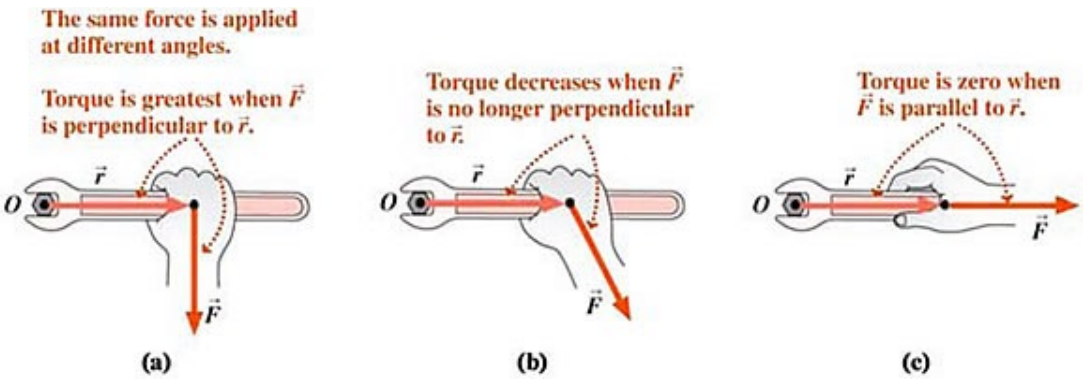
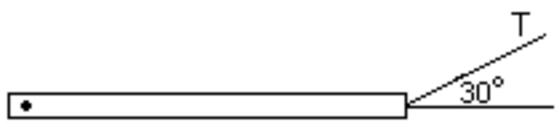
SI Workshop Problems #10: Rotational Equilibrium



1. A 0.5 kg uniform meter stick is hinged at 0.5 cm from one end and held horizontally by a force T applied at an angle of 30° with the horizontal as shown in figure 1.
   a. If T is applied at the end of the meter stick as shown, what is the magnitude of T and what is the force F exerted at the pivot on the meter stick?

figure 1



   b. If the force T is applied in the same direction but at 60 cm from the pivot, what are T and F? [T = 8.08N, F_P = 7.05N, θ_P = 7.0° in QII]
   c. How do T and F from part (b) change if, as shown in figure 2, a mass of 1 kg is suspended 35 cm from the left end of the meter stick? [T = 19.4N, F_P = 17.5N, θ_P = 16.6° in QII]

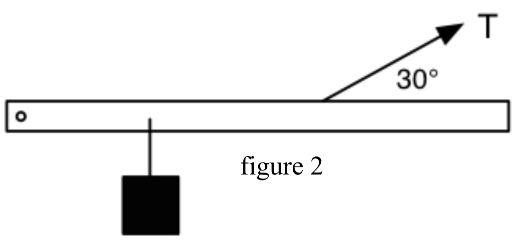
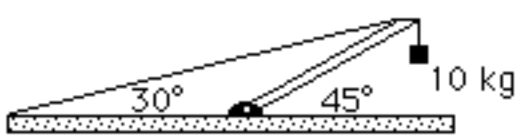


figure 2

2. Find the tension in the cable and the force exerted at the pivot in the system shown in fig 3. The strut is uniform and has a mass of 20 kg. [T = 535N, F_P = 728N, θ_P = 50.5° in QI]

figure 3



3. In figure 4, assume the wall is frictionless. The ladder is 12 ft, uniform, and weighs 20 lb. The painter weighs 160 lb and wants to climb 2/3 of the way up.
   a. What is the minimum coefficient of static friction, μ_s needed with the floor? [μ = 0.125]

b. If the wall has a coefficient of static friction of 0.2, what is the minimum coefficient of static friction needed with the floor?

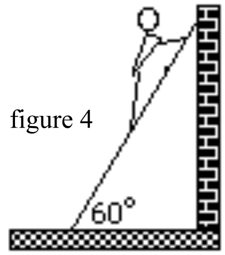


figure 4

4. A uniform 400 N boom is setup as in figure 5. Find the tension in the rope holding the boom and the magnitude and direction of the force at the pivot. [T=2,461 N, F_P=3423 N; θ_P = -5.8° in QIV (5.8° below the boom, Q4)]

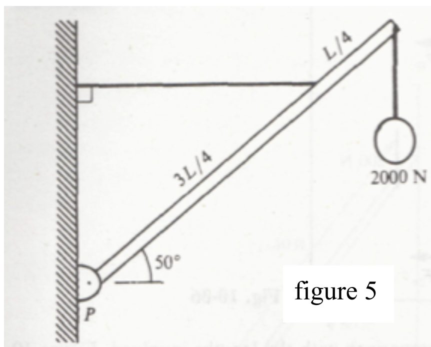


figure 5

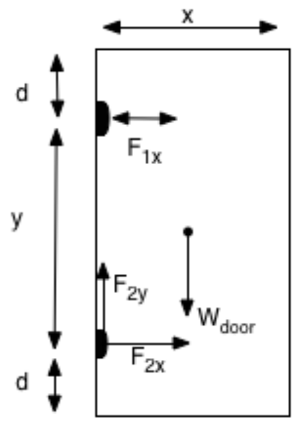


figure 6

5. In figure 6, the door is uniform and weighs 200 N. The hinges are 2.5 m apart. Each hinge is a distance d from the top or bottom corner, respectively. What are the forces exerted at the hinges? [F_1 = 40.0 N, F_2 = 204 N, θ_{P2} = 78.7° in QI]