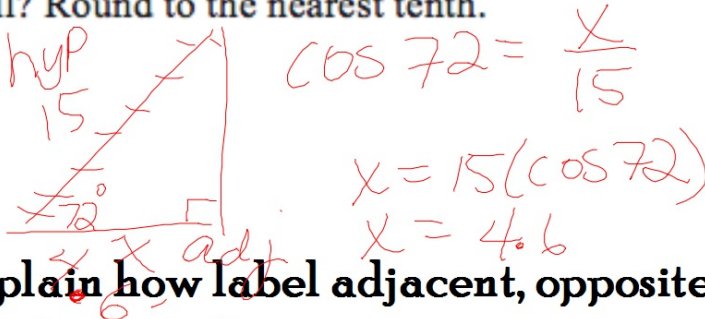Use the appropriate trig ratio to solve the problem below. Draw a pic and label.

1.

A 15-ft ladder is propped against a vertical wall and makes a 72° angle with the ground. How far is the foot of the ladder from the base of the wall? Round to the nearest tenth.

$$\cos 72 = \frac{x}{15}$$

hyp
15

72°
adj

$$x = 15(\cos 72)$$
$$x = 4.6$$

2. Explain how label adjacent, opposite and hypotenuse on a right triangle.

The angles in the Solve It are formed below the horizontal black pipe. Angles formed above and below a horizontal line have specific names.

Suppose a person on the ground sees a hang glider at a 38° angle above a horizontal line. This angle is the **angle of elevation.**

At the same time, a person in the hang glider sees the person on the ground at a 38° angle below a horizontal line. This angle is the **angle of depression.**

Notice that the angle of elevation is congruent to the angle of depression because they are alternate interior angles.

Essential Understanding You can use the angles of elevation and depression as the acute angles of right triangles formed by a horizontal distance and a vertical height.
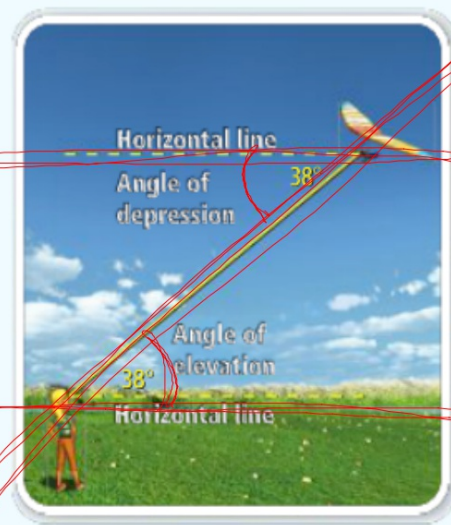
Horizontal line

Angle of depression

38°

Angle of elevation

38°

Horizontal line
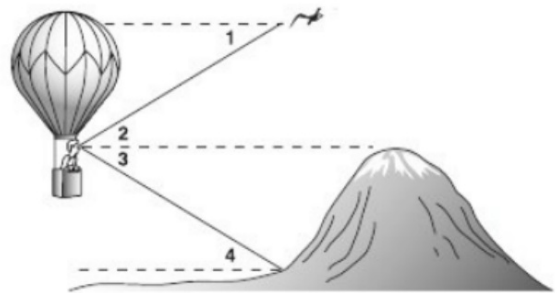
Problem 1   **Identifying Angles of Elevation and Depression**

What is a description of the angle as it relates to the situation shown?

A ∠1

∠1 is the angle of depression from the bird to the person in the hot-air balloon.

B ∠4

∠4 is the angle of elevation from the base of the mountain to the person in the hot-air balloon.

Got It? **1.** Use the diagram in Problem 1. What is a description of the angle as it relates to the situation shown?

a. ∠2   **b.** ∠3

Problem 2   **Using the Angle of Elevation**

Wind Farm Suppose you stand 53 ft from a wind farm turbine. Your angle of elevation to the hub of the turbine is 56.5°. Your eye level is 5.5 ft above the ground. Approximately how tall is the turbine from the ground to its hub?

