**Learning Outcomes:** What level of knowledge should you possess by the end of this section?

- Solve right triangles given the length of one side and one additional piece of information.

- Understand the meaning of angle of elevation and angle of depression.

- Understand how to use bearings to communicate directions.

- Understand the model of simple harmonic motion and be able to correctly determine the amplitude, period, and frequency of the oscillations.

- Interpret and solve trigonometric word problems using right triangle techniques.

**#1)** Sketch and solve the right triangle with $A = 35°$ and $b = 12$ cm for all unknown sides and angles. Present your work and final answers in an organized manner.

**#2)** Sketch and solve the right triangle with $B = 58°$ and $c = 3$ miles for all unknown sides and angles. Present your work and final answers in an organized manner.

**#3)** Sketch and solve the right triangle with $a = 17$ ft and $c = 28$ ft for all unknown sides and angles. Present your work and final answers in an organized manner.

When the sun creates a shadow, the length of the shadow is dependent upon where the sun is located. If the sun is high in the sky, then shadows are very short. When the sun is low on the horizon, the shadow lengths get very long. The reason this happens is that if you draw a straight line from the tip of the shadow to the top of the object casting the shadow, that line will point directly at the sun.

**#4)** Sketch a couple diagrams that demonstrates the preceding paragraph. Label one of your sketches as "large angle of elevation" and the other as "small angle of elevation."

**#5)** The sun is at an angle of elevation of 20° above the horizon. A tree casts a 123 foot long shadow. Determine the height of the tree.

**#6)** The sun is at an angle of elevation of 38° above the horizon. A 25 foot long street light is leaning towards the sun at an angle of 10° from vertical. Determine the length of the shadow that the street light casts.
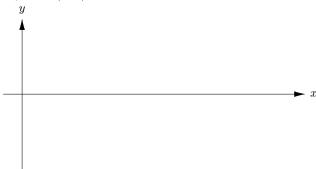
**#7)**   A camera is set on a tripod 6 feet from a wall with a painting on it. The angle of elevation to the top of the painting is 27° and the angle of depression to the bottom of the painting is 10°. Determine the height of the painting.

**#8)**   An observer in a lighthouse is 400 feet above sea level. He spots two boats in the water along a straight line from his position. The further one is at an angle of depression of 3.5°. The nearer one is at an angle of depression of 3.5°. What is the distance between the boats?

**#9)**  A boat leaves the dock bearing N 25° W. It travels at 15 knots for 3 hours. It then changes direction to S 68° E traveling 18 knots for 2 hours. Determine the distance from the boat to the dock and the bearing of the dock relative to the boat.

**#10)**  Different musical tones are generated by different frequencies. These are measured in Hertz (Hz), which is the same as cycles per second. The musical pitch A4 is created using a frequency of 440 Hz. This is modeled using a function of the form $y = \sin(\omega_A t)$, where $t$ is measured in seconds. Determine the value of $\omega_A$ that creates an A4.

**#11)**  The musical pitch E5 vibrates faster than the pitch A4 at a ratio of 3:2. This means that the model for E5 will have three vibrations in the amount of time it takes A4 to vibrate twice. Sketch a drawing of the two different oscillations on the same graph (label them clearly!) and use this graph to find a model of the form $y = \sin(\omega_E t)$ for the note E5.

**#12)** Write a word problem that uses compassing bearings (that is, 0° points north) and solve it. The word problem should be about pirates finding treasure. Use at least three different compass bearings in the problem. (And be creative!)

**Extra Credit Activity:** Your task is to estimate the height of the Nursing, Science, and Education building. Because different parts of the building are different heights, we will measure the height of the building on the east side at the door with the glass panels that go up the entire side of the building. (This is the door next to the back elevator and NSE 131.) We will say that the height is the distance from the bottom of the door to the top corner of the roof.

In order to do this, you will need to construct a homemade angle finder (look it up on the internet) as your equipment. If you need access to a meter stick or other measuring device, you can talk to me to get one. Take your measurements from at least two different locations. This will help to serve as a self-checking mechanism as well as give you a sense of the natural errors that arise from measurements.

Successful completion of this activity is worth the equivalent of a single homework assignment. You will be graded on the clarity and quality of your presentation. You are encouraged to submit a rough draft for review before your final report for feedback.

Report Outline:

- Introduction: State the problem you're solving, including the limitations special features about the assignment.

- Angle Finder: Discuss the construction of your angle finder. If you used internet resources to help you build your device, be sure to properly acknowledge your sources.

- Method: Describe your theoretical method in detail. Do not use any measurements at this time. Only use symbols to represent the measurements that you will need to take.

- Measurements and Calculations: State your measurements and complete the calculations.

- Conclusion: State your final result, and provide a short paragraph of commentary regarding the potential sources of errors in your measurements.