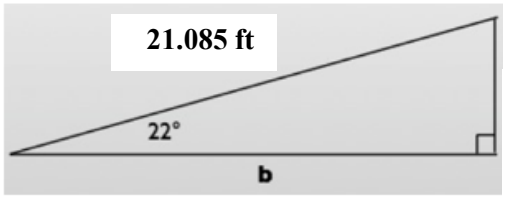
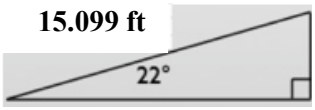
Write your questions here!

# 6.3 Trigonometry

Name: _____

**Opener:**




Are the triangles similar? Explain why or why not.

Find b.

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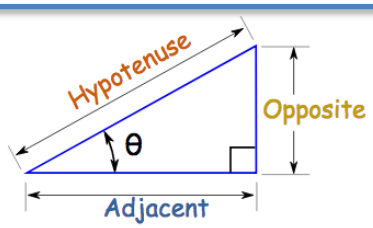
**Notes from Lesson:**

Trigonometry comes from the Greek words:

**Trigonon** which means "_____" and

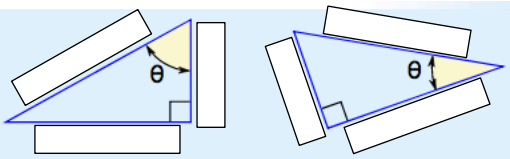
**Metron** which means "_____"




$\theta$ is just a variable, like $x$, used for unknown angle measures.

**Adjacent** is always next to the angle

And **Opposite** is opposite the angle




The **hypotenuse** is always opposite the right angle.

**Khan Academy Link**

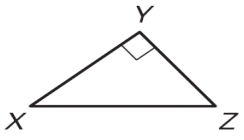
How to name sides of a right triangle according to the reference angle given.

*Circle:*

**#1:** A B C
**#2:** A B C
**#3:** A B C

**Use this diagram for Exercises 1 - 3.**

1. Name the hypotenuse
2. Name the leg opposite of $\angle X$
3. Name the leg adjacent to $\angle X$



# Right Triangle Exploration Activity (Part 1)

Using a protractor and a straight edge, draw 3 right triangles of any size on a separate sheet of paper with a *reference angle* of 40 degrees.

1. Label the opposite side **O**, the hypotenuse side **H**, and the adjacent side **A**.
2. Then with a ruler, as accurately as possible, measure and record the length of each side in centimeters.
3. Fill in the chart below for your unique triangle. Do so, by finding the following side ratios for your triangle in decimal form and round to 2 decimal places. (i.e. Divide the numerator by the denominator to get a decimal)

For a reference angle of 40 degrees within a right triangle.

| Right Triangle w/ $\theta = 40°$ | Drawing | $\frac{opp}{hyp}$ | $\frac{adj}{hyp}$ | $\frac{opp}{adj}$ |
|---|---|---|---|---|
| 1st Triangle | | | | |
| 2nd Triangle | | | | |
| 3rd Triangle | | | | |

What is a hypothesis that could be made about the corresponding side ratios of similar triangles?

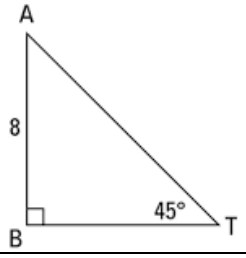
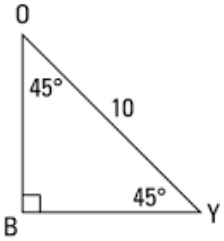
**Test your hypothesis with a different reference angle than 40 degrees.**

| Right Triangle w/ $\theta =$ ___ ° | Drawing | $\frac{opp}{hyp}$ | $\frac{adj}{hyp}$ | $\frac{opp}{adj}$ |
|---|---|---|---|---|
| 1st Triangle | | | | |
| 2nd Triangle | | | | |

Does your hypothesis still work?

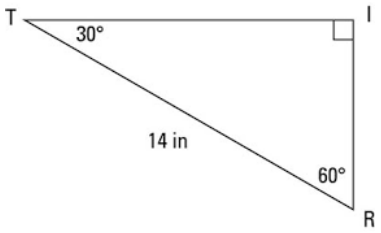
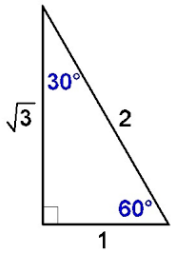
---

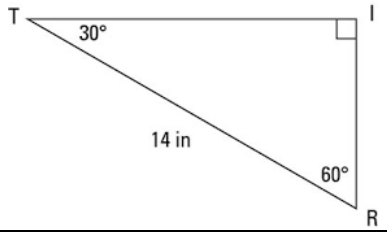
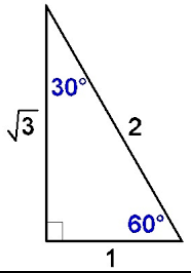
**Test your hypothesis with 45-45-90 special right triangles.**

| Right Triangle w/ $\theta = 45°$ | Drawing | $\frac{opp}{hyp}$ | $\frac{adj}{hyp}$ | $\frac{opp}{adj}$ |
|---|---|---|---|---|
| 1st Triangle |   | | | |
| 2nd Triangle |   | | | |

Does your hypothesis still work?