$$\tan 56.5° = \frac{x}{53}$$ Use the tangent ratio.
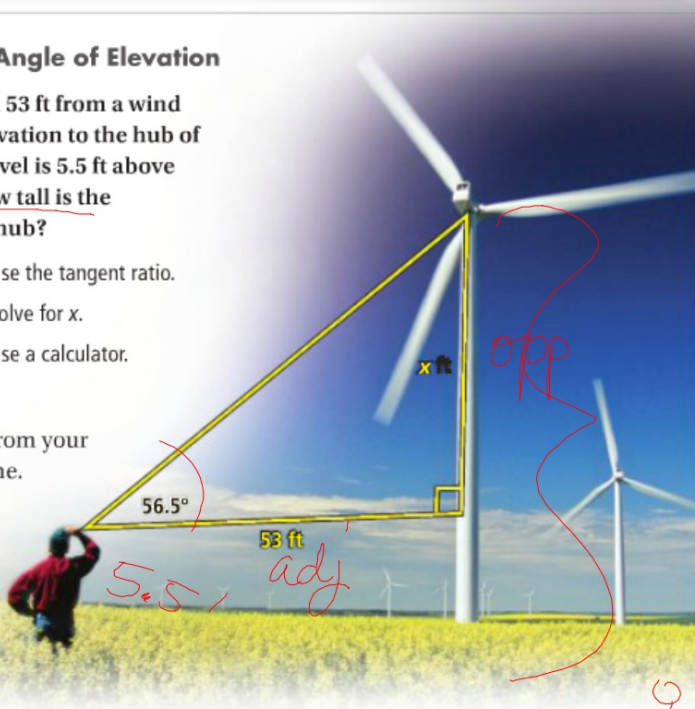
$$x = 53(\tan 56.5°)$$ Solve for x.

53 [tan] 56.5 [enter]   Use a calculator.

80.07426526

So $x \approx 80$, which is the height from your eye level to the hub of the turbine. To find the total height of the turbine, add the height from the ground to your eyes. Since 80 + 5.5 = 85.5, the wind turbine is about 85.5 ft tall from the ground to its hub.
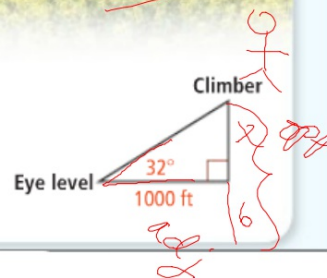
56.5°

53 ft

✅ **Got It?**   **2.** You sight a rock climber on a cliff at a 32° angle of elevation. Your eye level is 6 ft above the ground and you are 1000 ft from the base of the cliff. What is the approximate height of the rock climber from the ground?

Climber

Eye level

32°

1000 ft

Handwritten notes:

$\tan 56.5 = \frac{x}{53}$

$x = 80$

$\tan 32 = \frac{x}{1000}$

$x = 624.9$
$+ \quad 6$
_____
630.9

To approach runway 17 of the Ponca City Municipal Airport in Oklahoma, the pilot must begin a 3° descent starting from a height of 2714 ft above sea level. The airport is 1007 ft above sea level. To the nearest tenth of a mile, how far from the runway is the airplane at the start of this approach?
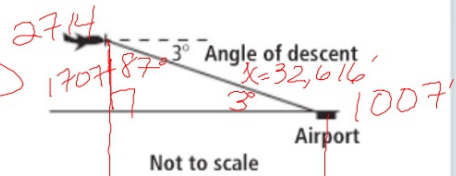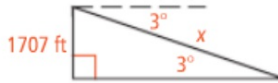
The airplane is 2714 − 1007, or 1707 ft, above the level of the airport.

3° Angle of descent

Airport

Not to scale

Think

Why is the angle of elevation also 3°?
The path of the airplane before descent is parallel to the ground. So the angles formed by the path of descent are congruent alternate interior angles.

1707 ft

3°

x

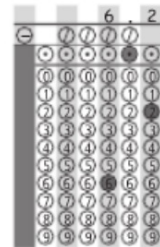3°

$\sin 3° = \dfrac{1707}{x}$ Use the sine ratio.

$x = \dfrac{1707}{\sin 3°}$ Solve for x.

1707 ÷ sin 3 enter 32616.19969   Use a calculator.
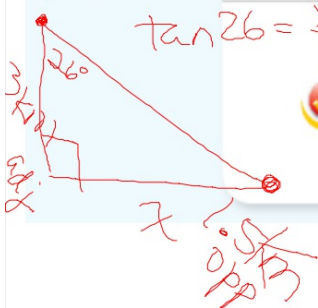
÷ 5280 enter 6.177310548   Divide by 5280 to convert feet to miles.

The airplane is about 6.2 mi from the runway.

Got It? 3. An airplane pilot sights a life raft at a 26° angle of depression. The airplane's altitude is 3 km. What is the airplane's horizontal distance d from the raft?
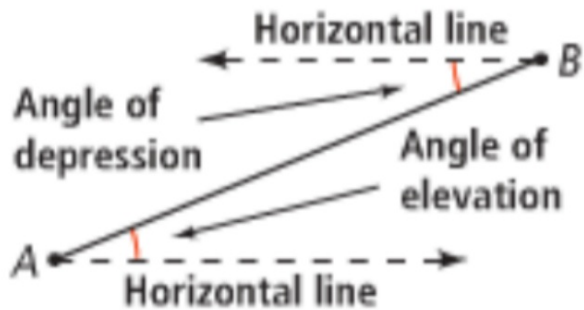
Angle of Elevation or Depression:
the angle formed by a horizontal line and the line of sight to an object above or below the horizontal line.

