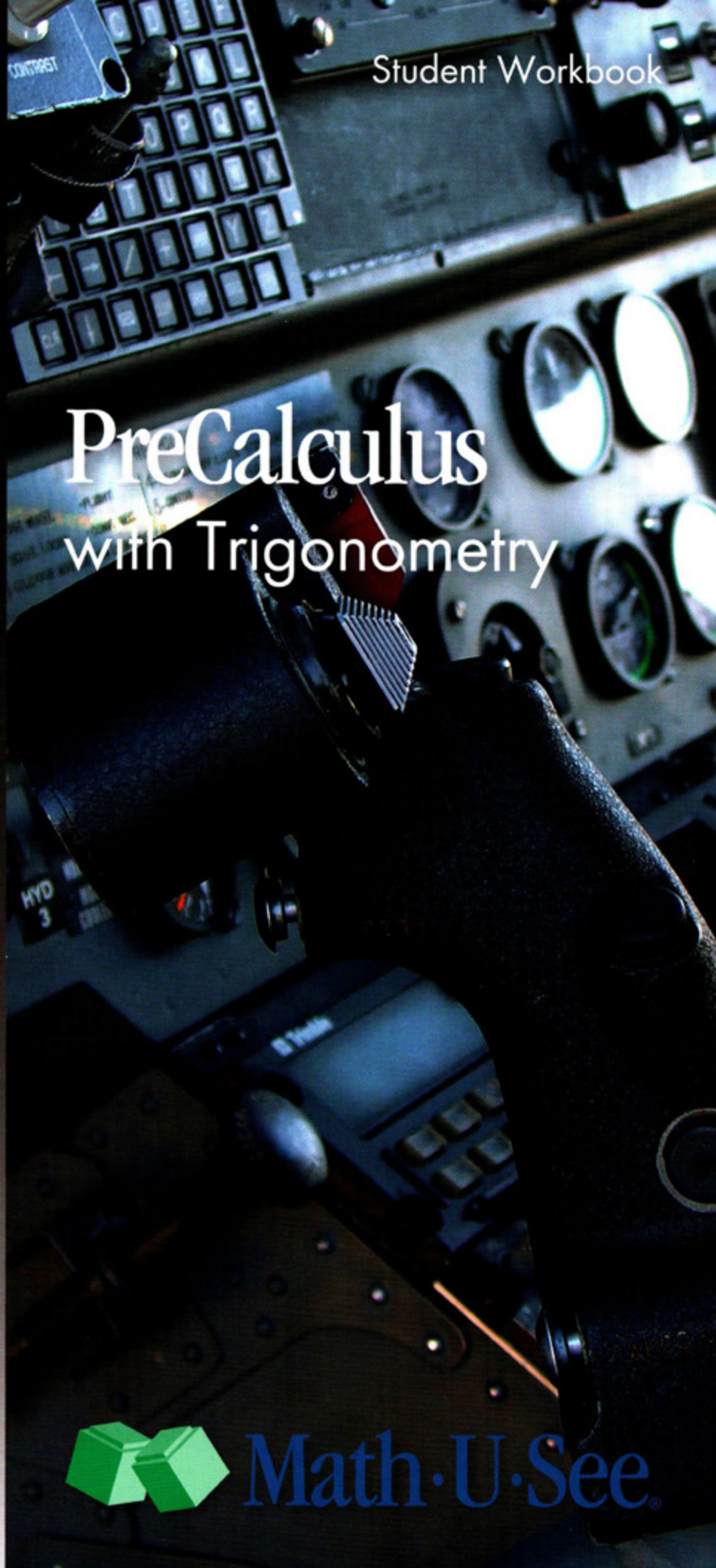

Student Workbook

PreCalculus
with Trigonometry

Math·U·See

PreCalculus
with Trigonometry

Student Workbook

By Steven P. Demme

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1-888-854-MATH (6284)
www.MathUSee.com

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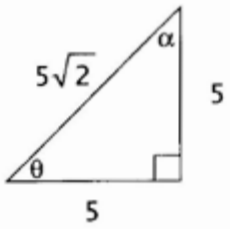
Find the sine, cosine, and tangent of θ and α, and express the ratios in fraction form.



