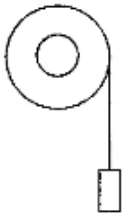
Physics 122

Handout – Torque

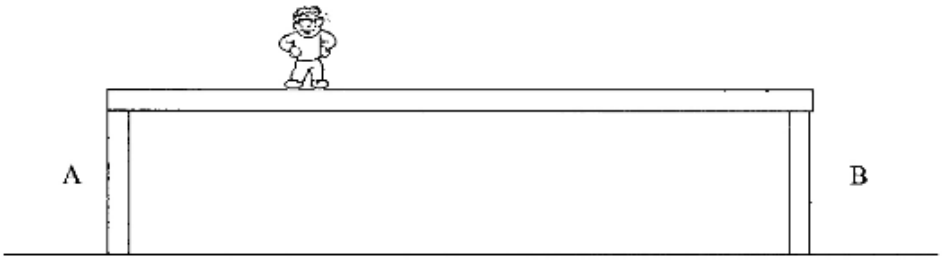
1. Consider a light string wound around a frictionless and massless wheel. The free end of the string is attached to a 1.2 kg mass that is allowed to fall freely. The wheel has a radius of 0.25 m. What torque is produced? (-2.94 Nm)



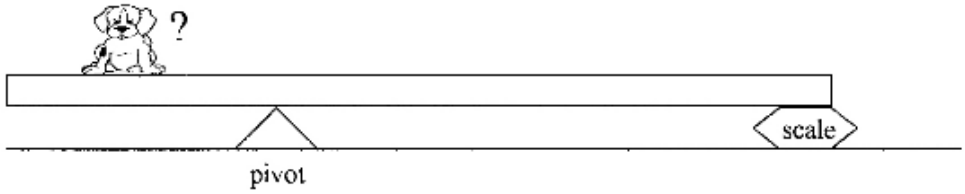
2. The magnitude of the maximum torque exerted by a person riding a bike when all his weight is put on the pedal is 92 Nm. What is the mass of the person if the pedals rotate in a circle of radius 17 cm? (55 kg)

3. A small boy of mass 30 kg is at one end of a seesaw of total length 3.0 m. Where must a girl of mass 21 kg sit in order that the seesaw be in equilibrium? (2.1 m from the pivot on the opposite as the boy)

4. Bob is standing on a bridge. The bridge itself weighs 10 000 N. The span between pillars A and B is 80 m. Bob is 20 m from the center of the bridge. Bob's mass is 100 kg. Assuming the bridge is in equilibrium, find the magnitude of the force exerted by pillar B on the bridge. (5.2×10^3 N)

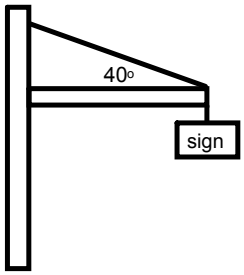


5. A 60 kg uniform board 2.4 m long is supported by a pivot 80 cm from the left end of the board and by a scale at the right end. Where should a 40 kg puppy be placed if the scale is to read 100 N? (61 cm from the left end of the board)

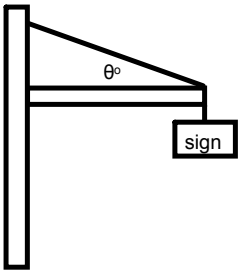


More Torque!

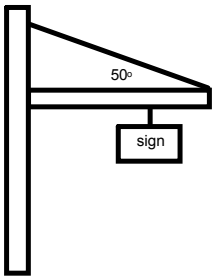
1. Determine the tension in the wire and the components of the force from the hinge. The beam has a mass of 170 kg, the sign has a mass of 75 kg, and the beam is 6.0 m long. (T = 2442 N, F_{hy} = 834 N, F_{hx} = 1870 N)



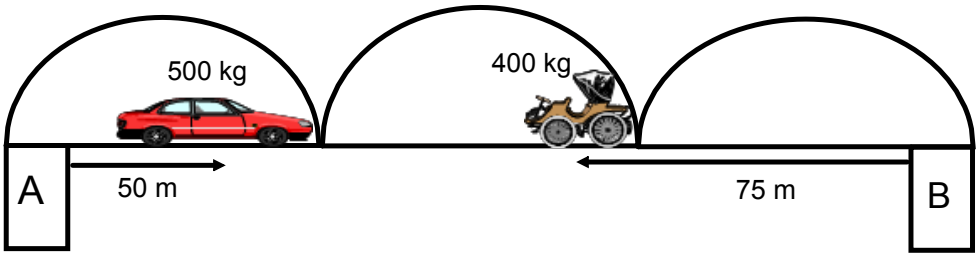
2. The cable in the diagram to the right will break if the tension reaches 1500 N. What is the smallest angle that can be made with the horizontal? The beam is 15 m long and has a weight of 1050 N. The sign has a weight of 500 N. (θ = 43°)



3. If the cable will break under a stress of 2300 N, what is the largest mass that can be hung from the beam? The beam is 150 kg and 8.0 m long. The cable makes an angle of 50 ◦ with the beam and the sign is 5.5 m from the left end of the beam. (152 kg)



4. The Morrissey bridge will collapse if column A must support more than 50000 N of weight. The bridge spans 225 m and has a mass of 8500 kg. Will the bridge collapse under the circumstances depicted in the diagram? (No, F_A = 46815 N)



A construction crane is designed such that part of the boom acts as a counterweight. The boom is constructed of uniform material with a linear density of 25 kg/m. The left side of the crane is 10 m long and the right side is 15 m.

a) If the mass at the right end is 300 kg what is the tension in the cable? (T = 6200 N)

b) What is the tension in the cable if there was no left side of the boom? (T = 7400 N)

c) Suppose each cable can support a tension of 12000 N. What is the maximum mass that each crane can support? (Left: 680 kg; Right: 600 kg)