**Test your hypothesis with 30-60-90 special right triangles.**

| Right Triangle w/ $\theta = 30°$ | Drawing | $\frac{opp}{hyp}$ | $\frac{adj}{hyp}$ | $\frac{opp}{adj}$ |
|---|---|---|---|---|
| 1st Triangle |  | | | |
| 2nd Triangle |  | | | |

| Right Triangle w/ $\theta = 30°$ | Drawing | $\frac{opp}{hyp}$ | $\frac{adj}{hyp}$ | $\frac{opp}{adj}$ |
|---|---|---|---|---|
| 1st Triangle |  | | | |
| 2nd Triangle |  | | | |

Does your hypothesis still work?

# Using the Trig Chart

Using the table to the right, answer the following questions:

1. Approximate the $\frac{adj}{hyp}$ side ratio (or Cos A) for a $40^0$ reference angle.

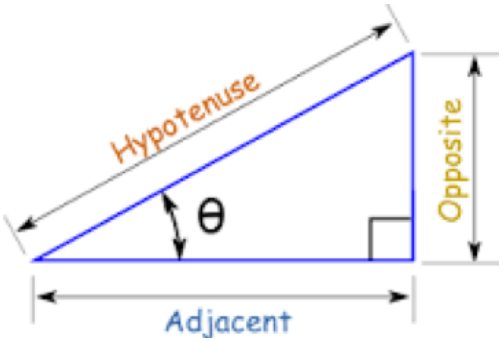
2. Approximate the measure of the acute $\angle A$ in a right triangle to the nearest degree given that the $\frac{opp}{adj}$ side ratio (or Tan A) is 1.93

3. Approximate the measure of the acute $\angle A$ in a right triangle to the nearest degree given that the $\frac{opp}{hyp}$ side ratio (or Sin A) is 0.34

| $m^\circ \angle A$ | sin A | cos A | tan A | $m^\circ \angle A$ | sin A | cos A | tan A |
|---|---|---|---|---|---|---|---|
| 1 | 0.0175 | 0.9998 | 0.0175 | 46 | 0.7193 | 0.6947 | 1.0355 |
| 2 | 0.0349 | 0.9994 | 0.0349 | 47 | 0.7314 | 0.6820 | 1.0724 |
| 3 | 0.0523 | 0.9986 | 0.0524 | 48 | 0.7431 | 0.6691 | 1.1106 |
| 4 | 0.0698 | 0.9976 | 0.0699 | 49 | 0.7547 | 0.6561 | 1.1504 |
| 5 | 0.0872 | 0.9962 | 0.0875 | 50 | 0.7660 | 0.6428 | 1.1918 |
| 6 | 0.1045 | 0.9945 | 0.1051 | 51 | 0.7771 | 0.6293 | 1.2349 |
| 7 | 0.1219 | 0.9925 | 0.1228 | 52 | 0.7880 | 0.6157 | 1.2799 |
| 8 | 0.1392 | 0.9903 | 0.1405 | 53 | 0.7986 | 0.6018 | 1.3270 |
| 9 | 0.1564 | 0.9877 | 0.1584 | 54 | 0.8090 | 0.5878 | 1.3764 |
| 10 | 0.1736 | 0.9848 | 0.1763 | 55 | 0.8192 | 0.5736 | 1.4281 |
| 11 | 0.1908 | 0.9816 | 0.1944 | 56 | 0.8290 | 0.5592 | 1.4826 |
| 12 | 0.2079 | 0.9781 | 0.2126 | 57 | 0.8387 | 0.5446 | 1.5399 |
| 13 | 0.2250 | 0.9744 | 0.2309 | 58 | 0.8480 | 0.5299 | 1.6003 |
| 14 | 0.2419 | 0.9703 | 0.2493 | 59 | 0.8572 | 0.5150 | 1.6643 |
| 15 | 0.2588 | 0.9659 | 0.2679 | 60 | 0.8660 | $0.5\bar{0}$ | 1.7321 |
| 16 | 0.2756 | 0.9613 | 0.2867 | 61 | 0.8746 | 0.4848 | 1.8040 |
| 17 | 0.2924 | 0.9563 | 0.3057 | 62 | 0.8829 | 0.4695 | 1.8807 |
| 18 | 0.3090 | 0.9511 | 0.3249 | 63 | 0.8910 | 0.4540 | 1.9626 |
| 19 | 0.3256 | 0.9455 | 0.3443 | 64 | 0.8988 | 0.4384 | 2.0503 |
| 20 | 0.3420 | 0.9397 | 0.3640 | 65 | 0.9063 | 0.4226 | 2.1445 |
| 21 | 0.3584 | 0.9336 | 0.3839 | 66 | 0.9135 | 0.4067 | 2.2460 |
| 22 | 0.3746 | 0.9272 | 0.4040 | 67 | 0.9205 | 0.3907 | 2.3559 |
| 23 | 0.3907 | 0.9205 | 0.4245 | 68 | 0.9272 | 0.3746 | 2.4751 |
| 24 | 0.4067 | 0.9135 | 0.4452 | 69 | 0.9336 | 0.3584 | 2.6051 |
| 25 | 0.4226 | 0.9063 | 0.4663 | 70 | 0.9397 | 0.3420 | 2.7475 |
| 26 | 0.4384 | 0.8988 | 0.4877 | 71 | 0.9455 | 0.3256 | 2.9042 |
| 27 | 0.4540 | 0.8910 | 0.5095 | 72 | 0.9511 | 0.3090 | 3.0777 |
| 28 | 0.4695 | 0.8829 | 0.5317 | 73 | 0.9563 | 0.2924 | 3.2709 |
| 29 | 0.4848 | 0.8746 | 0.5543 | 74 | 0.9613 | 0.2756 | 3.4874 |
| 30 | $0.5\bar{0}$ | 0.8660 | 0.5774 | 75 | 0.9659 | 0.2588 | 3.7321 |
| 31 | 0.5150 | 0.8572 | 0.6009 | 76 | 0.9703 | 0.2419 | 4.0108 |
| 32 | 0.5299 | 0.8480 | 0.6249 | 77 | 0.9744 | 0.2250 | 4.3315 |
| 33 | 0.5446 | 0.8387 | 0.6494 | 78 | 0.9781 | 0.2079 | 4.7046 |
| 34 | 0.5592 | 0.8290 | 0.6745 | 79 | 0.9816 | 0.1908 | 5.1446 |
| 35 | 0.5736 | 0.8192 | 0.7002 | 80 | 0.9848 | 0.1736 | 5.6713 |
| 36 | 0.5878 | 0.8090 | 0.7265 | 81 | 0.9877 | 0.1564 | 6.3138 |
| 37 | 0.6018 | 0.7986 | 0.7536 | 82 | 0.9903 | 0.1392 | 7.1154 |
| 38 | 0.6157 | 0.7880 | 0.7813 | 83 | 0.9925 | 0.1219 | 8.1443 |
| 39 | 0.6293 | 0.7771 | 0.8098 | 84 | 0.9945 | 0.1045 | 9.5144 |
| 40 | 0.6428 | 0.7660 | 0.8391 | 85 | 0.9962 | $0.087\dot{2}$ | 11.4301 |
| 41 | 0.6561 | 0.7547 | 0.8693 | 86 | 0.9976 | 0.0698 | 14.3007 |
| 42 | 0.6691 | 0.7431 | 0.9004 | 87 | 0.9986 | 0.0523 | 19.0811 |
| 43 | 0.6820 | 0.7314 | 0.9325 | 88 | 0.9994 | 0.0349 | 28.6363 |
| 44 | 0.6947 | 0.7193 | 0.9657 | 89 | 0.9998 | 0.0175 | 57.2900 |
| 45 | 0.7071 | 0.7071 | 1 | 90 | 1 | 0 | Undefined |