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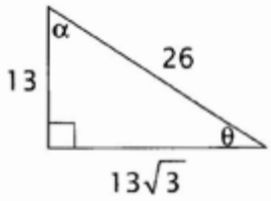

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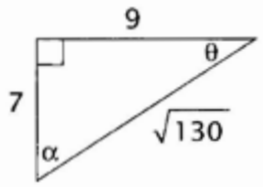

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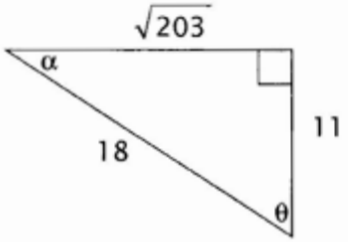

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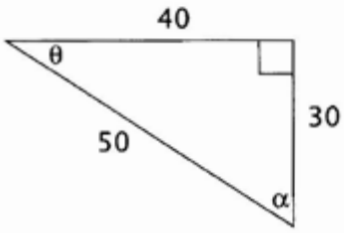

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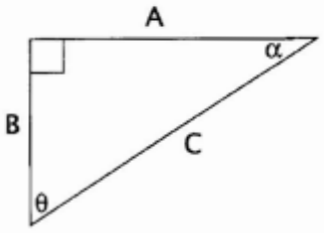

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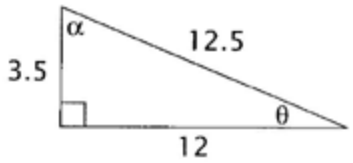

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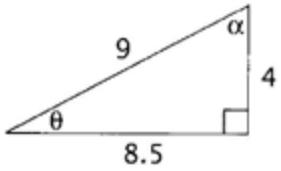

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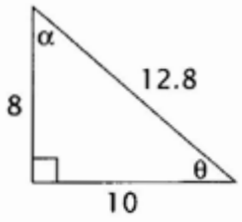

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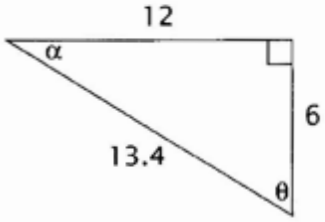

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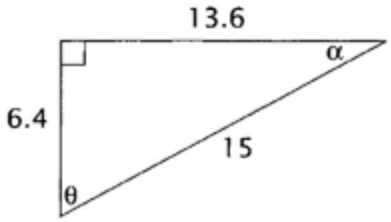

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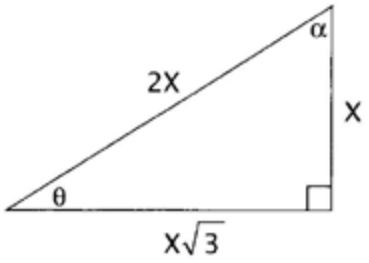

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There is no worksheet 1D for this lesson.

Honors Application Pages

The next page in this book is entitled Honors.

You will find a special challenge lesson after the last worksheet for each lesson. These lessons are optional, but highly recommended for students who will be taking advanced math or science courses.

In the honors lessons, you will find a variety of problems that do the following:

- Review previously learned material in an unfamiliar context.
- Provide practical application of math skills relating to science or everyday life.
- Challenge the student with more complex word problems.
- Expand on concepts taught in the text.
- Familiarize students with problems that are present in standardized testing.
- Prepare for advanced science courses, such as physics.
- Stimulate logical-thinking skills with interesting or unusual math concepts.

HONORS 4-STEP APPROACH

Here are four steps to help the student receive the most benefit from these pages.

Step 1. Read
Step 2. Think
Step 3. Compare
Step 4. Draw

Step 1. Read

Most of the honors lessons teach new topics or expand on the concepts taught in the regular lessons. Read the explanations carefully. Sometimes you will be led step-by-step to a new concept. When doing word problems, think through what is being described in the problem before trying to work out the math.

