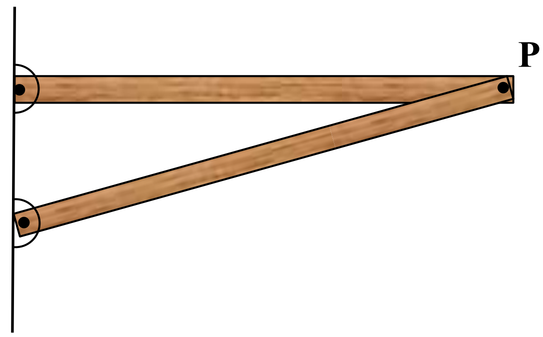
1. The structure shown is in static equilibrium. Using appropriate variables, find the normal forces.

a. Draw free-body diagrams for each beam.

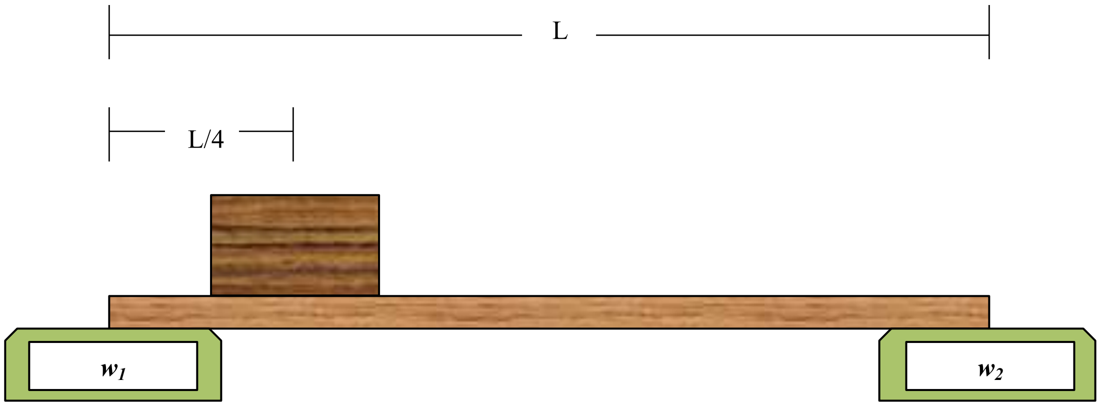
b. Write the force equations.

c. Write the torque equations about *P*.

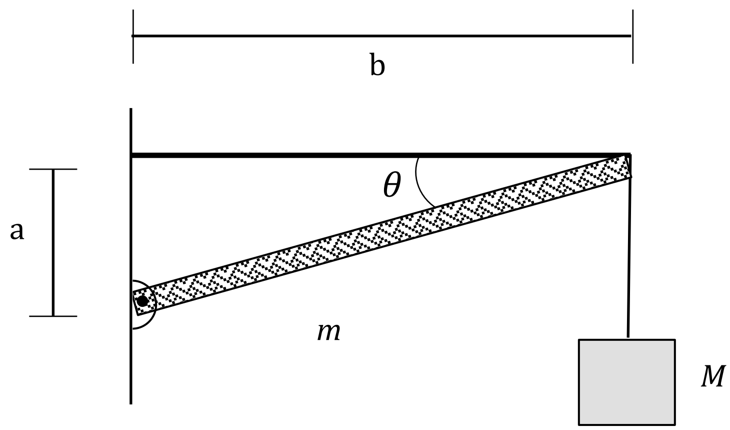
d. Solve for the unknowns.



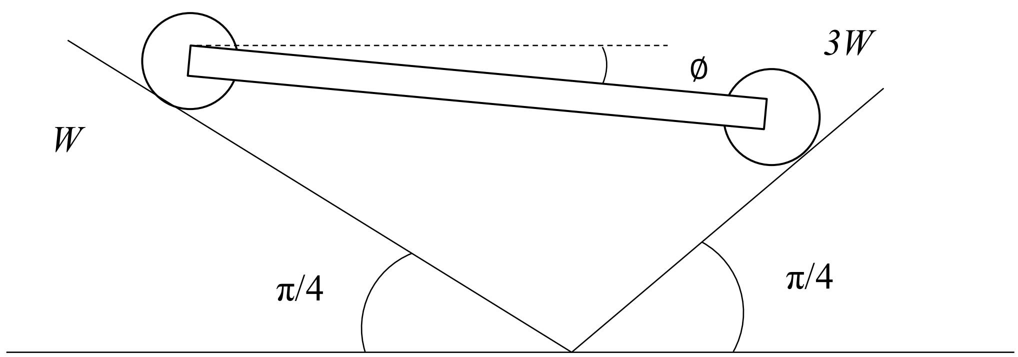
2. In the figure below, a uniform beam of length L and mass m is at rest on two scales. A uniform block with mass $2m$ is at rest on the beam with its center a distance $L/4$ from the beam's left end.
Given [L, m], find [w_1, w_2]
(w_1 and w_2 are what the left and right scale read, respectively.)