Write your questions here!

$$\sin\theta = \frac{\text{Opposite}}{\text{Hypotenuse}} \qquad \cos\theta = \frac{\text{Adjacent}}{\text{Hypotenuse}} \qquad \tan\theta = \frac{\text{Opposite}}{\text{Adjacent}}$$




**Watch the Basic Trigonometry KHAN Academy Video on SOH - CAH – TOA**

Complete the PowerPoint Quiz, Khan Academy Quiz, and IXL standard R1 to check for understanding and help you memorize terminology

Notes:

# Right Triangle Exploration Activity (Part 2)

Using a ruler and a protractor. Draw a 3-4-5 right triangle in cm in the box to the right.

1. Mark the smaller of the 2 acute angles as your reference angle, $\theta$ (or Theta).

2. Find the sine, cosine, and tangent side ratios for the 3-4-5 right triangle.

$\sin\theta =$ $\cos\theta =$ $\tan\theta =$

3. Put the side ratios from the video in decimal form.

$\sin\theta =$ $\cos\theta =$ $\tan\theta =$

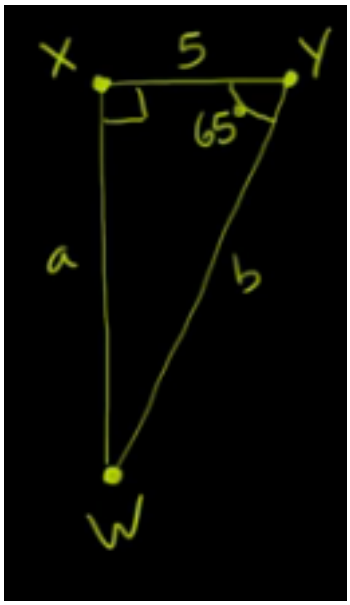
4. Using the chart find the reference angle.

5. Using a protractor find the reference angle. Does this angle you found match the angle measure when you physically measure it with a protractor?

Write your questions here!

