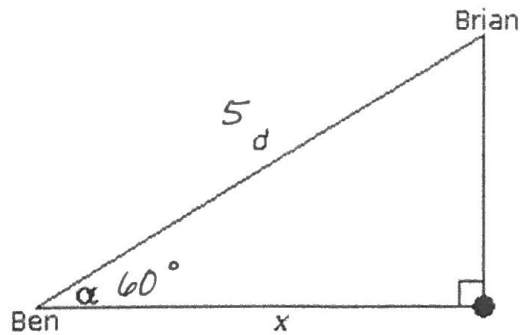## Applications of Trigonometry

1. Brian and Ben are playing golf and both of their golf balls have landed on a flat portion of the green. The distance, $d$, between Ben's golf ball and Brian's golf ball is 5 feet. If $\alpha = 60°$, then how far is Ben's golf ball from the center of the hole? <u>Round your answer to the nearest foot.</u>

$$\cos 60 = \frac{x}{5}$$

$$x = 2.5$$

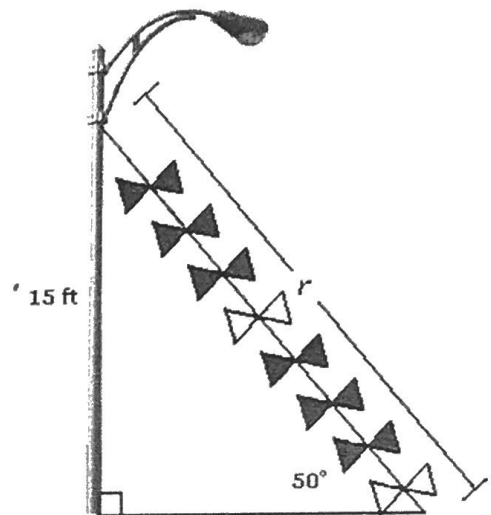$$\boxed{x \approx 3 ft}$$

Brian

5
d

$\alpha$ 60°
Ben      x

2. The manager of a gas station has attached a cable with flags on it to a light pole in order to attract more business. The cable is attached 15 feet above the base of the light and forms a 50° angle at the ground. Find the length of the cable, $r$. <u>Round your answer to the nearest tenth of a foot.</u>

$$\sin 50 = \frac{15}{r}$$

$$r = \frac{15}{\sin 50} \approx 19.58$$
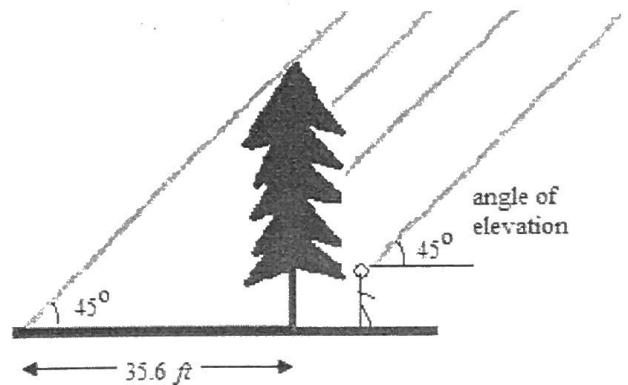
$$\boxed{r \approx 19.6}$$

15 ft

50°

3. One afternoon, a tree casts a shadow that is 35.6 feet long. At that time, **the angle of elevation** of the sun is 45°, as shown in the figure at the right. How tall is the tree? <u>Round your answer to the nearest foot.</u>
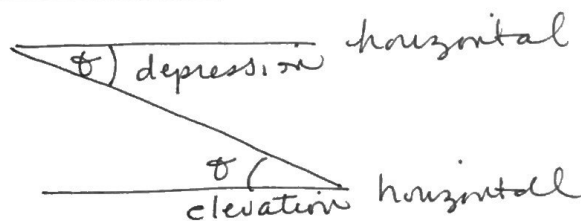
$$\tan 45 = \frac{x}{35.6}$$

$$x = \tan 45 \cdot 35.6$$

$$x = 35.6 \quad \boxed{x \approx 36 ft}$$

angle of
elevation

45°

45°

← 35.6 ft →

---

Note that an **angle of elevation is measured up from the horizontal** because, to look up at something, you need to raise, or elevate, your line of sight from the horizontal.

