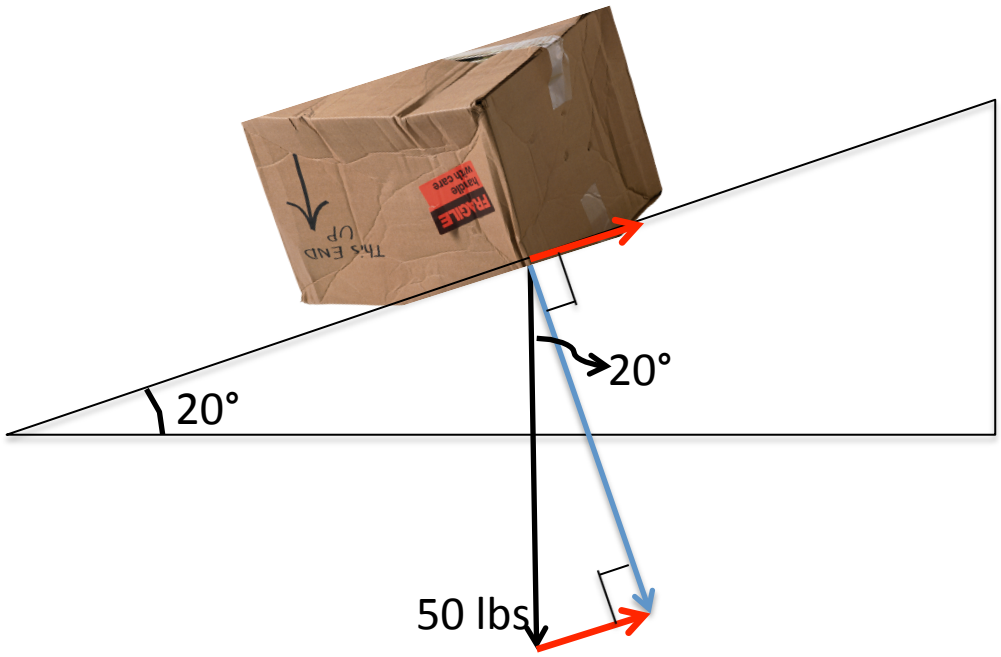
Force Required Not to Slide Back

A 50 pound box is on a ramp at an incline of 20° to the horizontal. What is the force required to keep it from sliding back down the ramp?

Picture 1st



What we learn

- The blue arrow in the right triangle (with the force of gravity) represents the vertical component of gravity with respect to the ramp
- The red arrow in the right triangle represents the horizontal component of gravity with respect to the ramp
- The red arrow is what we need since it is the force required to hold the box stationary on the ramp

How we get it

- sin 20° = opposite over hypotenuse

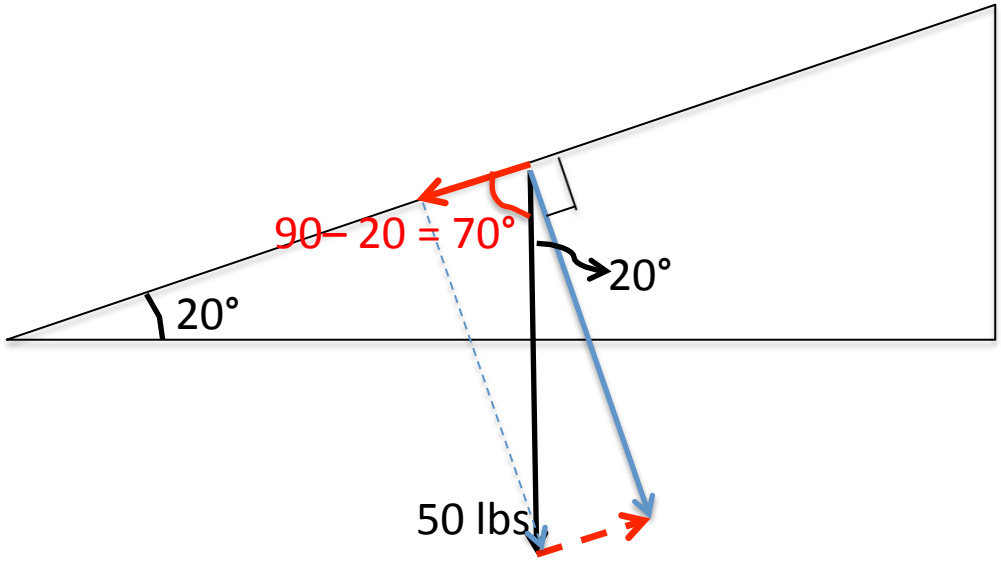
  opposite is the force we wish to find

  hypotenuse is known – 50 lbs due to gravity.

so, opposite = 50 sin 20°

Your Book's Interpretation

- Your book uses cosine instead of sine and they are using the other triangle. The triangle with the negative red vector along the ramp.



How Your Book's gets answer

- cos (90-20)° = adjacent over hypotenuse

  adjacent is the force we wish to find

  hypotenuse is known – 50 lbs due to gravity.

so, adjacent = 50 cos 70°

The Answer

- Whether you use sine

$$\text{Force} = 50 \sin 20^\circ \approx 17.1 \text{ lbs.}$$

- Or you use cosine

$$\text{Force} = 50 \cos 70^\circ \approx 17.1 \text{ lbs.}$$

Hence, the force required to keep a 50 lbs. box from sliding down a ramp with an incline of 20° is about 17 lbs.