**Worksheet 3: Static Equilibrium II – Balancing Torques**

1. A boy and girl are balanced on a massless see-saw. The boy has a mass of 70.0 kg and the girl's mass is 60.0 kg. If the boy sits 2.0 m from the pivot point on one side of the see-saw, where must the girl sit on the other side?

2. Pat and John are playing on a 4.0 m long see-saw that is supported at the center. If Pat has a mass of 30.0 kg and sits at one end of the see-saw, where should John (mass = 35.0 kg sit so the seesaw balances?

3. A 1.5×10^3 kg car is crossing a 1.2×10^2 m long flat bridge which is supported at both ends. When the car is 32 m from one end, what force must each end support be able to provide?

4. In the picture below the large uniform ladder is 12.0 m long and has a mass of 250 N. In order to reach the ladder the worker pulls on a rope that makes an angle of 40° with the ladder. A point on the roof of the van 1.5 m from the ladder's c of g serves as a pivot point. What is the minimum force in the rope beyond which the worker must go in order to make the ladder tip?
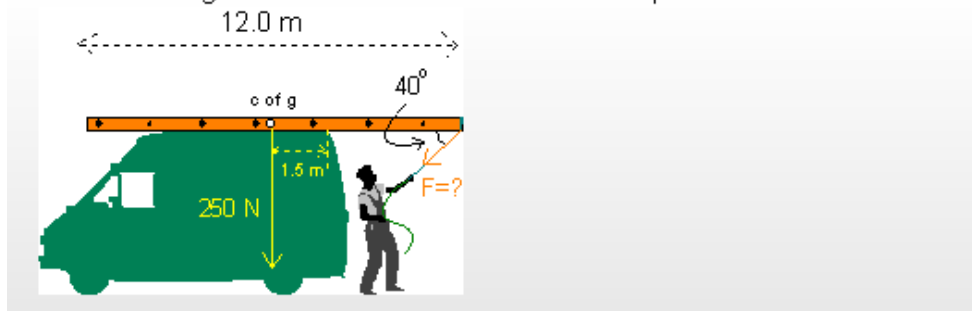

5. The 10.0 m plank in the picture is uniform and weighs 120 N. Your 12.0 N pussy cat is standing on the very end of the plank as it protrudes over your rooftop. What is the maximum length of plank that can be overhanging without the cat falling?


6. Two painters are above the first floor of a house on a scaffold which weighs 400.0 N, is 3.0 m wide and is supported by two ropes attached 0.250 m in from each end. The first painter whose mass is 80.0 kg is standing at the center, while the second painter, of mass 65.0 kg, stands 1.00 m from the left of the scaffold. Calculate the tension in each rope.

7. A bookshelf made of a uniform wooden board 1.5 m long weighs 20.0 N and is supported by two thin metal rods each 5.0 cm from its end as shown in the diagram. A book weighing 16.0 N is placed upright on the shelf at a distance of 0.400 m from **the right metal rod. Calculate the force on each rod must exert on the board to maintain static equilibrium.**


Metal Rods
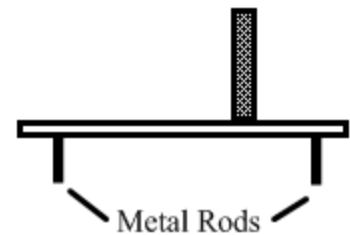
8. The crane shown in the diagram below is made up of a strut and a restraining cable. The strut is uniform with a length of 6.0 m and a mass of 85 kg. What is the tension in the restraining cable while the crane is supporting a 150 kg load?

restraining cable

strut

$m = 150$ kg

30°   50°
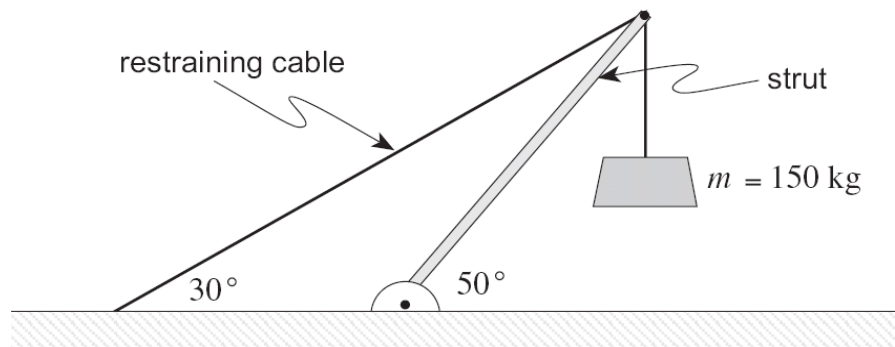
9. The boom of a crane in the figure at the right is uniform, 3.00 m long and weighs 500.0 N. It supports a tree stump and associated earth weighing 800.0 N at its far end. The boom makes an angle of 53.1° with the horizontal and the tie rope makes an angle of 36.9° with the horizontal.