---

$\theta$) depression  horizontal

$\theta$ (
elevation  horizontal

**4.** Daniel sees a lighthouse in the harbor. He estimates the angle of elevation is 70°. If the lighthouse is 120 feet tall, what is the approximate distance between Daniel and the top of the lighthouse? (Assume the lighthouse meets the ground at a right angle.) <u>Round your answer to the nearest foot.</u>
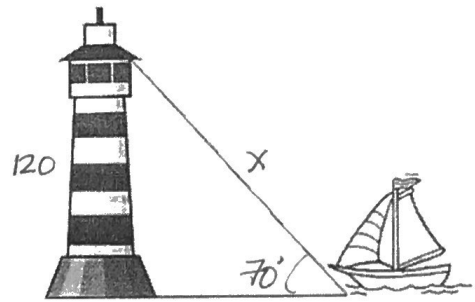
$$\sin 70 = \frac{120}{x}$$

$$x = 120/\sin 70 \approx 127.70 \approx \boxed{128 \text{ ft}}$$

**5.** A forest ranger is on a fire lookout tower in a national forest. His observation position is 214.7 feet above the ground when he spots an illegal campfire. The **angle of depression** of the line of site to the campfire is 12°.
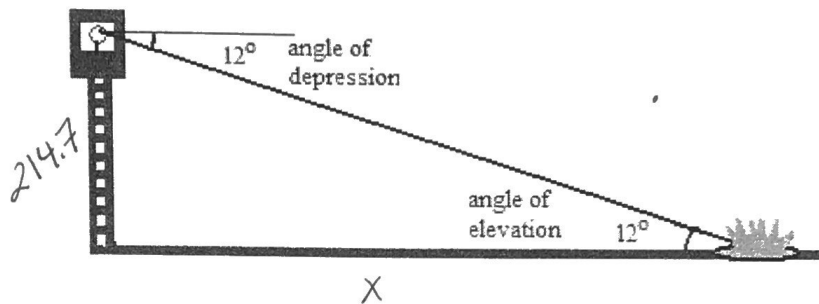
Note that an **angle of depression is measured down from the horizontal** because, to look down at something, you need to lower, or depress, your line of sight from the horizontal.

**(a)** The angle of depression is equal to the corresponding angle of elevation. Why?
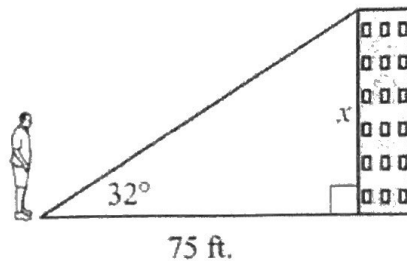
alternate interior angles are $\cong$.
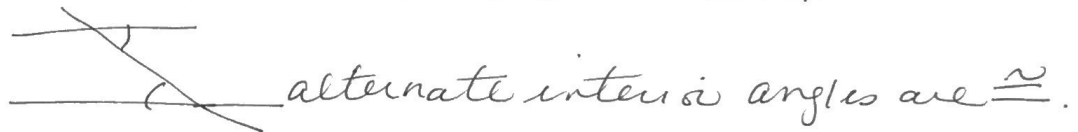
**(b)** Assuming that the ground is level, how far is it from the base of the tower to the campfire?

$$\tan 12 = \frac{214.7}{x}$$

$$x = 214.7/\tan 12 \approx 1010.08$$

$$\approx \boxed{1010.1 \text{ ft}}$$

12

,. Ricardo is standing 75 feet away from the base of a building. The angle of elevation from the ground where Ricardo is standing to the top of the building is 32°.

What is x, the height of the building, to the nearest tenth of a foot?

$\tan 32 = \dfrac{x}{75}$

$x = 75 \cdot \tan 32 \approx \boxed{46.9 \text{ ft}}$

* 46.87

75 ft.

Note: Figure not drawn to scale.

7. An airplane is at an altitude of 5,900 feet. The airplane descends at an angle of 3°.

a. Explain why the angle of depression is congruent to the angle of elevation.

alt. interior ∡'s
are ≅ for ‖ lines.

5,900 ft.
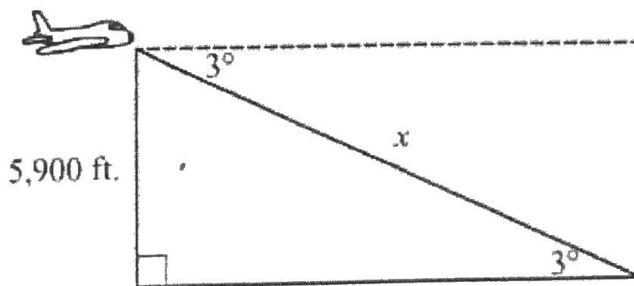
Note: Figure not drawn to scale.

b. About how far will the airplane travel in the air until it reaches the ground? Round your answer the nearest foot.

