

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$b^2 = a^2 + c^2 - 2ac \cdot \cos B$$

$$c^2 = a^2 + b^2 - 2ab \cdot \cos C$$

can be used to determine the unknown lengths of sides or the unknown measures of angles in *any* triangle.

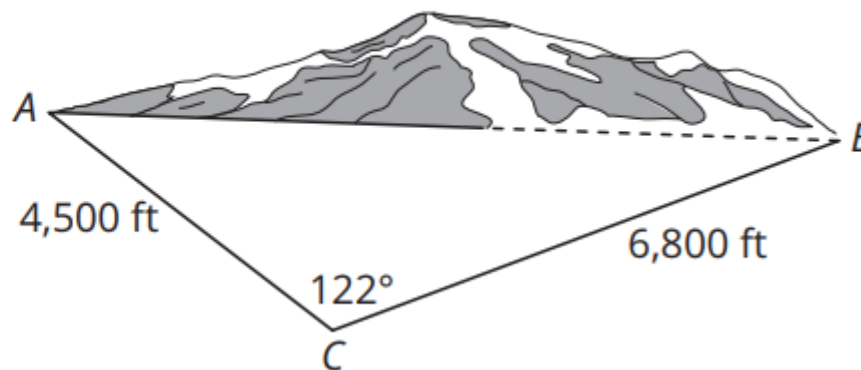
If finding an angle....get  
cos by itself

$$\cos A = \frac{a^2 - b^2 - c^2}{-2bc}$$

$$\angle A = \cos^{-1} \left( \frac{a^2 - b^2 - c^2}{-2bc} \right)$$

A surveyor was hired to determine the approximate length of a proposed tunnel, which will be necessary to complete a new highway. A mountain stretches from point  $A$  to point  $B$  as shown. The surveyor stands at point  $C$  and measures the distance from where she is standing to both points  $A$  and  $B$ , then measures the angle formed between these two distances.

1. Use the surveyor's measurements to determine the length of the proposed tunnel.



$$c^2 = (4500)^2 + (6800)^2 - 2(4500)(6800)\cos(122^\circ)$$

$$c^2 = 98,921,058.97$$

$$c = \sqrt{98,921,058.97}$$

$$c \approx 9945.9 \text{ ft}$$

How did she determine the distance across the river from point  $B$  to point  $C$ , and what is that distance?

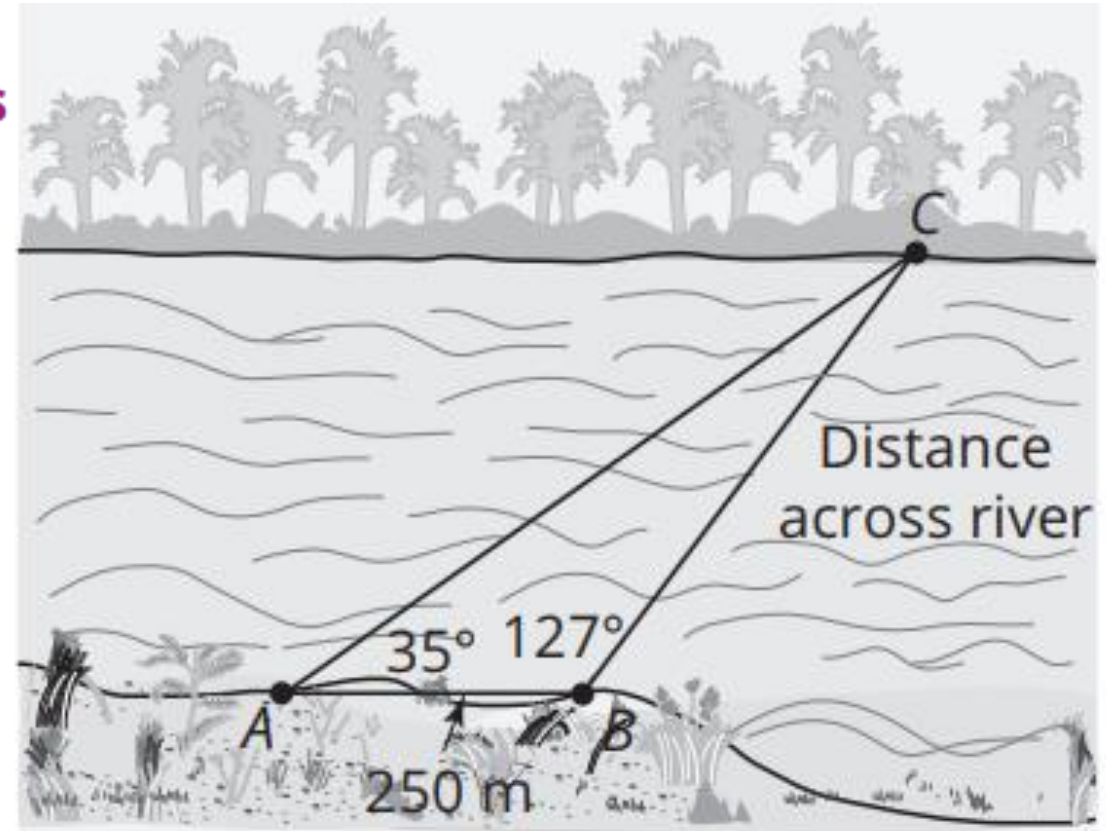
$$\angle C = 180^\circ - 35^\circ - 127^\circ$$