Step 2. Think

It has been suggested that one of the major problems with math instruction in the United States is that students do not take enough time to think about a problem before giving up. One of the purposes of the honors pages is to train you in problem-solving skills. Start by deciding what you already know about the concept being studied, and then look for ways to apply what you know in order to solve the problem. Don't be afraid to leave a difficult problem and come back to it later for a fresh look. You will notice that these lessons do not have as many detailed examples as those in the instruction manual. In real life, individuals must often use what they know in new or unexpected ways in order to solve a problem.

Step 3. Compare

Compare your solution to the one in the back of the instruction manual. If you solved the problem differently, see whether you can follow the given solution. There is often more than one way to solve a problem. The solutions may also give you hints that are not on the lesson pages. If you are not able to solve a problem on your own, do not be upset. Much of this material was purposely designed to stretch your math muscles. You will learn a great deal by giving a problem your best try and then studying the solution.

Step 4. Draw

When in doubt, draw! Often a picture will help you see the big picture and recognize which math skills are necessary to solve the problem.

SCHEDULING HONORS PAGES

There are several ways to schedule the honors. The first is to simply do each page after finishing the regular lesson pages. Be sure the student thoroughly understands the lesson material before attempting the honors.

If a student needs more time to become comfortable with the new concepts in the text before tackling more advanced problems, he may delay an honors page until he is two or three lessons ahead in the course. The student may also spread one honors section over two or three days while continuing to do the regular student pages. This approach allows time to come back to difficult problems for a fresh look.

Another option is to tackle all the honors pages after finishing the book as a review and as preparation for the next level. This approach works especially well if you are continuing your study through the summer months.

If you have a pre-2010 teacher manual, go online to mathusee.com/solutions to access the honors solutions.

Welcome to *PreCalculus* honors! Your textbook for this course begins with a definition of trigonometry. You may be wondering where calculus comes into the picture and what it is. This is a good time to look at what you have already studied in mathematics, and to see what doors this course can open for you.

Here is a summary of the common fields of mathematics.

Arithmetic is the foundation for all mathematics. It uses the basics—counting, adding, subtracting, multiplying, and dividing. The calculations are done with actual numbers. People have been using arithmetic in some form since the beginning.

Geometry as we know it today was developed by the ancient Greeks. It studies entities such as points, lines, and planes, and is also used to find perimeter, area, and volume. The geometry commonly studied in high school is sometimes called Euclidean geometry.

Algebra gives us tools for solving equations to find unknown values. It may use letters to represent unknown values. Algebra was developed in the Middle Ages.

Trigonometry was first used by astronomers. It is based on geometry, but uses many of the tools of algebra to solve problems that cannot be solved by geometry alone. In surveying and astronomy, it helps us find distances by using known parts of a triangle. We can also use trigonometry to describe curves with regularly repeating values, such as radio waves or electrical currents.

Calculus was first developed in the late seventeenth and early eighteenth century by Isaac Newton and others. It deals with values that change over time and is used in physics, biology, engineering, economics, and many other fields. Calculus will most likely be the math course you take after this one.

Calculus combines skills from all of the preceding levels of math to solve a wide variety of problems. Therefore, Math-U-See *PreCalculus* will focus on two areas. One is trigonometry, and the other is advanced algebra skills that you will need in calculus. The usefulness of some of these skills may not be apparent in this course. Do not be concerned, as they will come together in exciting ways as you continue your study of mathematics.

If you have a pre-2010 teacher manual, go online to mathusee.com/solutions to access the honors solutions.

Read the following problems and name the highest field of mathematics necessary to solve each problem.

1. George is working on a surveying project. He knows the distance along one side of a triangle drawn on his map, and the size of the angle closest to him. He needs to know the distances along the other sides of the triangle, but the ground is too rough to measure directly.

2. Sally has $324 that she wants to divide evenly among her three children.

3. A scientist has a formula that describes the relationship between the pressure and the volume of a certain gas. He knows all the values in the formula except for one, and needs to find the missing value.

