8–7 Applications of Right Triangle Trigonometry

**Objective:** Solve right triangle problems by correct selection and use of the tangent, sine, and cosine ratios.

If a person on the ground looks up to the top of a building, the angle formed between the line of sight and the horizontal is called the **angle of elevation**.

If a person standing on the top of a building looks down at a car on the ground, the angle formed between the line of sight and a horizontal line is called the **angle of depression**.

**Example 1**
At a certain time, a post 6 ft tall casts a 3 ft shadow. What is the angle of elevation of the sun?

**Solution**

\[
\tan x^\circ = \frac{6}{3} = 2
\]

\[
x^\circ \approx 63
\]

Express lengths correct to the nearest integer.

1. From a point 80 m from the base of a tower, the angle of elevation to the top of the tower is 28°. How tall is the tower?

2. 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?

3. When the sun is 62° above the horizon, a building casts a shadow 18 m long. How tall is the building?
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4. A kite is flying at an angle of elevation of about 55°. Ignoring the sag in the string, find the height of the kite if 85 m of string have been let out.

\[
\begin{align*}
\text{height} &= 85 \sin(55°) \\
x &= 85 \times \frac{\sin(55°)}{1}
\end{align*}
\]

5. A guy wire is attached to the top of a tower and to a point on the ground that is 35 m from the base of the tower. If the wire makes a 65° angle with the ground, how long is the wire?

\[
\begin{align*}
\text{distance} &= 35 \sec(65°) \\
x &= 35 \times \frac{1}{\cos(65°)}
\end{align*}
\]

Example 2
A person in a lighthouse 22 m above sea level sights a buoy in the water. If the angle of depression to the buoy is 25°, how far from the base of the lighthouse is the buoy?

Solution
The distance between the buoy and the lighthouse can be found in two ways.

\[
\begin{align*}
\text{Method 1} \\
m &\angle PBL = 25 \\
tan 25° &= \frac{22}{x} \\
x(tan 25°) &= 22 \\
x &= \frac{22}{tan 25°} \\
&\approx 47.1799
\end{align*}
\]

\[
\begin{align*}
\text{Method 2} \\
m &\angle BPL = 90 - 25 = 65 \\
tan 65° &= \frac{x}{22} \\
x &= 22(tan 65°) \\
&\approx 47.1792
\end{align*}
\]

The buoy is about 47 m away.

Express lengths correct to the nearest integer.

6. The angle of depression from the top of a tower to a boulder on the ground is 38°. If the tower is 25 m high, how far from the base of the tower is the boulder?

\[
\begin{align*}
\text{distance} &= \frac{25}{\sin(38°)} \\
x &= \frac{25}{\sin(38°)}
\end{align*}
\]

7. An observer at the top of a building sees a car on the road below. The angle of depression to the car is 28°. If the car is about 50 m from the building when it is seen, how tall is the building?

\[
\begin{align*}
\text{height} &= \frac{50}{\tan(28°)} \\
x &= \frac{50}{\tan(28°)}
\end{align*}
\]