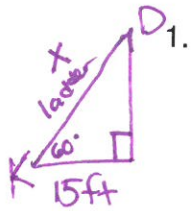# *Word Problems Using Right Triangle Trig*

Draw pictures! Make all answers accurate to the nearest tenth.

1. A damsel is in distress and is being held captive in a tower. Her knight in shining armor is on the ground below with a ladder. When the knight stands 15 feet from the base of the tower and looks up at his precious damsel, the angle of elevation to her window is 60 degrees. How long does the ladder have to be?

$$\cos(60) = \frac{15}{x}$$
$$x\cos(60) = 15$$
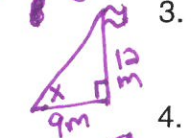$$x = \frac{15}{\cos 60}$$
$$\boxed{30 ft}$$
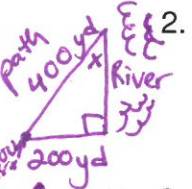
2. You are 200 yards from a river. Rather than walking directly to the river, you walk 400 yards along a straight path to the river's edge. Find the acute angle between path and the river's edge.

$$\sin(x) = \frac{200}{400}$$
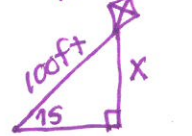$$x = \sin^{-1}\left(\frac{200}{400}\right)$$
$$\boxed{30°}$$

3. A 12 meter flagpole casts a 9 meter shadow. Find the angle of elevation of the sun.

$$\tan(x) = \frac{12}{9} \qquad x = \tan^{-1}(12/9)$$
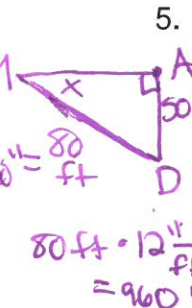$$\boxed{53.1°}$$

4. Suppose you're flying a kite, and it gets caught at the top of the tree. You've let out all 100 feet of string for the kite, and the angle that the string makes with the ground is 75 degrees. Instead of worrying about how to get your kite back, you wonder. "How tall is that tree?"

$$\sin(75) = \frac{x}{100}$$
$$x = 100\sin(75)$$
$$\boxed{96.6 ft}$$

5. Suppose that Mike and Dave are making measurements for the road-paving crew. They need to know how much the land slopes downward along a particular stretch of road. Dave walks 80 feet from Mike and holds up a long pole, perpendicular to the ground, that has markings every inch along it.   Mike looks at the pole through a sighting instrument. Looking straight across, parallel to the horizon, Mike sights a point on the pole 50 inches above the ground- call it point A. Then Mike looks through the instrument at the bottom of the pole, creating an angle of depression. Which is the angle of depression or slope of the road, to where Mike is standing?

$$\sin(x) = \frac{50}{960}$$
$$x = \sin^{-1}(50/960)$$
$$\boxed{3.0°}$$
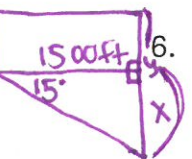
6. A submersible traveling at a depth of 250 feet dives at an angle of 15º with respect to a line parallel to the water's surface. It travels a horizontal distance of 1500 feet during the dive. What is the depth of the submersible after the dive?
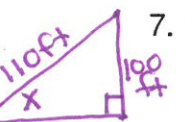
$$\tan(15) = \frac{x}{1500}$$
$$x = 1500\tan 15$$
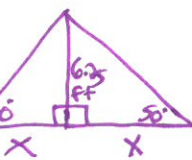$$x = 401.92$$
$$+ 250$$
$$\boxed{651.9 ft}$$

7. A fire department's longest ladder is 110 feet long, and the safety regulation states that they can use it for rescues up to 100 feet off the ground. What is the maximum safe angle of elevation for the rescue ladder?

$$\sin(x) = \frac{100}{110}$$
$$x = \sin^{-1}\left(\frac{100}{110}\right)$$
$$\boxed{65.4°}$$

8. Brothers Bob and Tom Katz buy a tent that has a center pole 6.25 feet high. If the sides of the tent are supposed to make a 50° angle with the ground, how wide is the tent?

$$\tan(50) = \frac{6.25}{x}$$
$$\frac{x\tan(50)}{\tan(50)} = \frac{6.25}{\tan(50)}$$
$$x = 5.24$$

$$x + x$$
$$\text{or } 2x$$
$$2(5.24)$$
$$\boxed{10.5 ft}$$

Side work:
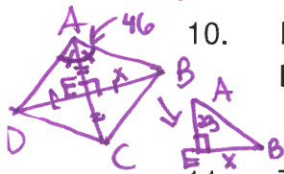$$160'' = 80 ft \qquad 80 ft \cdot 12\frac{''}{ft} = 960''$$

☐ In #10, add
rhombus facts

☐ Fix #10
→ Add AC = 10 cm
☐ Fix #15 15.90
51.9°
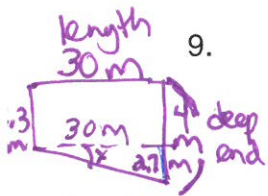
9. A swimming pool is 30 meters long and 12 meters wide. The bottom of the pool is slanted so that the water depth is 1.3 meters at the shallow end and 4 meters at the deep end. Find the angle of depression of the bottom of the pool.