3. The figure below shows a block of mass M hanging by a massless rope from a hinged beam of mass m and massless cable.
Given [M, m, θ, a, b], find
a. the tension T_c of the cable,
b. the sum of the forces on the beam.



4. Two wheels of weights W and $3W$ are connected by a bar of negligible weight and are free to roll on the $\pi/4$ inclines as shown below.
Given [W], find the angle ϕ that the bar makes with the horizontal when the system is in static equilibrium.



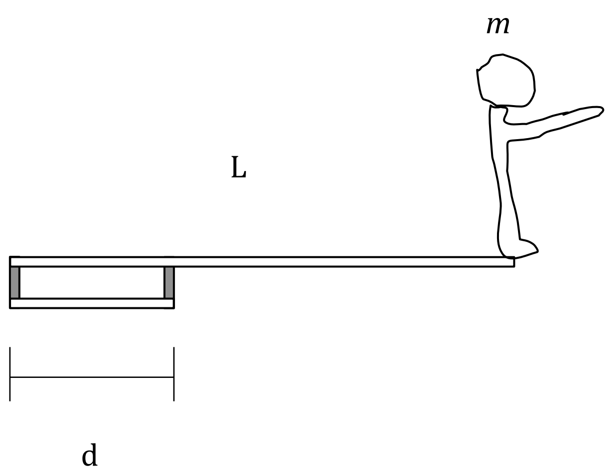
5. A diver of mass *m* stands at the end of a diving board of length *L* of negligible mass. The board is fixed to two supports separated by distance *d*. Given [*m*, *L*, *d*], find

a. the magnitude of the force from the left support,

b. the direction of the force from the left support (up or down),

c. the magnitude of the force from the right support, and

d. the direction of the force from the right support (up or down).



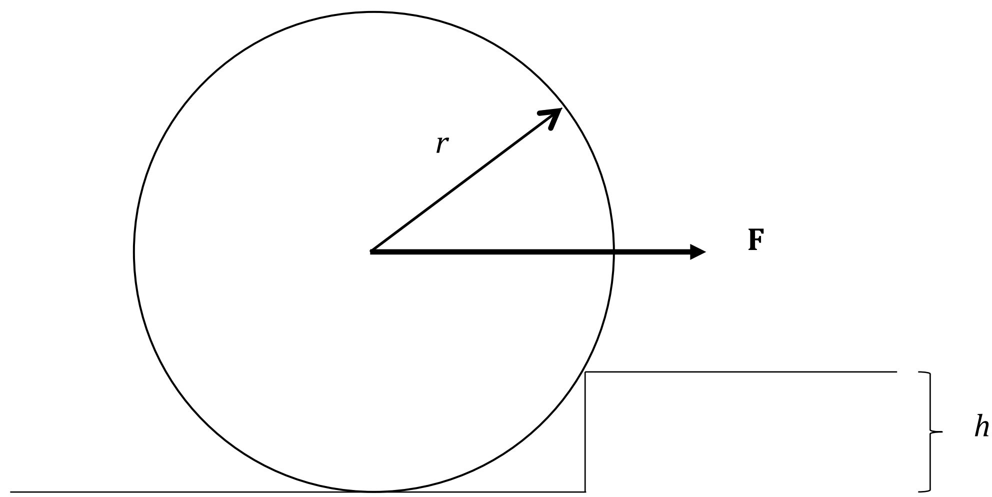
6. A meter stick balances horizontally on a knife-edge at the 50.0 cm mark. With two coins of mass *5m* each stacked over the 12.0 cm mark, the stick is found to balance at the 45.5 cm mark.
Given [*m*], find the mass of the meter stick.

7. A window cleaner of mass M uses a ladder of mass m and length ℓ. He places one end on the ground a distance $\ell/2$ from a wall, rest the upper end against a cracked window, and climbs the ladder. He is $3\ell/5$ up along the ladder when the window breaks. Ignoring friction between the ladder and the window and assume the base of the ladder does not slip.

Just before the window breaks, given [M, ℓ], find

a. the magnitude of the force on the window from the ladder,
b. the magnitude of the force on the ladder from the ground, and
c. the angle (relative to the horizontal) of that force on the ladder.

8. Given [h, r, m], find the magnitude of force applied horizontally at the axle of the wheel is necessary to raise the wheel over an obstacle of height h.



9. One end of a uniform beam of mass m is hinged to a wall, and the other end is supported by a wire.
Given [m, θ], find
a. the tension in the wire,
b. the horizontal components of the force of the hinge on the beam, and
c. the vertical components of the force of the hinge on the beam.