Right-Angle Trigonometry

Unit: Mathematics

NGSS Standards: N/A

MA Curriculum Frameworks (2006): N/A

AP Physics 1 Learning Objectives: N/A

Knowledge/Understanding Goals:

- trigonometry functions that are used heavily in physics

Skills:

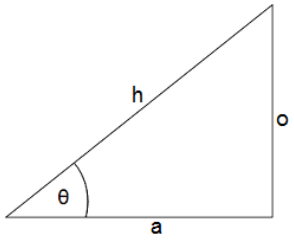
- find the *x*-component and *y*-component of a vector

Language Objectives:

- Understand and correctly use the terms "sine," "cosine," and "tangent."
- Accurately describe and apply the concepts described in this section, using appropriate academic language.

Notes:

If we have the following triangle:



- side "h" (the longest side, opposite the right angle) is the ***hypotenuse***.
- side "o" is the side of the triangle that is ***opposite*** (across from) angle θ.
- side "a" is the side of the triangle that is ***adjacent*** to (connected to) angle θ (and is not the hypotenuse).

Use this space for summary and/or additional notes.

In a right triangle, the ratios of the lengths of the sides will be a function of the angles, and vice-versa.

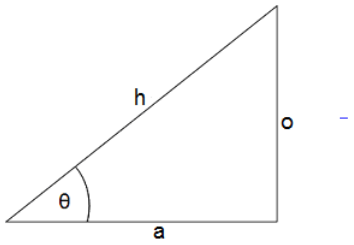
Trigonometry (from "trig" = "triangle" and "ometry" = "measurement") is the study of these relationships.

The three primary trigonometry functions are defined as follows:

$$\text{sine}\,\theta = \sin\theta = \frac{\text{opposite}}{\text{hypotenuse}} = \frac{o}{h}$$

$$\text{cosine}\,\theta = \cos\theta = \frac{\text{adjacent}}{\text{hypotenuse}} = \frac{a}{h}$$

$$\text{tangent}\,\theta = \tan\theta = \frac{\text{opposite}}{\text{adjacent}} = \frac{o}{a}$$

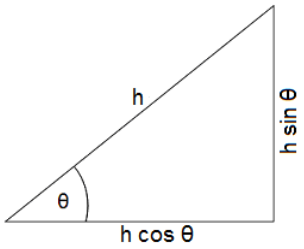


There are a lot of stupid mnemonics for remembering which sides are involved in which functions. My favorite of these is "**O**h **h**ell, **a**nother **h**our **o**f **a**lgebra!"

The most common use of trigonometry functions in physics is to decompose a vector into its components in the *x*- and *y*-directions. In this situation, the vector is the hypotenuse. If we know the angle of the vector, we can use trigonometry and algebra to find the components of the vector in the *x*- and *y*-directions:

$$\cos\theta = \frac{a}{h} \quad \text{which means} \quad a = h\cos\theta$$

$$\sin\theta = \frac{o}{h} \quad \text{which means} \quad o = h\sin\theta$$



This is often necessary in physics problems involving gravity. Because gravity acts only in the y-direction, the formulas that apply in the y-direction are often different from the ones that apply in the x-direction.

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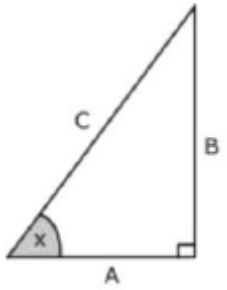
Homework Problems

Questions 2–5 are based on the following right triangle, with sides *A*, *B*, and *C*, and angle *x* between *A* and *C*.



Note that the drawing is not to scale, and that angle *x* and the lengths of *A*, *B* and *C* will be different for each problem.

Some problems may also require use of the fact that the angles of a triangle add up to 180◦.

1. If $A = 5$ and $C = 13$, what is B?

2. If $A = 5$ and $C = 13$, what is $\sin x$?

3. If $C = 20$ and $x = 50°$, what are A and B?

Use this space for summary and/or additional notes.

4. If $A = 100$ and $C = 150$, what is x?

5. If $B = 100$ and $C = 150$, what is x?

6. You are a golfer, and your ball is in a sand trap with a hill next to it. You need to hit your ball so that it goes over the hill to the green. If your ball is 10. m away from the side of the hill and the hill is 2.5 m high, what is the minimum angle above the horizontal that you need to hit the ball in order to just get it over the hill?

7. If a force of 80 N is applied at an angle of 40° above the horizontal, how much of that force is applied in the horizontal direction?

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