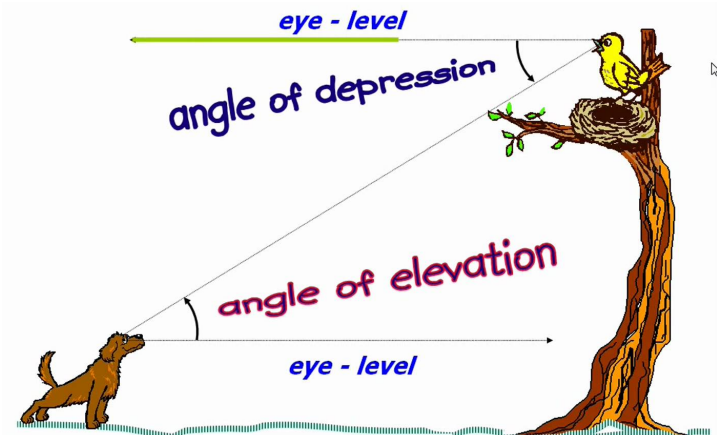
**Solving Trig Equations**

Solve the right triangle below. Give the length to the nearest tenth.




Watch the application video in its entirety and solve the problem below.

A 15 foot ladder is leaned against a house. If the base of the ladder is 4 feet from the house, what angle does the ladder make with the ground?

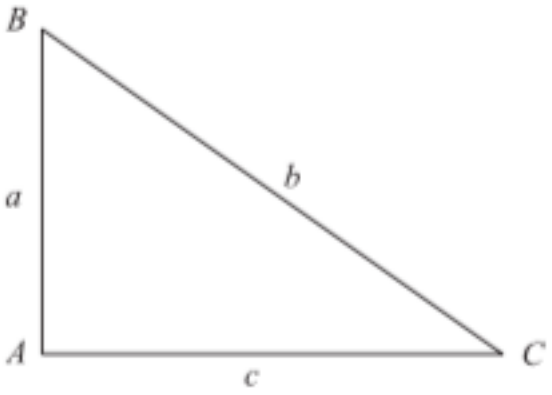


## 6.3 Problem Set

**SOH CAH TOA**

1. Multiple Choice:

For the right triangle $\Delta ABC$ shown below, what is $\sin C$?




**F.** $\frac{a}{b}$

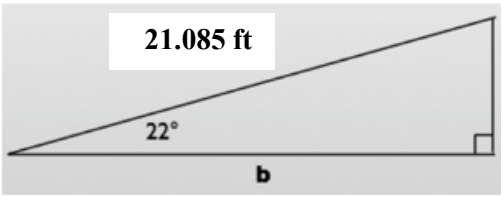
**G.** $\frac{a}{c}$

**H.** $\frac{b}{a}$

**J.** $\frac{c}{b}$

**K.** $\frac{c}{a}$

2. **Look back at opener:** This time we will solve for b only having one right triangle.




Label the opposite side **O**, the hypotenuse side **H**, and the adjacent side **A**.

$\_\_\_\_ 22^0 = \frac{\_\_\_\_}{\_\_\_\_}$ Fill in the blanks and find side ratio in the chart or calculator.

↓ ↓

$\frac{\_\_\_\_}{1} = \frac{\_\_\_\_}{\_\_\_\_}$ Cross multiply.

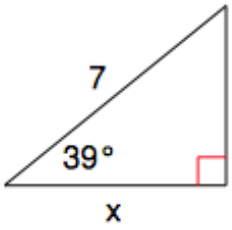
↓ ↓

$= \_\_\_\_$ Solve.

3. Complete the follow Geometry IXL standards:
   - R1 (should have already been completed)
   - R5-R10 Stop when you hit csc, sec, cot

**Mixed Review:** Find the missing side or angle.

4.

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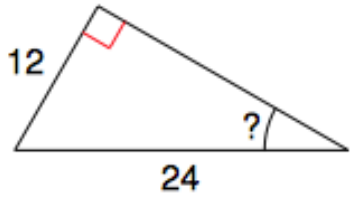


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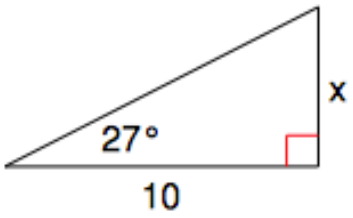


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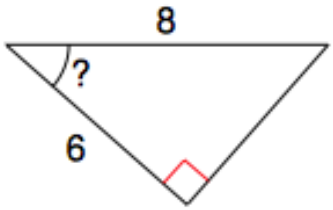


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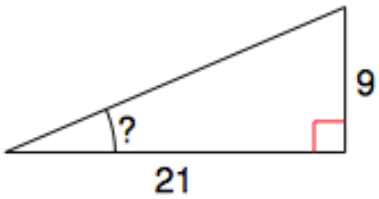


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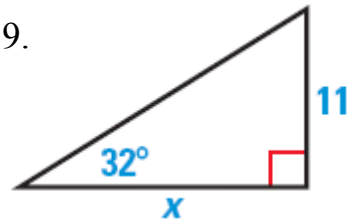

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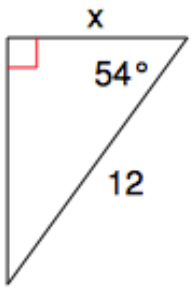


