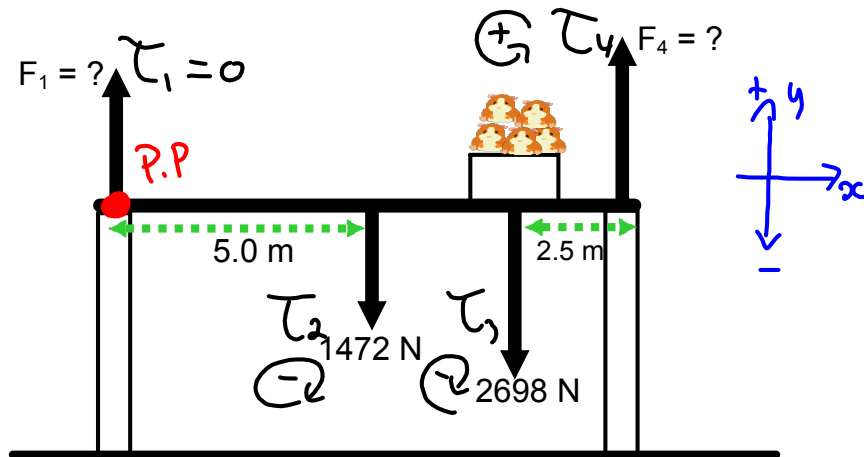


Example: A uniform 150 kg beam, 10.0 m long, supports a 27 kg box of hamsters 2.5 m from the right support column. Calculate the magnitude of the forces on the beam exerted by each of the vertical support columns.



Step 1 - Place pivot point at an unknown force. Then use net torque.

$$\tau_{\text{net}} = \tau_1 + \tau_2 + \tau_3 + \tau_4$$

$$0 = 0 - (5)(1472) - (7.5)(2698) + 10F_4$$

$$0 = -7360 - 20235 + 10F_4$$

$$27595 = 10F_4 \quad \therefore 2760 \text{ N} = F_4$$

$$F_{\text{net}} = \sum \text{Forces} = 0$$

$$F_{\text{net}} = F_1 + F_2 + F_3 + F_4$$

$$0 = F_1 - 1472 - 2698 + 2760$$

$$0 = F_1 - 1410 \quad 1410 \text{ N} = F_1$$

27. Mountain climbers have placed a 3.6 kg uniform ladder across an icy crevasse. The edges of the crevasse are 4.1 m apart. The first climber starts to cross the crevasse on the ladder and reaches a point 1.8 m from the edge. The mass of the climber and her gear is 87 kg. With what force is the ice on each side of the crevasse pushing up on the ladder?

