

Chapter 2 Mechanical Equilibrium

The Equilibrium Rule

A painter stands on the middle of a board that is suspended at the ends by two vertical ropes. The painter and the board are in mechanical equilibrium. The tension in each rope is 350 N, and the painter's weight is 550 N. What is the weight of the board?

1. Read and Understand

What information are you given?

$$\text{Tension in rope 1} = T_1 = 350 \text{ N}$$

$$\text{Tension in rope 2} = T_2 = 350 \text{ N}$$

$$\text{Weight of painter} = W_1 = 550 \text{ N}$$

2. Plan and Solve

What unknown are you trying to calculate?

$$\text{Weight of the board} = W_2 = ?$$

What mathematical equation can you use to calculate the unknown?

$$\Sigma F = 0$$

Determine the directions of all forces.

The tension in the ropes is upward. The weights of the painter and the board are downward.

Calculate the sum of the forces, being careful to use the correct signs.

$$\Sigma F = 350 \text{ N} + 350 \text{ N} - 550 \text{ N} - W_2 = 0$$

$$W_2 = 150 \text{ N}$$

3. Look Back and Check

Is your answer reasonable?

The sum of the upward forces is 700 N. The sum of the downward forces is 700 N. The answer is reasonable.

Math Practice

On a separate sheet of paper, solve the following problems.

- Three vertical ropes hold up a board that weighs 180 N. What is the tension in each rope?
- Suppose a painter weighing 700 N stands on the middle of a board suspended by two vertical ropes. If the weight of the board is 180 N, what is the tension in each rope?