Right Triangle Trigonometry: Solving Word Problems

Trigonometry is used on a daily basis in the workplace. Since trigonometry means "triangle measure", any profession that deals with measurement deals with trigonometry as well. Carpenters, construction workers and engineers, for example, must possess a thorough understanding of trigonometry.
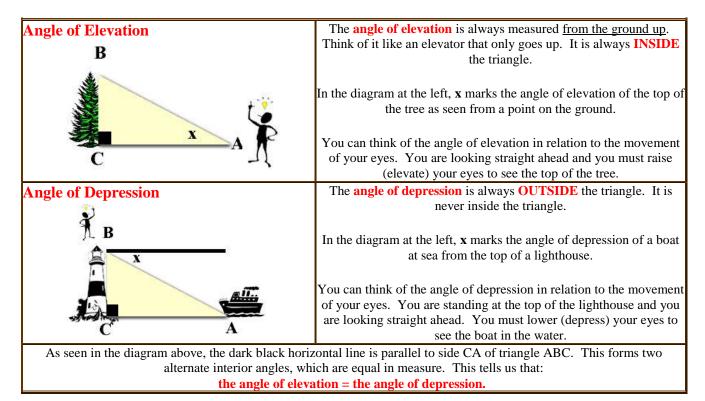
In word problems, the formulas remain the same:

$$\sin A = \frac{\text{opposite leg}}{\text{hypotenuse}} \qquad \cos A = \frac{\text{adjacent leg}}{\text{hypotenuse}} \qquad \tan A = \frac{\text{opposite leg}}{\text{adjacent leg}}$$

Word problems introduce two new vocabulary terms:

Angle of Elevation 	The **angle of elevation** is always measured <u>from the ground up</u>. Think of it like an elevator that only goes up. It is always **INSIDE** the triangle. In the diagram at the left, **x** marks the angle of elevation of the top of the tree as seen from a point on the ground. You can think of the angle of elevation in relation to the movement of your eyes. You are looking straight ahead and you must raise (elevate) your eyes to see the top of the tree.
Angle of Depression 	The **angle of depression** is always **OUTSIDE** the triangle. It is never inside the triangle. In the diagram at the left, **x** marks the angle of depression of a boat at sea from the top of a lighthouse. You can think of the angle of depression in relation to the movement of your eyes. You are standing at the top of the lighthouse and you are looking straight ahead. You must lower (depress) your eyes to see the boat in the water.

As seen in the diagram above, the dark black horizontal line is parallel to side CA of triangle ABC. This forms two alternate interior angles, which are equal in measure. This tells us that:
the angle of elevation = the angle of depression.

So what do we do with this angle of depression that is OUTSIDE of our triangle?

	There are two possible ways to use our **angle of depression** to obtain an angle INSIDE the triangle. 1. Find the angle adjacent (next door) to our angle. This adjacent angle will always be the complement of our angle. Our angle and the angle next door will add to 90°. In the diagram on the left, the adjacent angle is 55°. 2. Utilize the fact that the **angle of depression = the angle of elevation** and simply place 35° in angle A. (the easiest method)

Applications of Trigonometry
Solve each problem.   Round to the nearest hundredth.

1.) A tower casts a shadow that is 60 feet long when the angle of elevation of the sun is 65˚. How tall is the tower?	2.) Matt is standing on top of a cliff 305 feet above a lake. The measurement of the angle of depression to a boat on the lake is 42˚. How far is the boat from the base of the cliff?
3.) Matt is standing on top of a cliff 305 feet above a lake. The measurement of the angle of depression to a boat on the lake is 42˚. How far is the boat from Matt?	4.) A ladder that is 20 ft. long is leaning against the side of a building. If the angle formed between the ladder and the ground is 75°, how far is the bottom of the ladder from the base of the building?
5.) A ladder that is 30 ft long needs to reach 27 ft up a building. What should the angle off of the vertical be?	6.) You are standing 50 meters from a hot air balloon that is preparing to take off. The angle of elevation to the top of the balloon is 28˚. Find the height of the balloon.
7.) A man is in a boat that is floating 175 feet from the base of a 200-foot cliff. What is the angle of depression between the cliff and the boat?	8.) John wants to measure the height of a tree. He walks exactly 100 feet from the base of the tree and looks up. The angle from the ground to the top of the tree is 33° . How tall is the tree?
9.) The flagpole in front of CB East casts a shadow 40 feet long when the measurement of the angle of elevation to the sun is 31˚. How tall is the flagpole?	10.) Kelly is flying a kite to which the angle of elevation is 70˚. The string on the kite is 65 meters long. How far is the kite above the ground?
11.) A straight waterslide is 175 feet above ground and is 200 feet long. What is the angle of depression to the bottom of the slide?	12.) From a 200-foot observation tower on the beach, a man sights a whale in difficulty. The angle of depression of the whale is 7˚. How far is the whale from the shoreline?