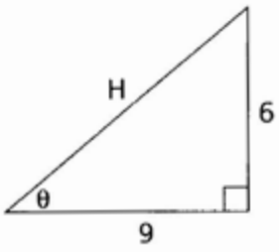
4. A speeder is challenging a ticket based on the distance between toll booths and her elapsed time. Her rate of speed varied during the trip, and she is attempting to prove that at no time could it have exceeded the speed limit.

5. Tom knows the dimensions of his triangular garden and wishes to find the area before buying fertilizer.

If this interests you, there are other fields of mathematics that you may want to investigate. Examples are statistics, number theory, non-Euclidean geometry, and various studies of patterns such as tessellation. All of them use skills from the basic five described in this lesson.

Find the missing side of each right triangle. Evaluate all six trig ratios of θ and give the answers in fraction and decimal form.

1.



Example $6^2 + 9^2 = H^2$

$36 + 81 = H^2$

$\sqrt{117} = H$

$10.82 = H$

$\sin\theta = \frac{6}{10.82} = .5545$

$\cos\theta = \frac{9}{10.82} = .8318$

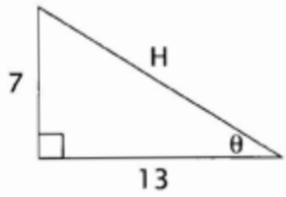
$\tan\theta = \frac{6}{9}$

$\csc\theta =$ $=$

$\sec\theta =$ $=$

$\cot\theta =$ $=$

2.



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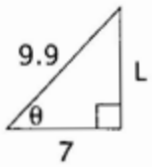

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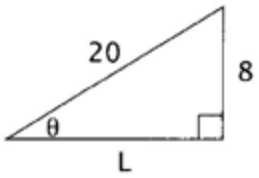

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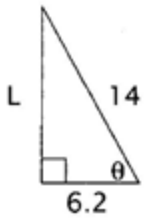

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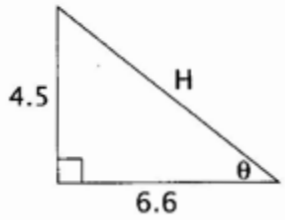

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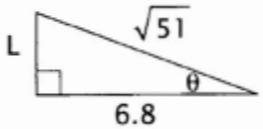

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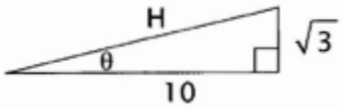

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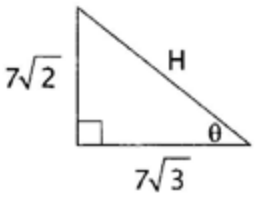

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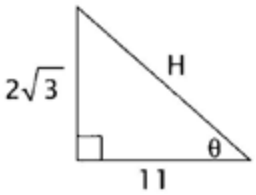

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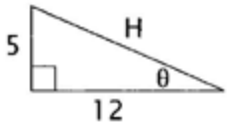

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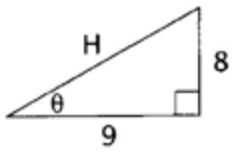

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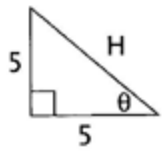

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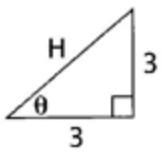

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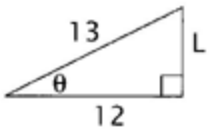

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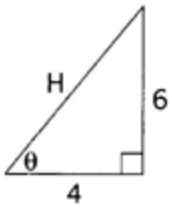

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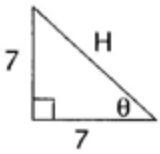
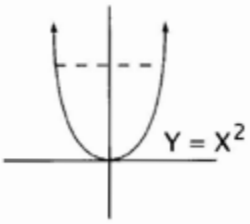


There is no worksheet 2D for this lesson.