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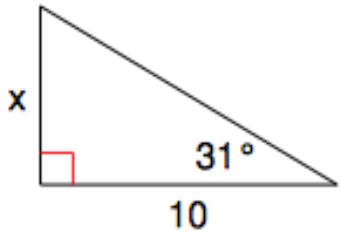


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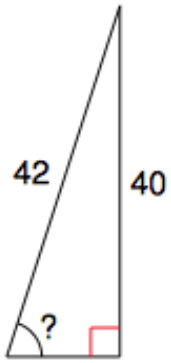


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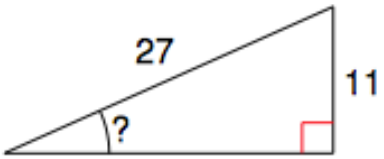


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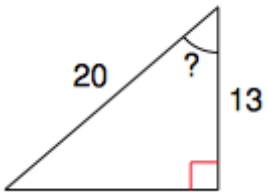


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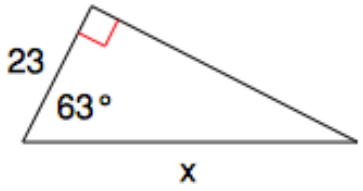


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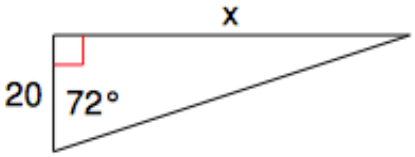


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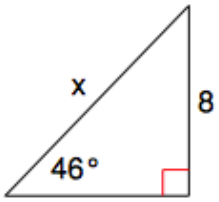
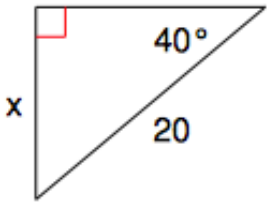



18.



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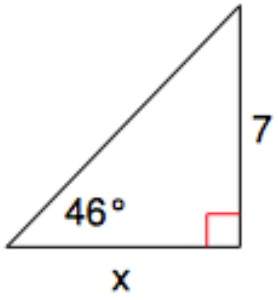


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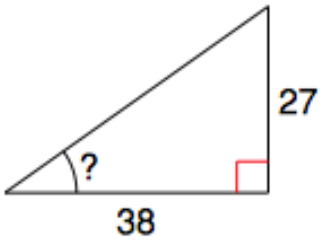


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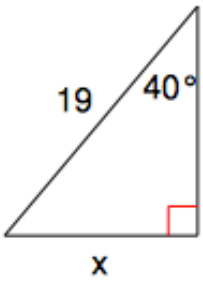


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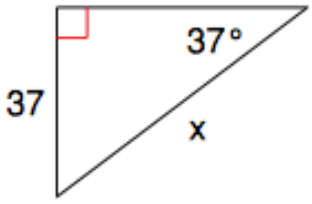


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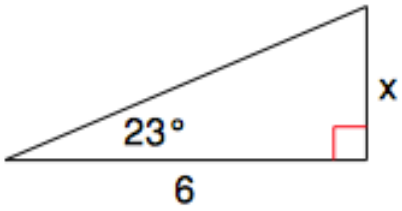


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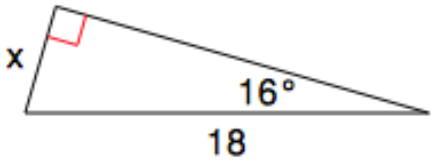
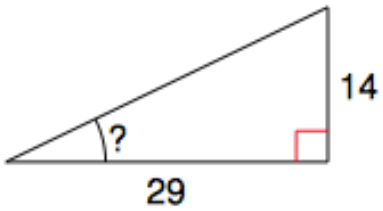



25.

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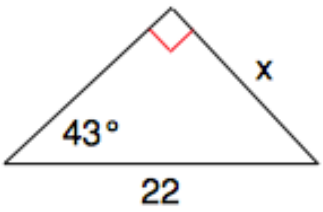

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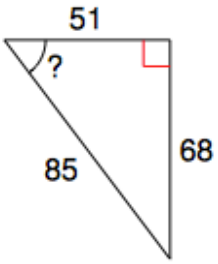


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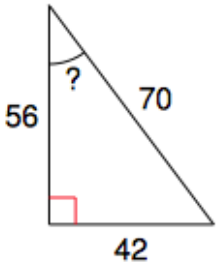


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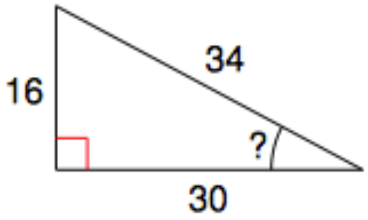
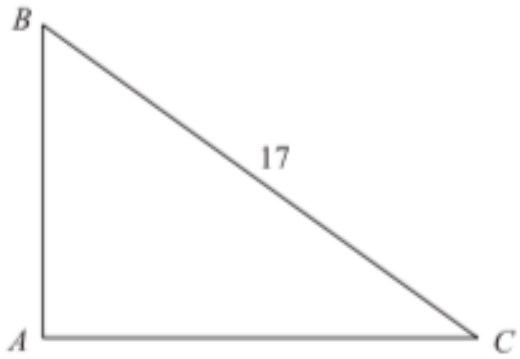



31. Solve the right triangle.

Draw and label all three sides of a right triangle that has a 40° angle and a hypotenuse of 10 cm.

