

# Static Equilibrium

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## Conditions for Equilibrium

$$a = 0$$

$$\alpha = 0$$

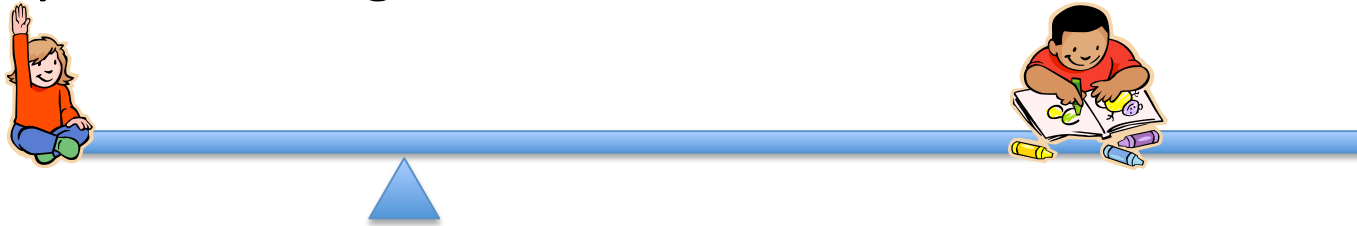
$$\sum F_x = 0$$

$$\sum F_y = 0$$

$$\sum \tau = 0$$

1. Draw a force diagram for the object.
2. Put the axis on the UNKNOWN force.
3. Write the three equilibrium equations. Solve.

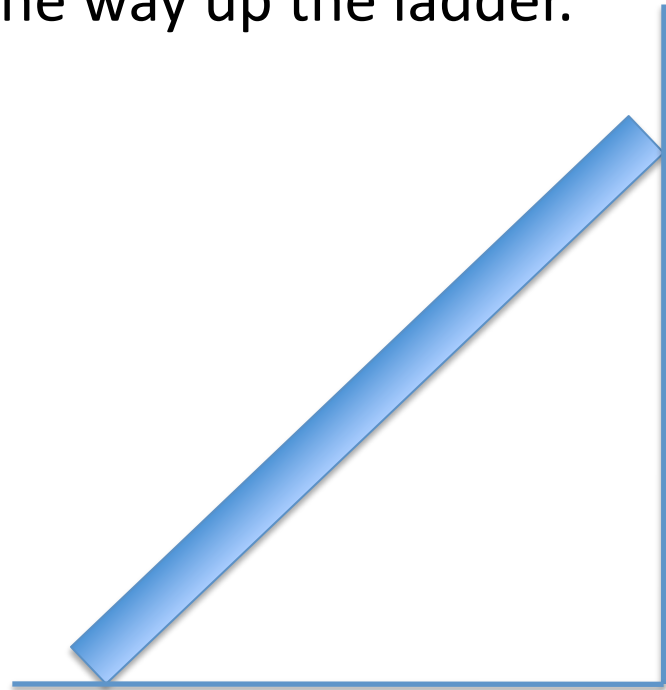
**Ex:** An 8-m long seesaw of mass 20 kg has its fulcrum located 3 m from its left end. A 40-kg child sits on the left extreme end of the seesaw and a child of unknown mass sits one meter away from the right extreme end.



- A) Draw a free-body diagram for the seesaw.
- B) What is the mass of the second child?
- C) What is the normal force supplied by the fulcrum?

A 10-m long uniform ladder weighing 400 N rests against a frictionless wall. The ladder makes a  $50^\circ$  angle with the horizontal. A 750-N painter is  $\frac{3}{4}$  of the way up the ladder.

- A) Draw a free-body diagram of the ladder.
- B) What is the force the wall exerts on the ladder?
- C) What is the y-component of the force the ground exerts on the ladder?
- D) What is the x-component of the force the ground exerts on the ladder?
- E) If the ladder is on the verge of slipping in its current condition, what is the coefficient of static friction between the ladder and the ground?



A shop sign weighing 350 N is supported by a 135-N beam as shown below. The length of the beam is 1.80 m and the wire supporting the beam is located 1.30 m from its left end. The angle between the wire and the beam is  $30^\circ$ .

- A) Draw a free-body diagram of the beam.
- B) Find the tension in the wire.
- C) What are the horizontal and vertical forces exerted by the hinge on the beam?