*** In any single example, the angle of elevation is equal to the angle of depression because they are alternate interior angles.***
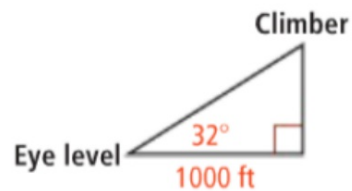
Horizontal line

Angle of
depression

Angle of
elevation

Horizontal line

Example 1) What is a description of the angle as it relates to the situation shown?

Airplane
1
Air Traffic
Controller
2
3   Ground
4   Crew
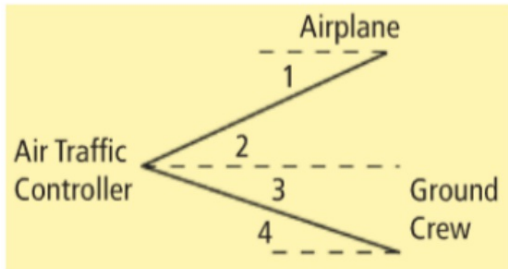
a. ∠1

b. ∠4

Example 2) You sight a rock climber on a cliff at a 32° angle of elevation. Your eye level is 6 ft above the ground and you are 1000 ft from the base of the cliff. What is the approximate height of the rock climber from the ground?
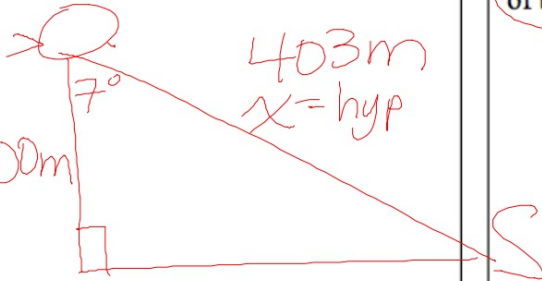
Climber

Eye level   32°
1000 ft

Example 3) An airplane pilot sights a life raft at a 26° angle of depression. The airplane's altitude is 3 km. What is the airplane's horizontal distance d from the raft? *Hint: Draw a Picture!!!*

$$\cos = \frac{a}{h}$$

adj

7°

400m

403m
$x = hyp$

S

Example 4) A blimp provides aerial television views of a football game. The television camera sights the stadium at a 7° angle of depression. The altitude of the blimp is 400m. What is the line-of-sight distance from the television camera to the base of the stadium? Round to the nearest hundred meters.

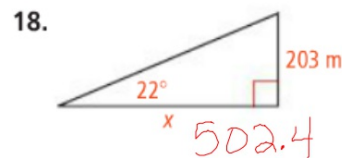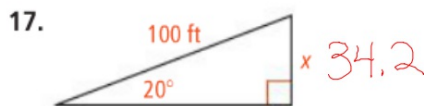$$\cos 7 = \frac{400}{x}$$

$$x = \frac{400}{\cos 7}$$

$$x = 403m$$

<u>Your turn</u> Textbook p.519 Draw a pic for each word problem and label.

Grab a partner and work on the following seven problems together

**Find the value of x. Round to the nearest tenth of a unit.** ◀ **See Problem 2.**

17.

100 ft
20°
x **34.2**

18.

203 m
22°
x **502.4**

19. Meteorology A meteorologist measures the angle of elevation of a weather balloon as 41°. A radio signal from the balloon indicates that it is 1503 m from his location. To the nearest meter, how high above the ground is the balloon? **986m**

Find the value of x. Round to the nearest tenth of a unit. ◀ **See Problem 3.**

20.

27°
580 yd
x **263.3**

21.

18°
x **0.6**
2 km
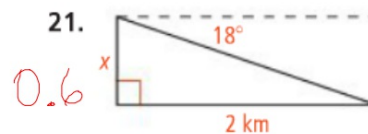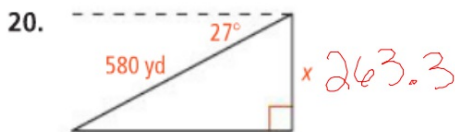
22. Indirect Measurement A tourist looks out from the crown of the Statue of Liberty, approximately 250 ft above ground. The tourist sees a ship coming into the harbor and measures the angle of depression as 18°. Find the distance from the base of the statue to the ship to the nearest foot. **769**

23. Flagpole The world's tallest unsupported flagpole is a 282-ft-tall steel pole in Surrey, British Columbia. The shortest shadow cast by the pole during the year is 137 ft long. To the nearest degree, what is the angle of elevation of the sun when casting the flagpole's shortest shadow? **64°**

EXIT TICKET An airplane pilot sights a life raft at a $26°$ angle of depression. The airplane's altitude is 3 km.

What is the airplane's horizontal distance d from the raft?

$\tan 26 = \dfrac{opp}{adj}$

$\tan 26 = \dfrac{x}{3}$

$x = 1.5 m$

$26°$

$3 km = adj$

$x = opp$