$$\angle C = 18^\circ$$

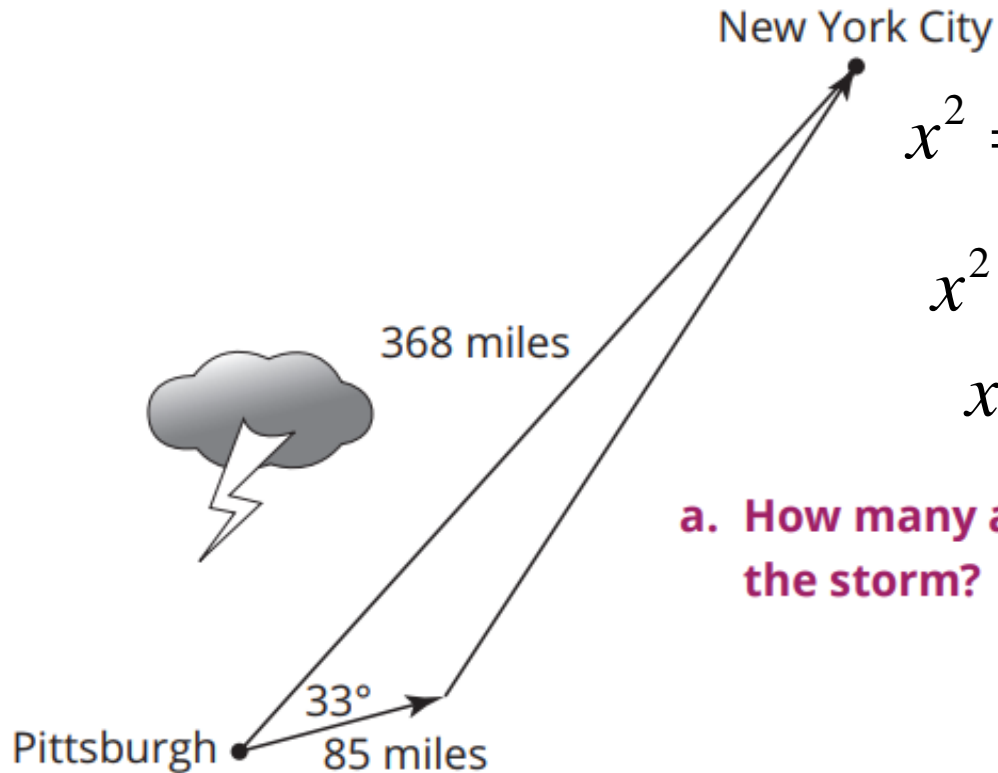
$$\frac{\sin(18^\circ)}{250} = \frac{\sin(35^\circ)}{BC}$$

$$BC = \frac{250 \sin(35^\circ)}{\sin(18^\circ)}$$

$$BC \approx 464.03m$$



3. A typical direct flight from Pittsburgh, Pennsylvania, to New York City is approximately 368 miles. A pilot alters the course of his aircraft  $33^\circ$  for 85 miles to avoid a storm and then turns the aircraft heading straight for New York City, as shown.



$$x^2 = (85)^2 + (368)^2 - 2(85)(368)\cos(33^\circ)$$

$$x^2 = 90181.76927$$

$$x \approx 300.3mi$$

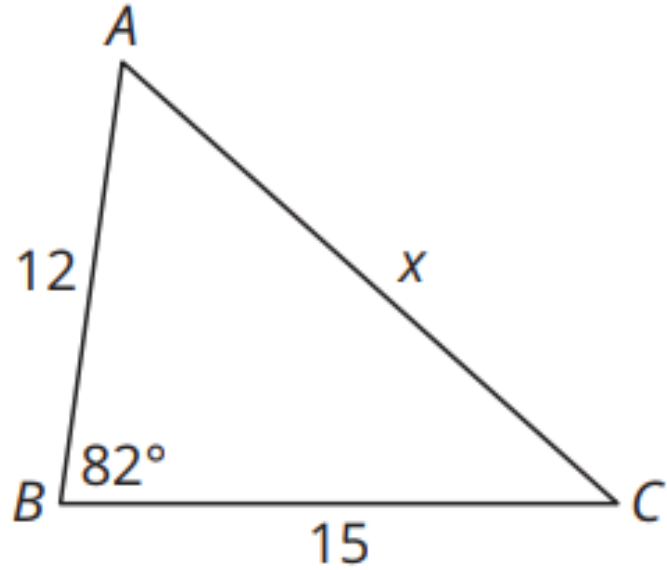
- a. How many additional miles did the aircraft travel to avoid the storm?

additional miles

$$\approx 300.3 + 85 - 368$$

$$\approx 17.3mi$$

c.



$$c^2 = (12)^2 + (15)^2 - 2(12)(15)\cos(82^\circ)$$

$$c^2 = 318.897\dots$$

$$c \approx 17.86$$

# Practice

1. Solve for  $x$  in each triangle. Round each answer to the nearest tenth.