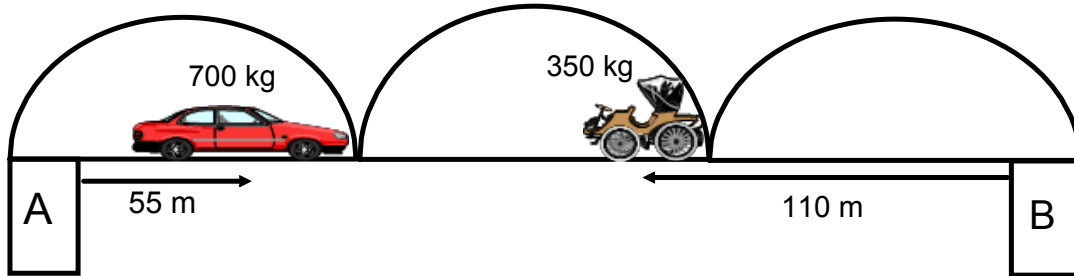


497 N

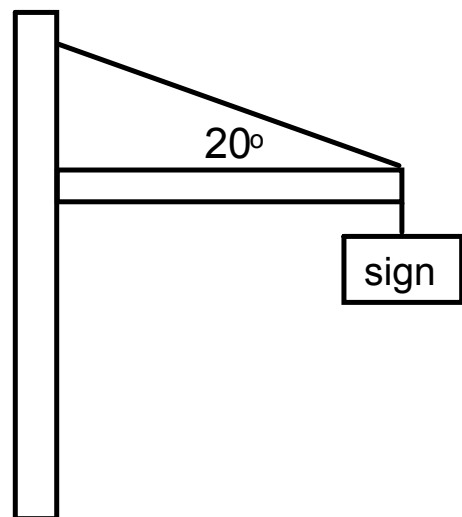
392 N

**Torque Review**

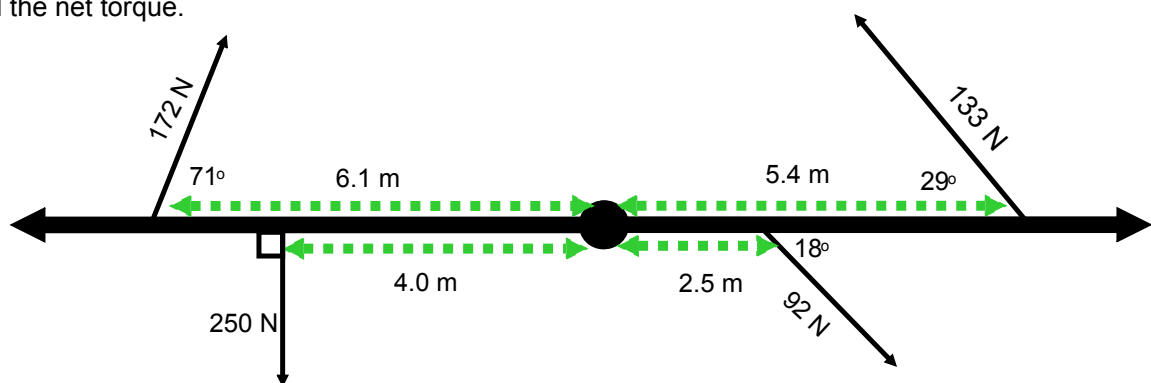
1. Find the force each column supports. The bridge spans 300 m and has a mass of 12 500 kg.



2. Determine the tension in the wire. The beam has a mass of 225 kg, the sign has a mass of 1055 kg, and the beam is 15 m long.

