lever and a place to stand and I will move the world!

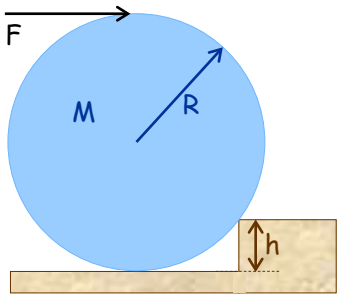
~ Archimedes

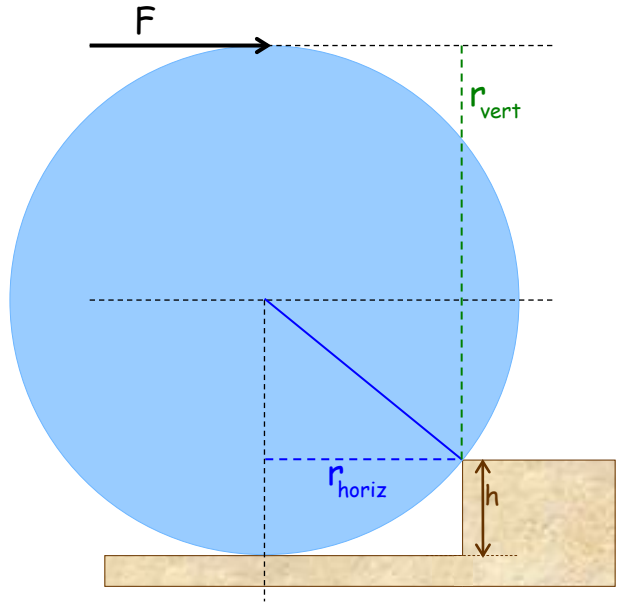
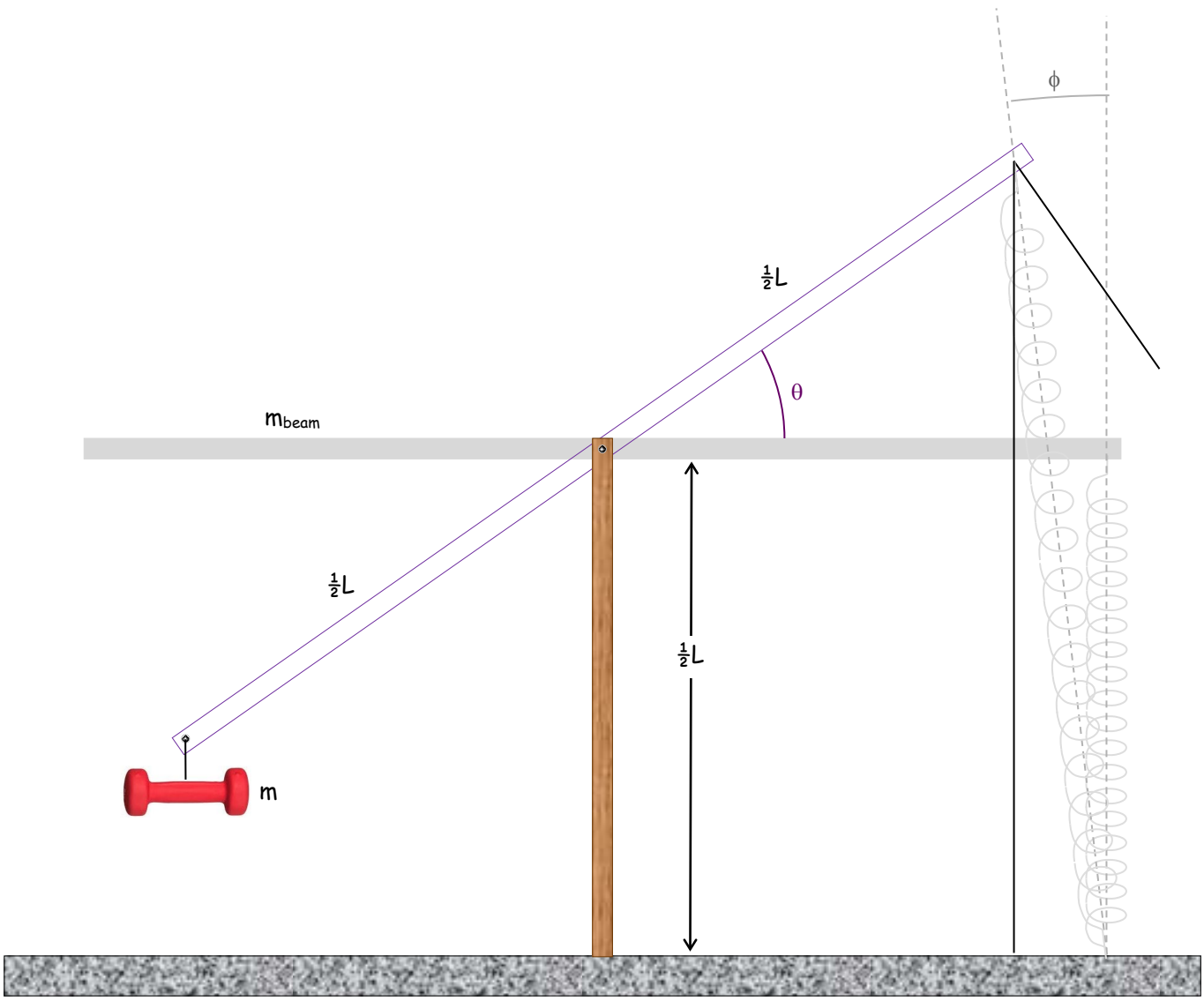
North entrance to *Old Main*, Clarkson University, Main Street, Potsdam, NY.

Schematics for problems 1 & 2








Schematic for problem 3