

## **Module 5c: Solving Right Triangles in Context**

### **Math Practice(s):**

- Make sense of problems & persevere in solving them.
- Model with mathematics.

### **Learning Target(s):**

- Apply trig ratios to determine the lengths of missing sides and the measures of missing angles of a right triangle (involving angles of elevation & depression).

### **Homework:**

HW#5: 5c #1-9

Warmup

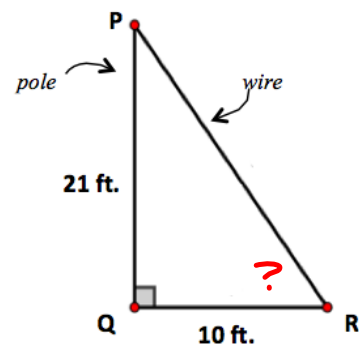
1. A pole that stands 21 feet tall is perpendicular to the ground. A wire is attached to the top of the pole, and the other end of the wire is placed on the ground, 10 feet away from the pole. What is the measure of the angle that is formed between the wire and the ground?

$$\tan R = \frac{21}{10}$$

$$\tan^{-1}\left(\frac{21}{10}\right) = R$$

$$R = 65^\circ$$

The angle formed between the wire & the ground is about  $65^\circ$ .



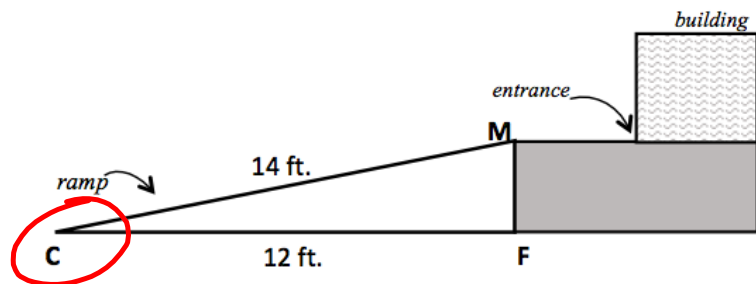
2. A school needs to build a ramp so that someone who uses a wheelchair can easily access the entrance to a building that is not on ground level. The diagram below shows the ramp that will be designed to form a right triangle where the ramp has a length of 14 feet and the beginning of the ramp is 12 feet away from the point on the ground below the top of the ramp.

What is the measure of the angle between the ground and the beginning of the ramp? (Note: the ramp "begins" at vertex C in the triangle in the diagram below.)

$$\cos C = \frac{12}{14}$$

$$\cos^{-1}\left(\frac{12}{14}\right) = C$$

$$C = 31^\circ$$



The measure of the angle between the ground & the ramp is about  $31^\circ$ .

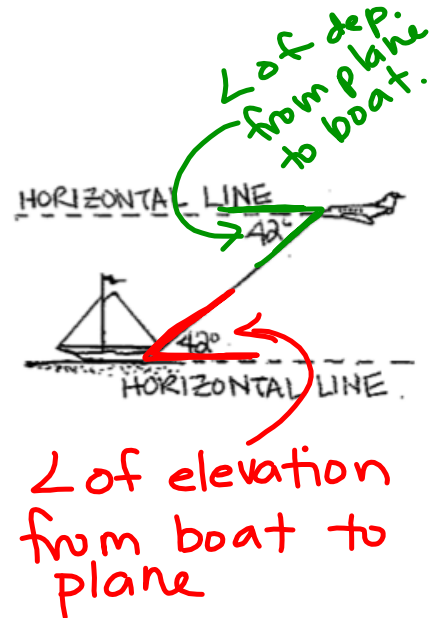
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**Angle of Elevation (#VOC)**

An angle above a horizontal line that an observer must look to see an object above.

**Angle of Depression (#VOC)**

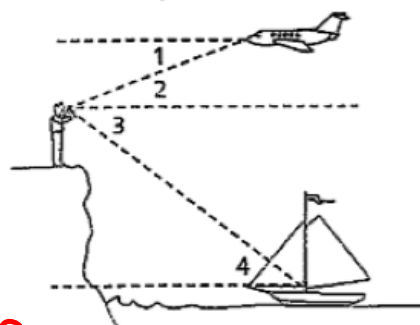
An angle below a horizontal line that an observer must look to see an object below.