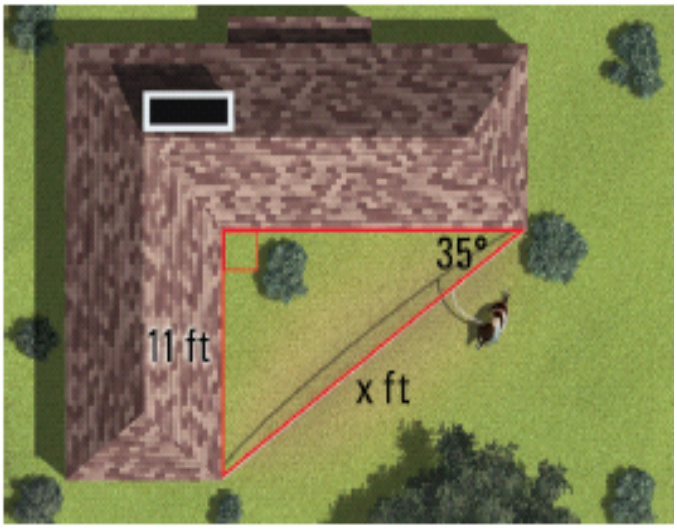
**32.** The hypotenuse of the right triangle $\Delta ABC$ shown below is 17 feet long. The cosine of angle $C$ is $\frac{3}{5}$. How many feet long is the segment $AC$?



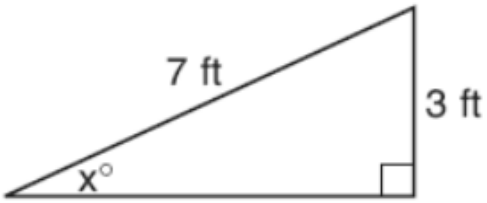

**F.** 6
**G.** 10.2
**H.** 12
**J.** 15
**K.** 28.3

**6.3 Applications**

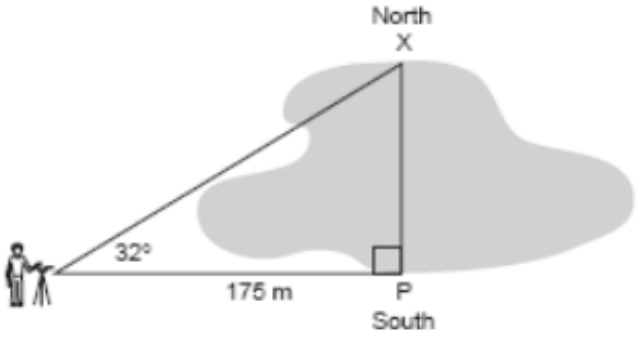
1. You want to string cable to make a dog run from two corners of a building, as shown in the diagram. Write and solve a proportion using a trigonometric ratio to approximate the length of cable you will need.



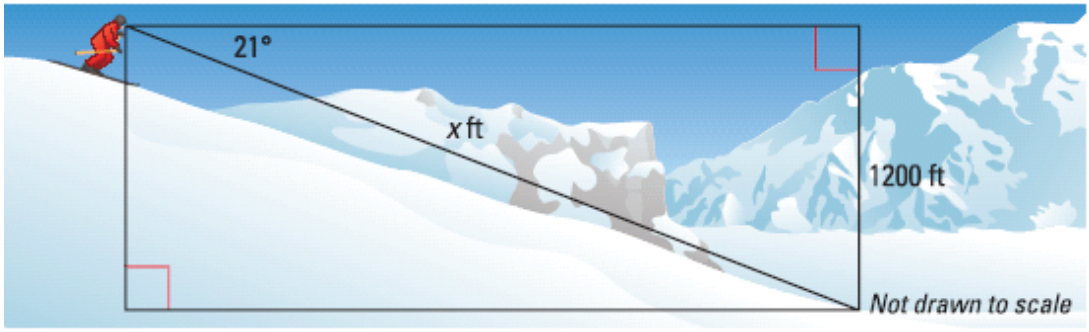

2. Ron and Francine are building a ramp for performing skateboard stunts, as shown in the accompanying diagram. The ramp is 7 feet long and 3 feet high. What is the measure of the angle, $x$, that the ramp makes with the ground, to the *nearest tenth of a degree*?




3. A surveyor needs to determine the distance across the pond shown in the accompanying diagram. She determines that the distance from her position to point $P$ on the south shore of the pond is 175 meters and the angle from her position to point $X$ on the north shore is 32°. Determine the distance, $PX$, across the pond, rounded to the *nearest meter*.

