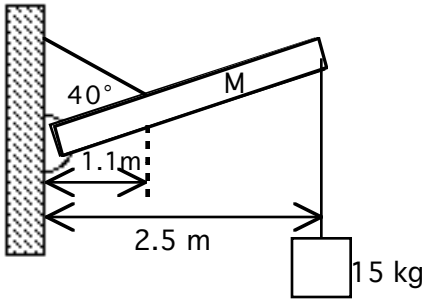
HW#9: Rotational Equilibrium

1. A uniform beam of unknown mass is attached to the wall with a pin and supported by a string at 18° above the horizontal as shown in figure 1. The maximum tension that can be applied to the string is 600 N.



   a. If a 15 kg mass is suspended from the end of the beam, what is the greatest total mass of the beam before the string breaks? [$M_{beam\ (MAX)}$ = 6.40 kg]

   b. What is the force and angle on the beam at the pivot? [θ = -1.1°(from x-axis), Q4; F= 556.4N]

2. A uniform crane with a wrecking ball needs a support braced against the ground. The brace is 3/5 of the length of the crane from the pivot.

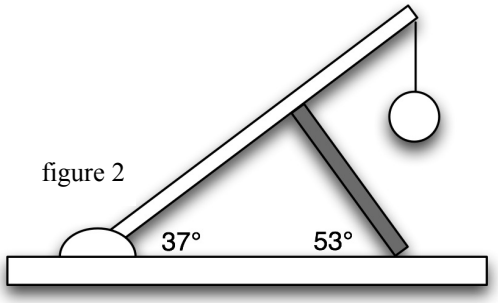


figure 2

   a. If the mass of the crane is 2000 kg and the maximum force the can be applied to the brace is 60,000 N, what is the maximum mass of the wrecking ball? [M(MAX) = ~3600 kg]

   b. What is the magnitude and direction of the force at the pivot? [θ = 10.7°(from x-axis), Q1; F= 48,850 N]

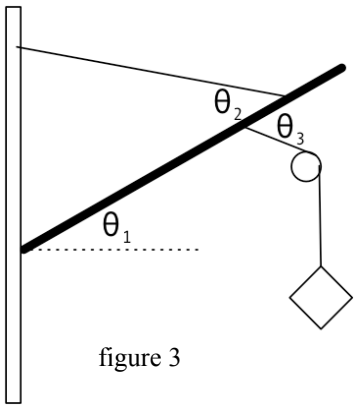


figure 3

3.Refer to figure 3. Given the following information: angles θ_1= 20°, θ_2= 30°, θ_3= 41°, a 200 lb hanging weight positioned at 3/4 the length of the 50 lb uniform bar, find the tension in the wire positioned at 4/5 the length of the bar and the force at the pivot.[T=304.75 lb.; θ_P = 11.2° (above the bar, Q1); F_P= 132.6 lb.]

3b. Refer to figure 3. Given the following information: angles θ_1= 20°, θ_2= 30°, θ_3= 41°, a 35 kg hanging mass positioned at 3/4 the length of the 20 kg uniform bar, find the tension in the wire positioned at 4/5 the length of the bar and the force at the pivot. [T=652 N, θ_P = 12.6° (above the bar, Q1); F_P= 382 N]

4. Assume that the end of the uniform beam in figure 4 is just resting against a frictionless wall. If the cable is attached at 3/4 of the length and the mass of the weight is 20 kg, determine the mass of the beam and the tension in the string. (Note: There is no pivot force working here)

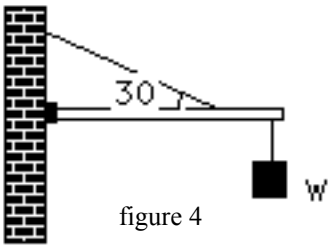


figure 4

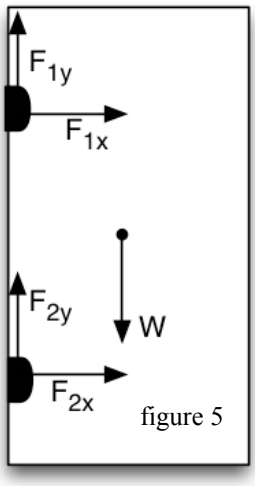


figure 5

5. A uniform door with two hinges and a mass of 100 kg is shown in figure 5. The y-component of F_1 is 250 N, the distance from hinge to hinge is 1.5 m, and the distance from hinge 1 and the top is equal to the distance from hinge 2 and the bottom. The width of the door is 1.0 m. Determine the magnitudes and directions of F_1 and F_2.
[θ_1 = -37.4°(Q2) F_1=411.3 N; θ_{12} = 65.9°(Q1) F_1=800 N]

6. Go over your Rotational Equilibrium lab. If you are the student holding the write-up, make sure you give your lab partners a photocopy to study.