# Section 4.8, Applications and Models

Homework: 4.8 #17, 21, 23, 25, 27, 37

This section consists of (primarily) word problems. For most students, practice is the most helpful way to learn to do these, so be sure to do the homework for this section. Also, a right triangle will be used in most problems, so if you don't know where to start, draw a picture! Furthermore, a calculator will be necessary for some of the problems, since some of the angles used are not ones that we have memorized.

**Examples**

1. The sun is 30° above the horizon. Find the length of a shadow cast by a telephone pole that is 25 feet high.

   We can describe this scenario with a right triangle. The side opposite the angle of 30° is 25 feet. We are looking for the length of the side, $x$, adjacent to the 30° angle. Therefore, tangent (or cotangent) will be the most useful trigonometric function, and

   $$\tan 30^\circ = \frac{25}{x}$$
   $$\frac{\sqrt{3}}{3} = \frac{25}{x}$$
   $$x = 25\frac{3}{\sqrt{3}} = 25\sqrt{3} = 43.301 \text{ feet}$$

2. The length of the shadow of a building is 100 feet when the angle of elevation of the sun is 25°. What is the height of the building?

   Let $x$ represent the height of the building. Then,

   $$\tan 25^\circ = \frac{x}{100}$$
   $$x = 100 \tan 25^\circ = 46.631 \text{ feet}$$

3. (#24) A Global Positioning System satellite orbits 12,500 miles above Earth's surface. Find the angle of depression from the satellite to the horizon. Assume the radius of Earth is 4000 miles. (See diagram in the book)

   Let $\theta$ represent the angle of depression, which is also the angle drawn with the vertex the center of the earth. We know that the adjacent side is 4000 miles, and the hypotenuse of the triangle is $12500 + 4000 = 16500$. Then,

   $$\cos\theta = \frac{4000}{16500} = \frac{8}{33}$$
   $$\theta = \cos^{-1}\frac{8}{33} = 75.970^\circ$$

4. (#38) A passenger in an airplane at an altitude of 10 kilometers sees two towns directly to the east of the plane. The angles of depression to the towns are 28° and 55°. How far apart are the towns?

   Let $y$ be the horizontal distance to the nearer town (angle of depression 55°). Then, $\tan 35^\circ = y/10$, so $y = 10 \tan 35^\circ$ kilometers. Let $z$ be the horizontal distance to the further town (with

angle of depression $28°$). Then, $\tan 62° = z/10$, so $z = 10 \tan 62°$ kilometers. The distance between the two towns is:

$$z - y = 10 \tan 62° - 10 \tan 35° = 11.805 \text{ km}$$