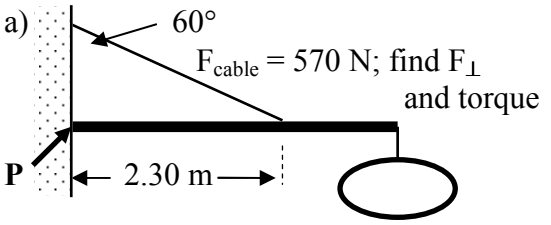
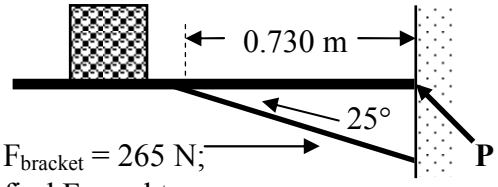
PHYSICS 12 ROTATIONAL EQUILIBRIUM WORKSHEET 1

1. For the following diagrams, determine the perpendicular component $\mathbf{F}_\perp$ for each force shown, as well as its torque, relative to pivot **P**:

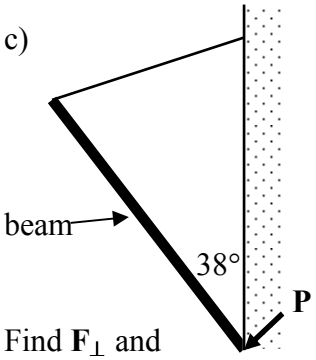
a)



b)

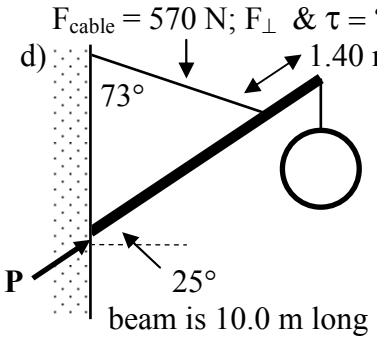


c)



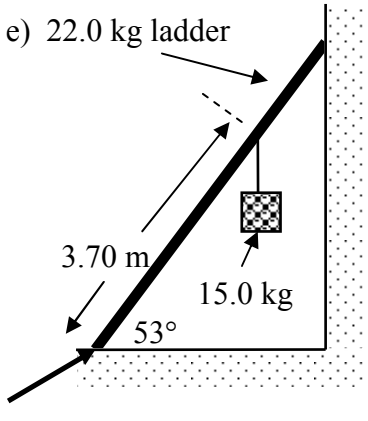
Find $\mathbf{F}_\perp$ and torque of the 5.00 m-long, 45.0 kg <u>uniform</u> beam.

d)



beam is 10.0 m long

e) 22.0 kg ladder



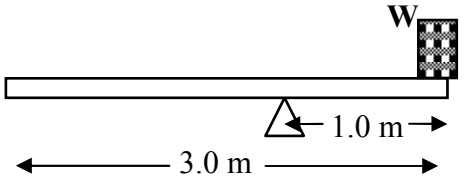
length of uniform ladder = 4.80 m

Find $F_\perp$ and τ for ladder <u>and</u> mass

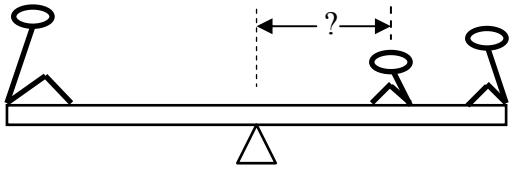
2. A young woman is sitting on the edge of a seesaw that is balanced on the other end. The seesaw is 10.0 m long and the fulcrum (which acts as the **pivot point**) is at the midpoint of its length. If her mass is 40.0 kg, how much torque is she applying?

3. A camper is trying to move a rock by creating a lever out of a steel pipe and another rock. Using the second rock as a fulcrum, he places it 1.50 m from the point at which he will exert a force. How much torque will he exert if he applies a force of 200. N:
a) perpendicular to the pipe? b) at 45° to the pipe?