A) Calculate the tension in the tie rope.
B) Calculate the force acting along the hinge in the horizontal and vertical direction.


36.9°   53.1°
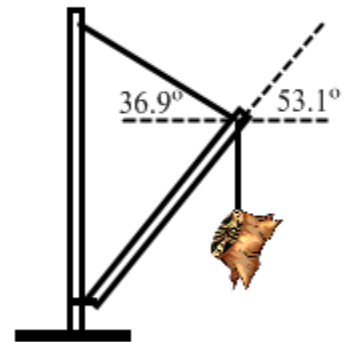
10. A young girl weighing 400.0 N and her friend who weighs 500.0 N wish to make a see-saw from a plank 4.00 m long. The plank is uniform and weighs 300.0 N. If each girl sits 0.25 m from each end and the heavier girl is on the left end, at what distance from the left end should the board be placed across the pipe so that it will balance with the girls on it?

10. A uniform rod of length 2 .0 m and mass 4.0 kg is hinged at the left end. A 25.0 kg sign is suspended from the right end. A guy wire is connected to the end of the rod and is fastened to the wall.

A   Determine the tension in the wire.

B   Determine the vertical and horizontal components of the force acting on the hinge.

guy wire
wall
F_H 30°
hinge
Sign
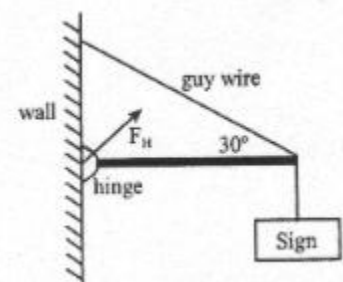
11.	A uniform 4.0 m long beam with a mass of 15 kg rests on a pivot at one end and is kept horizontal by a cable at the other end. The beam is supporting a 25 kg mass as shown. What is the tension in the cable?

55°

15 kg beam

25 kg

1.5 m
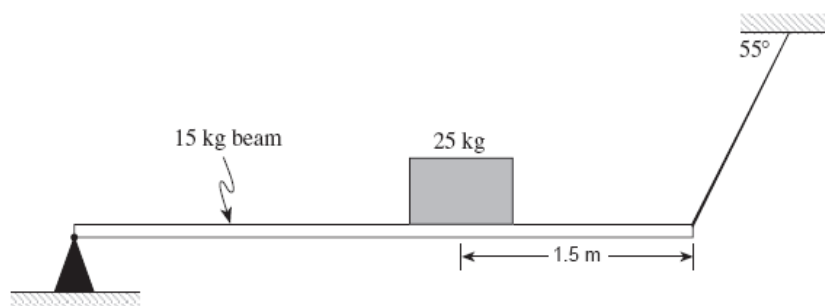
12.	A 1.00 m stick supports a 500 g load as shown at the right. The stick makes an angle of 70° with the horizontal. What is the horizontal force in the support string when
a) we ignore mass of the stick
b) we assume a uniform stick with mass 150 g

r = 1.00m

500 g

70

0

P
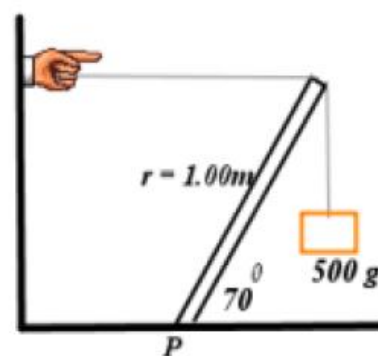
13.	A 45.0 kg boy walks along a 3.00 m long wooden plank of mass 20.0 kg that overhangs a partially completed wooden deck by 0.75 m. How far away from the deck edge can the boy walk before the plank tips?