Example 1

Describe each angle as it relates to the objects in the diagram.

- a)  $\angle 1$   $\angle$  of depression from plane to person.
- b)  $\angle 2$   $\angle$  of elevation from person to plane.
- c)  $\angle 3$   $\angle$  of depression from person to boat.
- d)  $\angle 4$   $\angle$  of elevation from boat to person.



Example 2

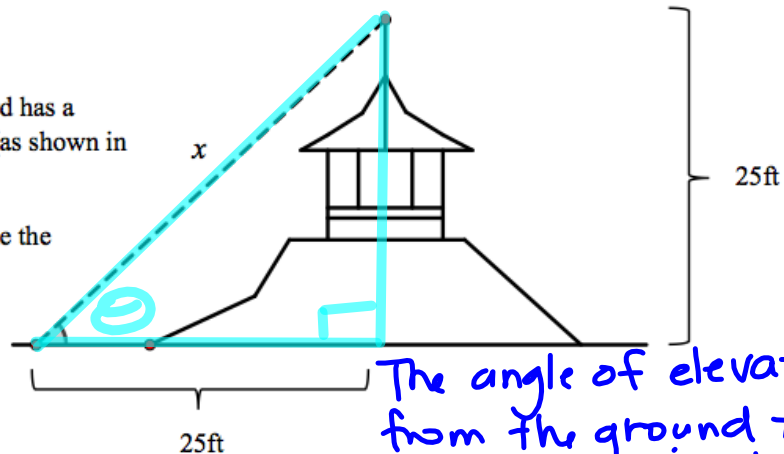
The gazebo in Grandma's backyard has a lightning rod attached to the roof (as shown in the diagram to the right).

- a. From the ground, determine the angle of elevation to the lightning rod?

$$\tan \theta = \frac{25}{25}$$

$$\tan^{-1}\left(\frac{25}{25}\right) = \theta$$

$$\theta = 45^\circ$$



The angle of elevation from the ground to lightning rod is  $45^\circ$ .

- b. Set up an equation involving a trig. ratio (sine, cosine or tangent), then, solve your equation to determine the value of  $x$  in the diagram.

trig table

$$\cos 45^\circ = \frac{25}{x}$$

$$\frac{\sqrt{2}}{2} = \frac{25}{x}$$

$$\frac{x \cdot \sqrt{2}}{\sqrt{2}} = \frac{50}{\sqrt{2}}$$

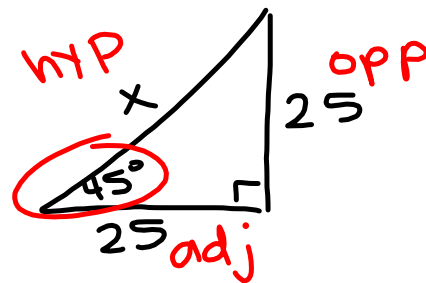
$$x \approx 35.355 \text{ ft}$$

calculator

$$x \cdot (\cos 45^\circ) = \frac{25}{x} \cdot x$$

$$\frac{x \cdot \cos 45^\circ}{\cos 45^\circ} = \frac{25}{\cos 45^\circ}$$

$$x \approx 35.355 \text{ ft}$$



**Example 3**

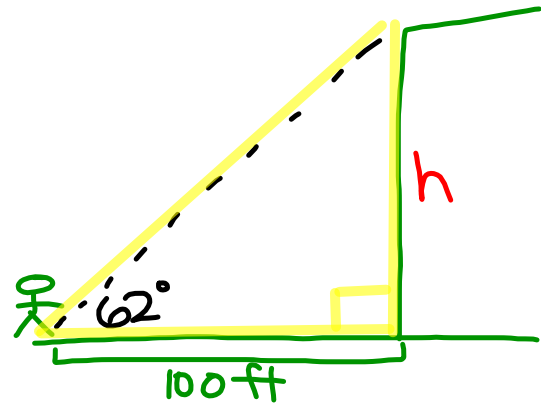
A man standing 100 ft from a building measures the angle of elevation to the top of the building from the point where he is standing. If that angle is approximately  $62^\circ$ , to the nearest foot, how tall is the building? Draw and label a diagram to represent this situation, then solve the problem.

$$\tan 62^\circ = \left(\frac{h}{100}\right) \cdot 100$$

$$100 \cdot \tan 62^\circ = h$$

$$h = 188.072$$

The building is about 188 ft tall.