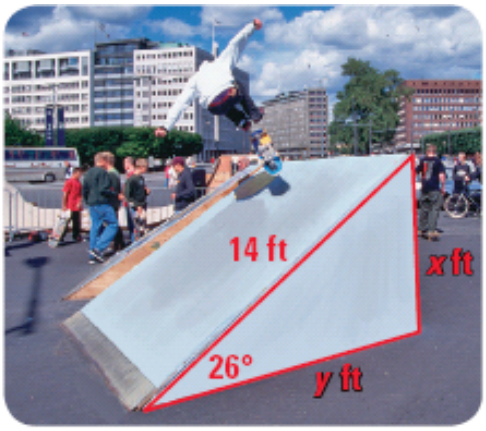


4. You are skiing on a mountain with an altitude of 1200 meters. The angle of depression is 21°. About how far do you ski down the mountain?



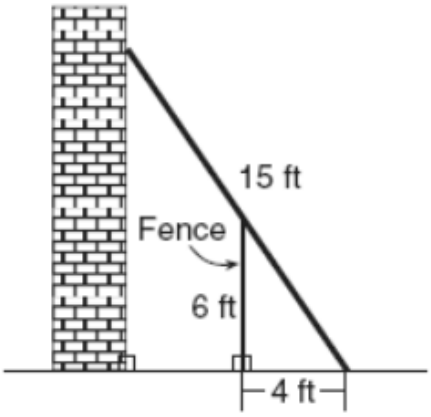

5. A person measures the angle of depression from the top of a wall to a point on the ground. The point is located on level ground 62 feet from the base of the wall and the angle of depression is 52°. How high is the wall, to the *nearest tenth of a foot*?

6. You want to build a skateboard ramp with a length of 14 feet and an angle of elevation of 26°. You need to find the height and length of the base of the ramp.



7.

In the accompanying diagram, the base of a 15-foot ladder rests on the ground 4 feet from a 6-foot fence.

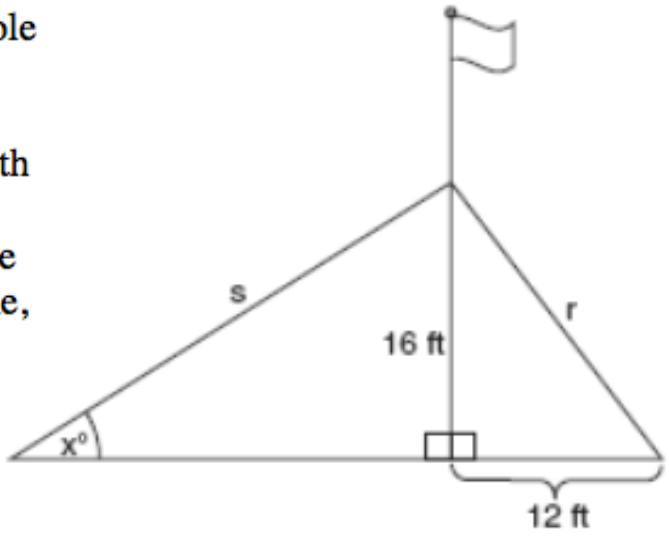



*a* If the ladder touches the top of the fence and the side of a building, what angle, to the *nearest degree*, does the ladder make with the ground?

*b* Using the angle found in part *a*, determine how far the top of the ladder reaches up the side of the building, to the *nearest foot*.

8.

The accompanying diagram shows a flagpole that stands on level ground. Two cables, *r* and *s*, are attached to the pole at a point 16 feet above the ground. The combined length of the two cables is 50 feet. If cable *r* is attached to the ground 12 feet from the base of the pole, what is the measure of the angle, *x*, to the *nearest degree*, that cable *s* makes with the ground?



9. Multiple Choice

The angle of elevation from a point 25 feet from the base of a tree on level ground to the top of the tree is 30°. Which equation can be used to find the height of the tree?

[A] $\tan 30° = \frac{x}{25}$ [B] $\sin 30° = \frac{x}{25}$

[C] $30^2 + 25^2 = x^2$ [D] $\cos 30° = \frac{x}{25}$

10. **Based on these quick facts, guess what degree from vertical is the Leaning Tower of Pisa leaning?**

*Leaning-Tower of Pisa*

QUICK FACTS:

→ **Name:** Tower of Pisa, Leaning Tower of Pisa, Bell Tower of Pisa
→ **Italian Name:** Torre Pendente di Pisa
→ **Location:** City of Pisa, Italy.
→ **Accommodation:** Find Hotels in Pisa
→ **Construction Year:** started in 1173, finished in 1399
→ **Original Height:** 60 m
→ **Actual Height:** 56.67m =highest side; 55.86m =lowest side
→ **Stairs:** 251 steps
→ **Weight:** 14,500 tonnes

11. **INTERACTIVE PROBLEM: Will the neighbor tree hit the house?**

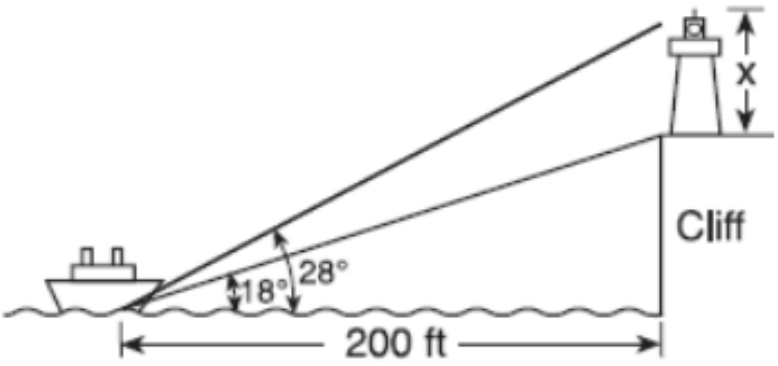
If my neighbors wanted to cut that tree down themselves to save money, knowing the exact height would be important. They would need to cut the tree, so it falls in their lot and not the street because it is not okay for them to block the street. If the tree needs to fall in their lot towards their house, knowing the height would be vital to ensure that there would be no possibly for property damage.