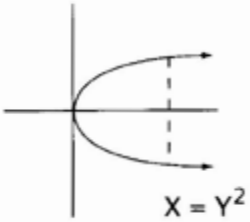
Symmetry has surprising and important applications in advanced mathematics. Informally, we say something is symmetric about a line when it is the same on both sides of a line drawn down its center. Here is what this looks like with the graphs of some common curves.

Figure 1



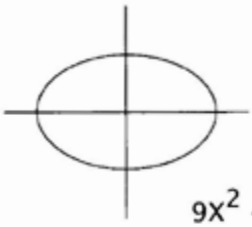
This parabola is symmetric with respect to the y-axis. If a horizontal line segment was drawn at any point across the curve, the y-axis would be the midpoint of the line segment.

Figure 2



This parabola is symmetric with respect to the x-axis. If a vertical line segment was drawn at any point across the curve, the x-axis would be the midpoint of the line segment.

Figure 3



This ellipse is symmetric with respect to both the x- and y-axes.

$9X^2 + 4Y^2 = 36$

Some equations are symmetric with respect to the x- or y-axes. There are easy tests to check for this kind of symmetry.

Example 1

Is $3y^3 = x^2$ symmetric about the y-axis?

It is symmetric with respect to the y-axis if replacing x with (-x) produces the original equation.

$3y^3 = x^2$	original equation
$3y^3 = (-x)^2 \Rightarrow 3y^3 = x^2$	Yes, the equation is symmetric with respect to the y-axis.

Example 2

Is $3y^3 = x^2$ symmetric about the x-axis?

It is symmetric with respect to the x-axis if replacing y with (-y) produces the original equation.

$3y^3 = x^2$	original equation
$3(-y)^3 = x^2 \Rightarrow -3y^3 = x^2$	No, the equation is not symmetric with respect to the x-axis, because the test changes the sign of one side of the equation.

Test each equation to see if its graph is symmetrical around the x-axis or the y-axis.

1. $y^4 = 2x^2$

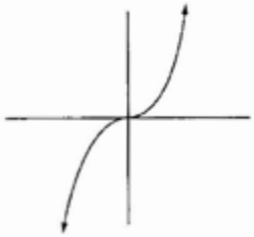
2. $2y^3 = x + 5$

3. $y = x^4$

A graph is symmetric around the origin if replacing x with (–x) and replacing y with (–y) maintains the equality. These graphs are known as "odd" graphs.

Example 3

Is $y = x^3$ symmetric with respect to the origin?



$y = x^3$	original equation
$(-y) = (-x)^3 \Rightarrow -y = -x^3$	Replace y with (-y) and x with (-x).
$-y = -x^3 \Rightarrow y = x^3$	Multiplying both sides by (-1) yields the original equation. The graph is symmetric with respect to (or around) the origin.

Test each equation to see if its graph is symmetrical around the x-axis, the y-axis, or the origin.

4. $9x^2 + 4y^2 = 35$

5. $3y^2 = x + 2$

6. $xy = \sqrt{2}$

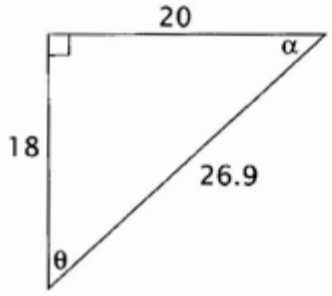
7. $y = |x| - 3$

Using the trig table in the instruction manual, find the ratios for the following trigonometric functions.

1. cos 37° =
2. tan 51° =
3. sin 20° =
4. sin 49° =
5. cos 65° =
6. tan ___° = .6249
7. cos ___° = .4540
8. tan ___° = .0875
9. sin ___° = .9781
10. tan ___° = 14.3007

Use all three ratios to confirm the measures of angle θ and angle α.