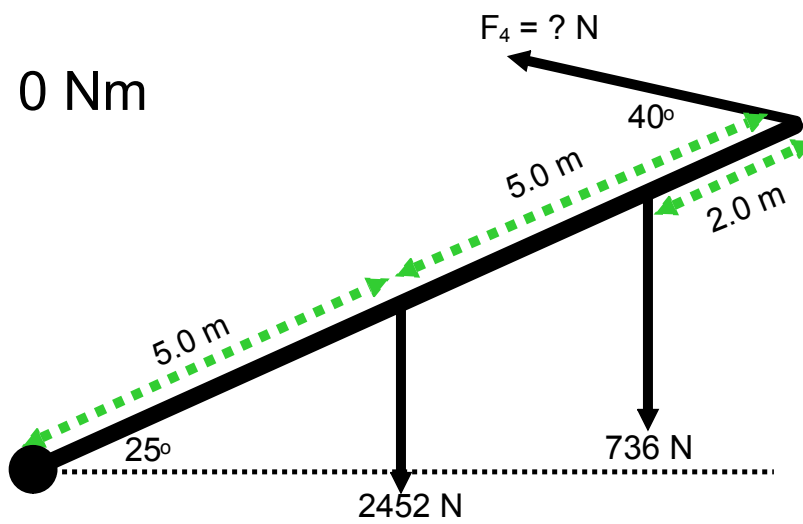


3. Find the net torque.



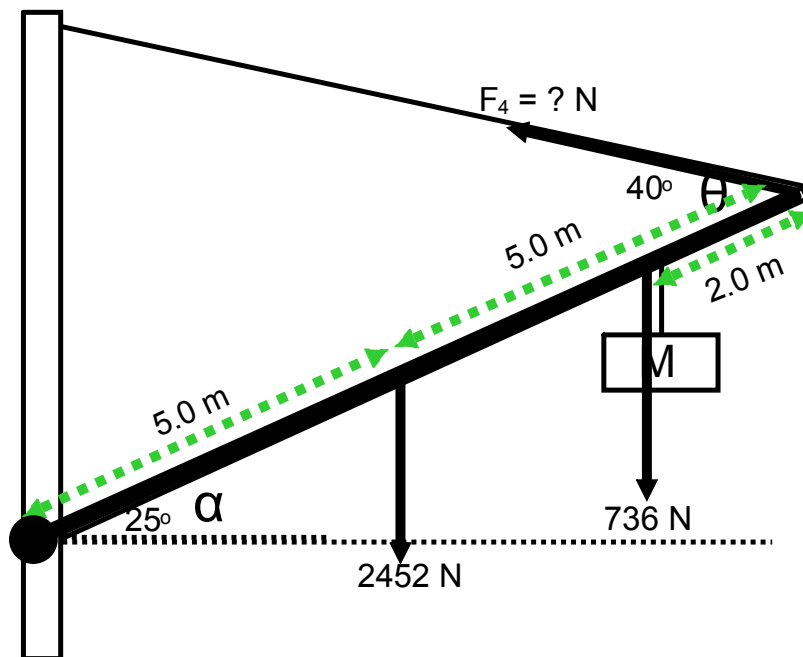
## Angled Beam Review

$$\tau_{\text{net}} = 0 \text{ Nm}$$

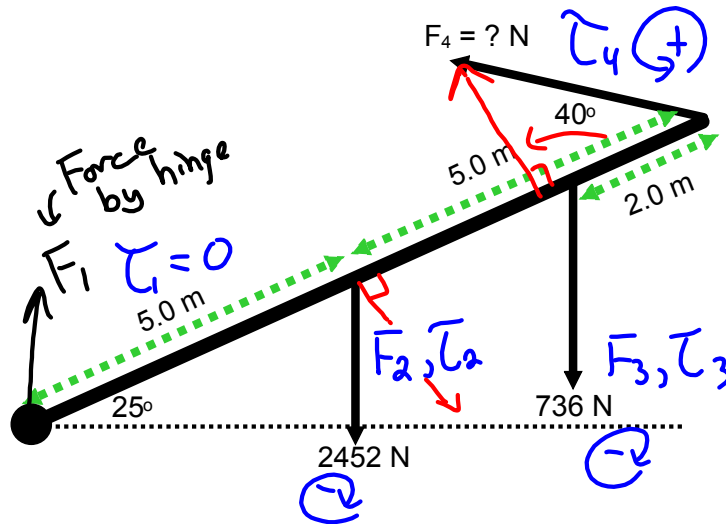


The arm of this crane is angled  $25^\circ$  to the horizontal. The cable is attached at an angle of  $40^\circ$ . The beam is 10 m long and has a mass of 250 kg. A mass of 75 kg is attached 2 m from the end.

1. Calculate the force of tension in the cable.
2. Calculate the net force on the hinge attaching the arm to the pole.



1. Calculate the force of tension in the cable.



$$\tau_1 = 0 \text{ Nm}$$

$$\begin{aligned}\tau_2 &= -(5)(2452) \cos 25^\circ \\ &= -11111 \text{ Nm}\end{aligned}$$

$$\begin{aligned}\tau_3 &= -(8)(736) \cos 25^\circ \\ &= -5336 \text{ Nm}\end{aligned}$$

$$\begin{aligned}\tau_4 &= (10) F_4 \sin 40^\circ \\ &= 6.43 F_4\end{aligned}$$

$$\tau_{\text{net}} = \tau_1 + \tau_2 + \tau_3 + \tau_4$$

$$0 = 0 - 11111 - 5336 + 6.43 F_4$$

$$16447 = 6.43 F_4$$

$$\boxed{2558 \text{ N} = F_4}$$

## Attachments

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balancing-act\_en.jar