

Seminar 4: Lectures 7 - 8

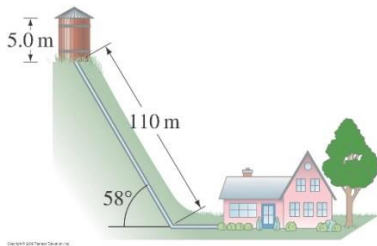
Equilibrium:

1. A 110 kg horizontal beam is supported at each end. A 320 kg piano rests a quarter of the way from one end. What is the vertical force on each of the supports?
2. A 56.0 kg person stands 2.0 m from the bottom of the stepladder shown in the figure below. Determine (a) the tension in the horizontal tie rod, which is halfway up the ladder, (b) the normal force the ground exerts on each side of the ladder, and (c) the force (magnitude and direction) that the left side of the ladder exerts on the right side at the hinge on the top. Ignore the mass of the ladder and assume the ground is frictionless. [Hint: Consider free-body diagrams for each section of the ladder.]

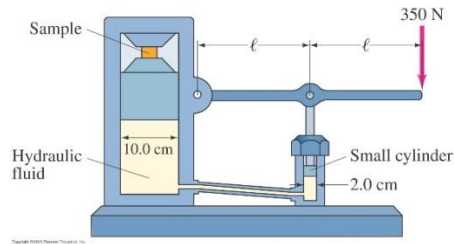


Pressure and Pascal's Principle:

3. Estimate the pressure needed to raise a column of water to the height of a 35 m tall oak tree.
4. A house at the bottom of a hill is fed by a full tank of water 5.0 m deep and connected to the house by a pipe that is 110 m long at an angle of 58° from the horizontal (see the figure below). (a) Determine the water gauge pressure at the house. (b) How high could the water shoot if it came vertically out of a broken pipe in front of the house?



5. A hydraulic press for compacting powdered samples has a large cylinder which is 10.0 cm in diameter, and a small cylinder with a diameter of 2.0 cm (see the figure below). A lever is attached to the small cylinder as shown. The sample, which is placed on the large cylinder, has an area of 4.0 cm^2 . What is the pressure on the sample if 350 N is applied to the lever?



Buoyancy and Archimedes' Principle:

6. A crane lifts the 16,000 kg steel (density of steel = $7,800 \text{ kg/m}^3$) hull of a sunken ship out of the water. Determine (a) the tension in the crane's cable when the hull is fully submerged in the water, and (b) the tension when the hull is completely out of the water.
7. A cube of side length 10.0 cm and made of unknown material floats at the surface between water and oil. The oil has a density of 810 kg/m^3 . If the cube floats so that it is 72% in the water and 28% in the oil, what is the mass of the cube and what is the buoyant force on the cube?

Fluid Flow and Bernoulli's Equation:

8. A fish tank has dimensions 36 cm wide by 1.0 m long by 0.60 m high. If the filter should process all the water in the tank once every 4.0 h, what should the flow speed be in the 3.0 cm diameter input tube for the filter?
9. What is the lift (in newtons) due to Bernoulli's principle on a wing of area 88 m^2 if the air passes over the top and bottom surfaces at speeds of 280 m/s and 150 m/s, respectively?