11.



sin θ = ——— = . _ _ _ _

cos θ = ——— = . _ _ _ _

tan θ = ——— = . _ _ _ _

θ = _ _ °

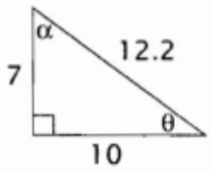
sin α = ——— = . _ _ _ _

cos α = ——— = . _ _ _ _

tan α = ——— = . _ _ _ _

α = _ _ °

12.



sin θ = ——— = . _ _ _ _

cos θ = ——— = . _ _ _ _

tan θ = ——— = . _ _ _ _

θ = _ _ °

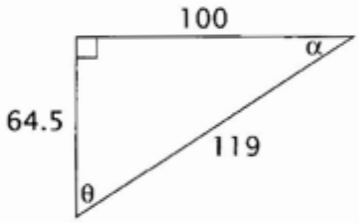
sin α = ——— = . _ _ _ _

cos α = ——— = . _ _ _ _

tan α = ——— = . _ _ _ _

α = _ _ °

13.



sin θ = ——— = . _ _ _ _

cos θ = ——— = . _ _ _ _

tan θ = ——— = . _ _ _ _

θ = _ _ °

sin α = ——— = . _ _ _ _

cos α = ——— = . _ _ _ _

tan α = ——— = . _ _ _ _

α = _ _ °

Using the trig table in the instruction manual, find the ratios for the following trigonometric functions.

1. sin 12° =

2. cos 86° =

3. sin 40° =

4. tan 22° =

5. cos 18° =

6. sin ___° = .9336

7. tan ___° = 4.0108

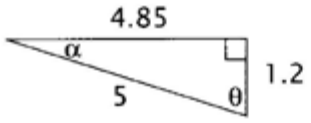
8. sin ___° = .9986

9. tan ___° = 1.4826

10. cos ___° = .9925

Use all three ratios to confirm the measure of angle θ and angle α.

11.



sin θ = ——— = . – – – –

cos θ = ——— = . – – – –

tan θ = ——— = . – – – –

θ = – – °

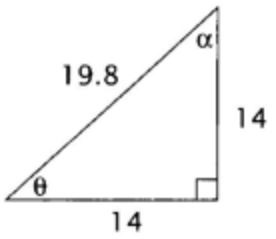
sin α = ——— = . – – – –

cos α = ——— = . – – – –

tan α = ——— = . – – – –

α = – – °

12.



$\sin\theta = \frac{\quad}{\quad} = .\_\_\_\_$

$\cos\theta = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan\theta = \frac{\quad}{\quad} = .\_\_\_\_$

$\theta = \_\_^\circ$

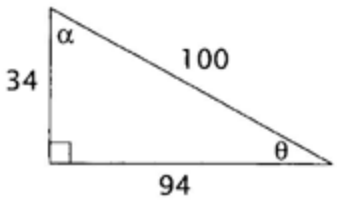
$\sin\alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\cos\alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan\alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\alpha = \_\_^\circ$

13.



$\sin\theta = \frac{\quad}{\quad} = .\_\_\_\_$

$\cos\theta = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan\theta = \frac{\quad}{\quad} = .\_\_\_\_$

$\theta = \_\_^\circ$

$\sin\alpha = \frac{\quad}{\quad} = .\_\_\_\_$

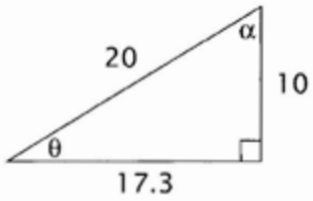
$\cos\alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan\alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\alpha = \_\_^\circ$

Use all three ratios to confirm the measure of angle θ and angle α.

1.



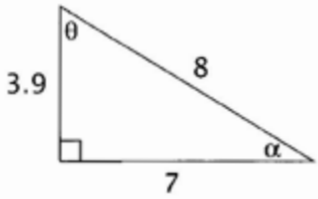
$\sin \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\sin \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\cos \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\cos \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\tan \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\theta = \_\_^\circ$ $\alpha = \_\_^\circ$

2.