length 30 m

.3 m 30 m 4 deep end

$\tan(x) = \frac{2.7}{30}$
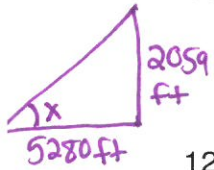
$x = \tan^{-1}\left(\frac{2.7}{30}\right)$

$\boxed{5.1°}$

10. In rhombus ABCD, diagonals $\overline{AC}$ and $\overline{BD}$ meet at point E. If the measure of angle DAB is 46°, find the length of $\overline{EB}$.
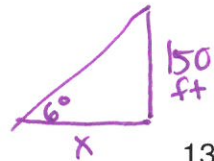
≅ sides, ⊥ diagonals, diagonals bisect angles
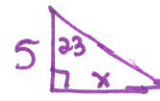
$\tan(23) = \frac{x}{5}$

$x = 5\tan(23)$

$\boxed{2.1 \text{ cm}}$

11. The tallest television transmitting tower in the world is in North Dakota, and it is 2059 feet tall. If you are on level ground exactly 5280 feet (one mile) from the base of the tower, what is your angle of elevation looking up at the top of the tower?

2059 ft
x
5280 ft

$\tan(x) = \frac{2059}{5280}$

$x = \tan^{-1}\left(\frac{2059}{5280}\right)$

$\boxed{21.3°}$

12. Ophelia Payne is walking to her office building which she knows is 150ft high. The angle to the top of the building from her current location is 6°. How much further does she need to walk?

150 ft
6°
x

$\tan(6) = \frac{150}{x}$

$x = \frac{150}{\tan(6)}$ $\boxed{1427.2 \text{ ft}}$
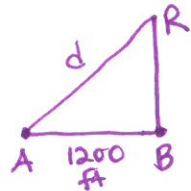
13. An observer on the ground at point A watches a rocket ascend. The observer is 1200 feet from the launch point B. As the rocket rises, the distance d from the observer to the rocket increases.
 a. Express the measure of angle A in terms of d.
  b. Find the measure of angle A if $d = 1500$ feet.
  c. Find the measure of angle A if $d = 2000$ feet.

d R

A 1200 ft B

$\cos(A) = \frac{1200}{d}$ ⓐ $\boxed{A = \cos^{-1}\left(\frac{1200}{d}\right)}$

$\cos(A) = \frac{1200}{1500}$ $A = \cos^{-1}\left(\frac{1200}{1500}\right)$ $\boxed{36.9°}$

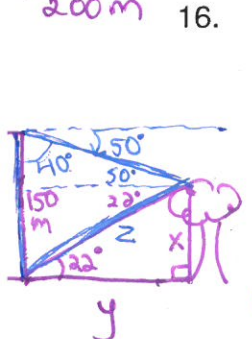$\cos(A) = \frac{1200}{2000}$ $A = \cos^{-1}\left(\frac{1200}{2000}\right)$ $\boxed{53.1°}$
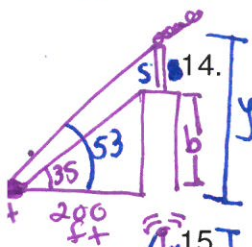
14. At a point 200 feet from the base of a building, the angle of elevation to the bottom of a smokestack is 35°, and the angle of elevation to the top is 53°. Find the height s of the smokestack.

S
53 b
35
200 ft

$\tan(35) = \frac{b}{200}$

$b = 200\tan(35) = \underline{140.04 \text{ ft}}$

$\tan(53) = \frac{y}{200}$

$y = 200\tan(53) = \underline{265.41}$

$s = y - b$
$s = 265.41 - 140.04$
$\boxed{s = 125.4 \text{ ft}}$
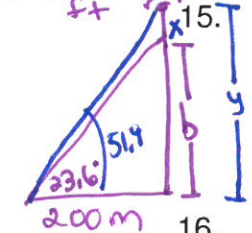
15. A communications tower is built on top of a building with the following specifications: from a point 200 meters from the base of the building, the angle of elevation to the top of the building is 23.6° and the angle of elevation to the top of the tower is 15.9°. Find the height of the tower.

x
51.4
23.6
200 m

$\tan(23.6) = \frac{b}{200}$ $b = 200\tan(23.6)$ $\tan(51.9) = \frac{y}{200}$ 51.9° $x = y - b$

$b = 87.38 \text{ m}$ $y = 200\tan(51.9)$ $x = 255.07$

$y = 255.07$ -87.38

$\boxed{167.7 \text{ m}}$

16. From the foot of a building I have to look upwards at an angle of 22° to sight the top of a tree. From the top of a building, 150 meters above ground level, I have to look down at an angle of depression of 50° to look at the top of the tree.
  a. How tall is the tree?
  b. How far from the building is the tree?

40° 50°
50°
150 m 22°
22°
z x
y

① $\frac{\sin(40)}{z} = \frac{\sin(72)}{150}$ 50 + 22

$150\sin(40) = z\sin(72)$

$\frac{150\sin(40)}{\sin(72)} = \frac{z\sin(72)}{\sin(72)}$

$101.38 \text{ m} = z$

② ⓐ $\sin(22) = \frac{x}{101.38}$

$x = 101.38\sin(22)$

ⓐ $\boxed{x = 37.98 \text{ m}}$

③ b. $\cos(22) = \frac{y}{101.38}$

$y = 101.38\cos(22)$

b. $\boxed{y = 94.0 \text{ m}}$