*Now it is time to explore this scenario in more detail. Go online to my website to complete this interactive problems ☺*

12. 3 ACT Math - Height of the flagpole problem

13.

A lighthouse is built on the edge of a cliff near the ocean, as shown in the accompanying diagram. From a boat located 200 feet from the base of the cliff, the angle of elevation to the top of the cliff is 18° and the angle of elevation to the top of the lighthouse is 28°. What is the height of the lighthouse, $x$, to the *nearest tenth of a foot*?



14.

If $\sin\theta = \frac{4}{5}$ and $\frac{\pi}{2} < \theta < \pi$, then $\tan\theta = ?$

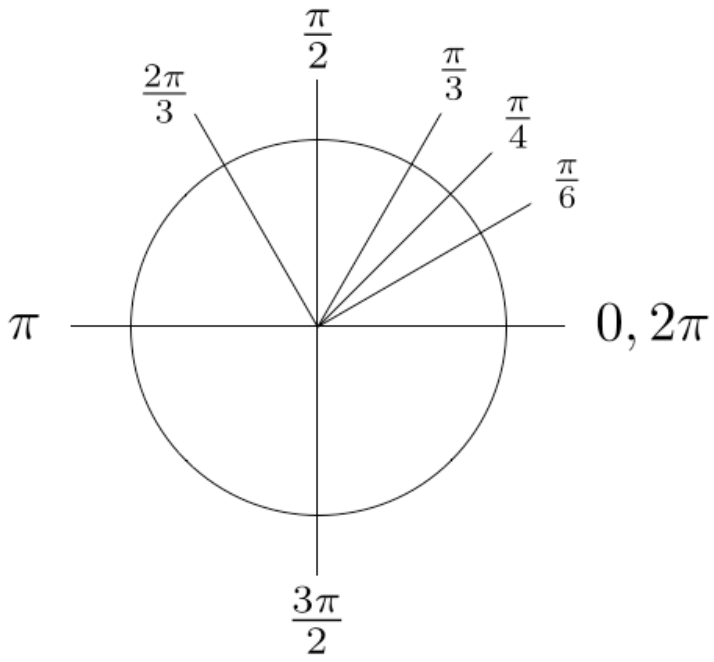
**F.** $-\frac{5}{4}$

**G.** $-\frac{4}{3}$

**H.** $-\frac{3}{5}$

**J.** $\frac{4}{3}$

**K.** $\frac{3}{4}$




11.

If $\cos\theta = -\frac{3}{5}$ and $\frac{\pi}{2} < \theta < \pi$, then $\tan\theta = ?$

**F.** $-\frac{5}{4}$

**G.** $-\frac{4}{3}$

**H.** $-\frac{3}{5}$

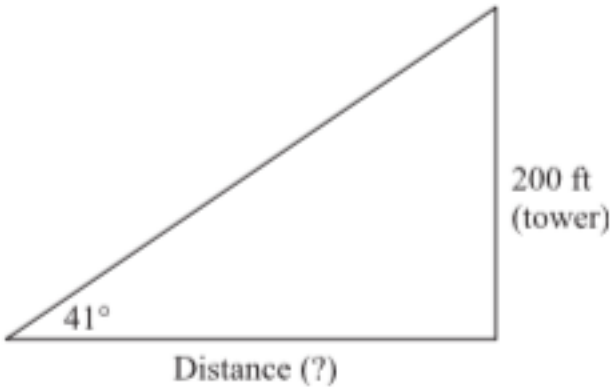
**J.** $\frac{3}{4}$

**K.** $\frac{4}{3}$

For 2 extra credit tickets:

- watch the Khan video - https://www.khanacademy.org/math/geometry-home/right-triangles-topic/reciprocal-trig-ratios-geo/v/example-the-six-trig-ratios
- Complete the follow Geometry IXL standards to 100%:
    1. R1 (should have already been completed)
    2. R2 Stop when you hit csc, sec, cot
    3. R5-R10 Stop when you hit csc, sec, cot
- and answer the question below.

When measured from a point on the ground that is a certain distance from the base of a cell phone tower, the angle of elevation to the top of the tower is 41°, as shown below. The height of the cell phone tower is 200 feet. What is the distance, in feet, to the cell phone tower?




**F.** $200 \tan 41°$
**G.** $200 \sin 41°$
**H.** $200 \cos 41°$
**J.** $200 \sec 41°$
**K.** $200 \cot 41°$