$\sin \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\sin \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

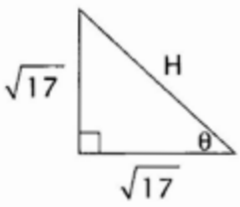
$\cos \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\cos \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\tan \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

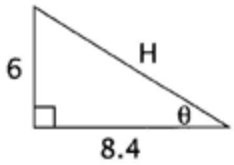
$\theta = \_\_^\circ$ $\alpha = \_\_^\circ$

Find the missing side of each right triangle. Round your answers to the nearest hundredth. Evaluate all six trig ratios of θ and give the answers in fraction and decimal form.

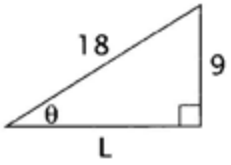
3.



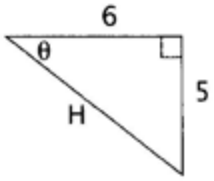
4.



5.

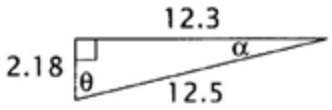


6.



Use all three ratios to confirm the measure of angle θ and angle α.

1.



$\sin \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\sin \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

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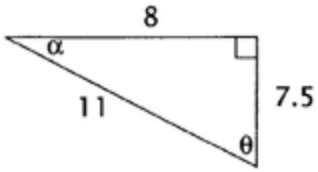
$\tan \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\tan \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\theta = \_\_^\circ$ $\alpha = \_\_^\circ$

2.



$\sin \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\sin \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\cos \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\cos \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\tan \theta = \frac{\quad}{\quad} = .\_\_\_\_$ $\tan \alpha = \frac{\quad}{\quad} = .\_\_\_\_$

$\theta = \_\_^\circ$ $\alpha = \_\_^\circ$

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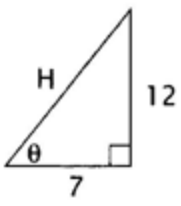

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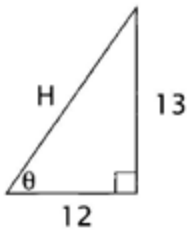
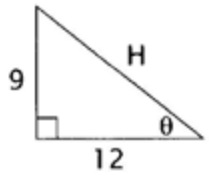
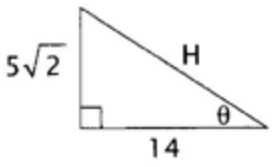


5.



6.



PreCalculus
with Trigonometry

PREREQUISITE: The student should have completed ALGEBRA 1, GEOMETRY, and ALGEBRA 2 or comparable courses.

- Trigonometric Ratios
- Reciprocal Ratios
- Calculators and Arc Functions
- Angles of Elevation
- Reference Angles
- Cofunctions
- Negative Angle Relationships
- Trigonometric Identities
- Graph Trigonometric Functions
- Radian Measure
- Polar Coordinates
- Rectangular Coordinates
- Polar Equations
- Vectors
- Functions and Relations
- Logarithms
- Sequences and Series
- Limits

After completing Math·U·See Trigonometry (currently PreCalculus) . . . he was very ready for college level calculus. Thank you for Math·U·See and being a significant part of Michael's becoming an excellent math student and potential engineer." –Dan & Elizabeth, KY

We have used the Math·U·See Trigonometry (currently PreCalculus) and loved it! We hope the calculus course is on its way! Thanks for the wonderful work you have done in the area of mathematics! –Robbin Fowler, AL

The Math·U·See strategy at this level involves two components: video and written instruction with examples for the teacher and student, and textbooks to provide practice, long term review, and real life applications.

Watch the DVD until you understand the new topic, read the instruction manual and study the examples, and work through the student text until the math concept has been internalized. Then take the test to demonstrate that this topic has been mastered before moving to the next lesson.

For success with PreCalculus, we recommend these materials:

PRECALCULUS
INSTRUCTION PACK

PRECALCULUS
STUDENT PACK

mathusee.com

Our goal at Math·U·See is to encourage students to be confident problem solvers who understand and enjoy math. The reason we study math is so we can apply math in everyday situations. We do want students to learn their math facts, rules, and formulas, but we also want them to be able to use this knowledge in everyday life.

–Steve Demme, *author and founder*

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