**Example 4**

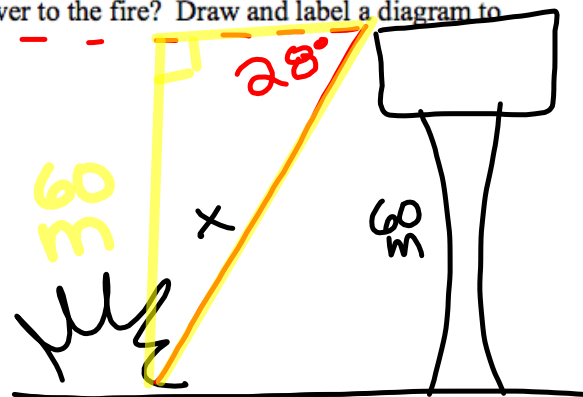
The angle of depression from the top of a water tower to a fire is  $28^\circ$ . If the tower is 60 m tall, to the nearest meter, what is the distance from the top of the tower to the fire? Draw and label a diagram to represent this situation, then solve the problem.

$$\sin 28^\circ = \left(\frac{60}{x}\right) \cdot x$$

$$\frac{x \cdot \sin 28^\circ}{\sin 28^\circ} = \frac{60}{\sin 28^\circ}$$

$$x \approx 127.803$$

The distance from the top of the tower to the fire is about 128 m.



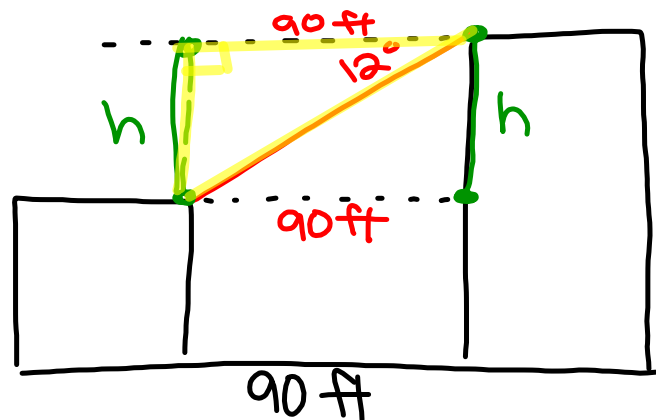
**Example 5**

Two buildings are standing 90 ft apart at their closest points. At those points, the angle of depression from the top of the taller building to the top of the shorter building is  $12^\circ$ . How much taller is the taller building? Draw and label a diagram to represent this situation, then solve the problem.

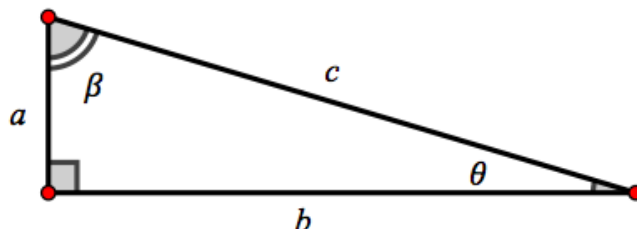
$$\tan 12^\circ = \frac{h}{90}$$

$$h = 19.130$$

The taller building is 19 ft taller than the shorter building.

**Example 6**

The right triangle to the right satisfies  $0 < a < b < c$ .



Answer the following questions using what you know about trigonometric ratios.

a. Which of the following statements is true for all values of  $a$ ,  $b$ , and  $c$ ? Explain how you know.

i.  $\sin(\theta) < \cos(\theta)$

ii.  $\sin(\theta) > \cos(\theta)$

iii.  $\sin(\theta) = \cos(\theta)$

$$\sin \theta = \frac{a}{c} \quad \cos \theta = \frac{b}{c}$$

since  $b > a$ ,  $\frac{b}{c} > \frac{a}{c}$