4. A fulcrum is placed 1.0 m from the edge of a 3.0 m-long wooden uniform plank of mass 20 kg. A weight **W** is placed at the edge of the short end to balance it. What is the proper amount of weight needed to balance the plank? (Hint: first find the plank's weight and draw its vector in the correct location)



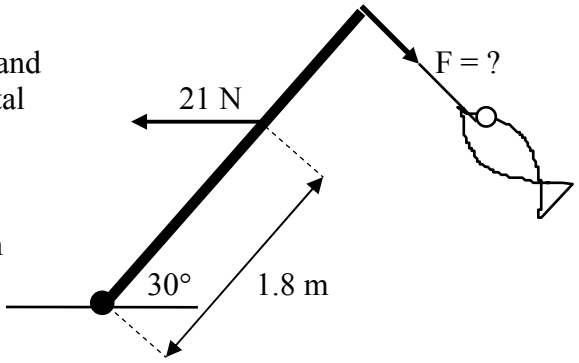
5.



Two children are on opposite ends of an 8.00 m-long seesaw that is pivoted in the middle. One child weighs 300. N while the other weighs 200. N. A third child weighing 150. N attempts to hop on and balance the seesaw. How far from the fulcrum should she sit?

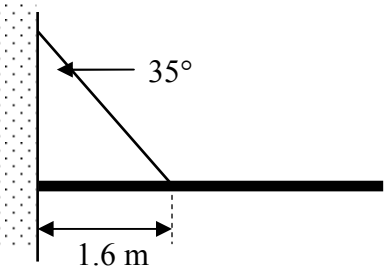
6. A 3.0 m-long bamboo fishing rod of negligible mass is pivoted at one end, and held in equilibrium by a 21 N-horizontal force while a fish pulls on a fishline attached to the rod as shown below.

How much force does the fish exert on the rod? Assume this force is perpendicular to the rod.



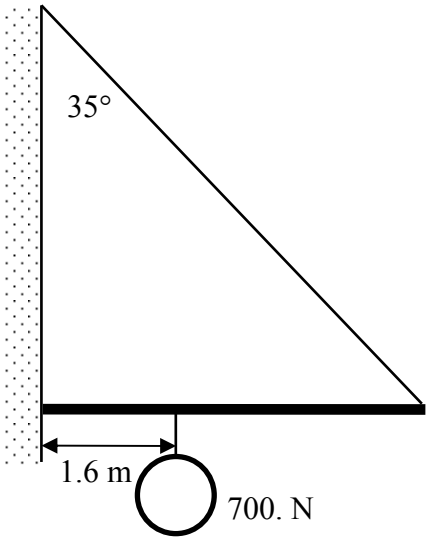
7. a) A 4.0 m-long uniform beam to the right weighs 500. N and is supported by a cable as shown. What is the tension in that cable?

b) The beam now has a 700. N weight that hangs at its end. What is the tension in the cable now?

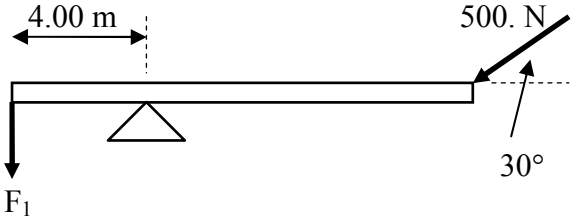


c) The same beam, mass and cable is now used in a different configuration as shown to the right. Calculate the new tension in the cable now.

d) Using physics principles, explain the advantages of using the arrangement in (c) over that in (b).



8. In the diagram to the right, the mass of the 12.0 m-long uniform board is 25.0 kg.
a) Calculate the unknown force F_1 needed to balance the system.
b) How much force does the fulcrum apply:
- vertically upward on the board?
- horizontally?
- overall? (magnitude and direction)



1. a) 285 N, 656 N-m b) 112 N, 82 N-m c) 272 N, 679 N-m d) 381 N, 3.28 x 10^3 N-m e) ladder: 130 N, 311 N-m; mass: 88.5 N, 327 N-m 2. 1960 N-m 3. a) 300 N-m b) 212 N-m 4. 98 N 5. 2.67 m 6. 6.3 N
7. a) 763 N b) 2900 N c) 647 N d) answers should be based on different cable tensions caused by torque due to relative positions of cable and weight 8. a) 623 N b) 1.12 x 10^3 N, 433 N to right, 1.20 x 10^3 N @ 69° up to the right