$\sin 3 = \dfrac{5900}{x}$

$x = 5900/\sin 3 \approx 112{,}733.20 \approx \boxed{112{,}733 \text{ ft}}$

8. A ramp with an elevation of 11° leads to a door that has a brick base that is 45 feet away from the start of the ramp. How many feet long is the ramp? Round your answer to the nearest foot.
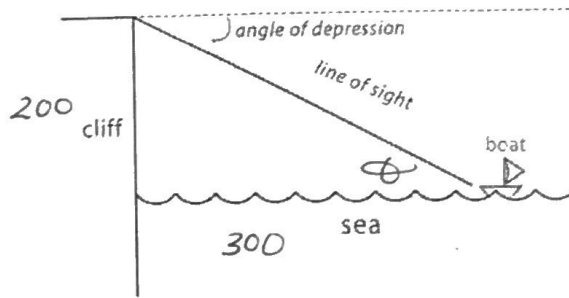
x

11°

45 ft.
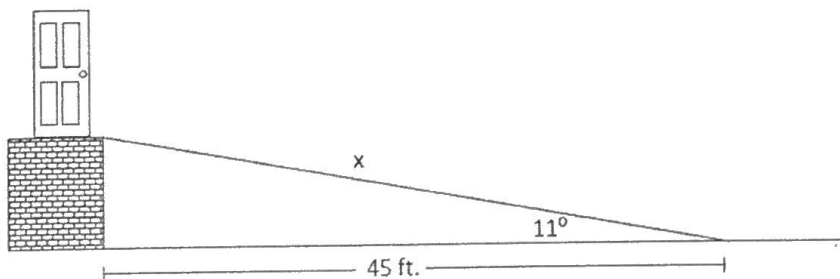
$\cos 11 = \dfrac{45}{x}$

$x = 45/\cos 11 \approx 45.84 \approx \boxed{46 \text{ ft}}$

13

9. From a 200 feet high cliff a boat is noticed floundering at sea! The boat is approximately 300 yards from the base of the cliff. What is the angle of depression, to the *nearest degree*, of the line of sight to the boat?

$$\tan \theta = \frac{200}{300}$$

$$\theta = \tan^{-1}\left(\frac{200}{300}\right)$$

$$\theta \approx 33.69 \approx \boxed{34°}$$



200 cliff

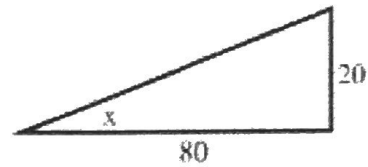) angle of depression

line of sight

boat

300    sea

10. A bird rises 20 meters vertically over a horizontal distance of 80 meters. What is the angle of elevation? Round your answer to the nearest tenth.
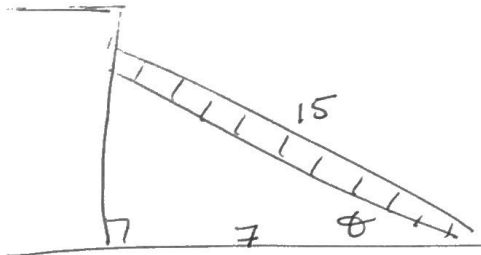
$$\tan x = \frac{20}{80}$$

$$x \approx \tan^{-1}\left(\frac{20}{80}\right)$$

$$\boxed{x \approx 14.0°}$$



20

x

80

11. A ladder is leaning against the side of a house so that the distance on the ground between the base of the ladder and the house is 7 feet. If the length of the ladder is 15 feet, then what is the angle at which the ladder is leaning? At what height does it reach the house? Round your answer to the nearest tenth.



15

7

$$\cos \theta = \frac{7}{15}$$

$$\theta \approx 62.18 \approx \boxed{62.2°}$$

12. Find, to the *nearest degree*, the angle which the sun's rays make with the ground when a flagpole 40 feet high casts a shadow 30 feet long.
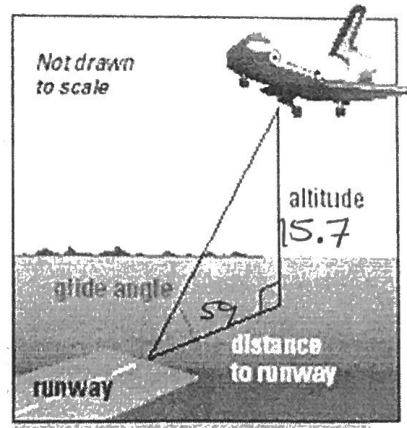


40

30
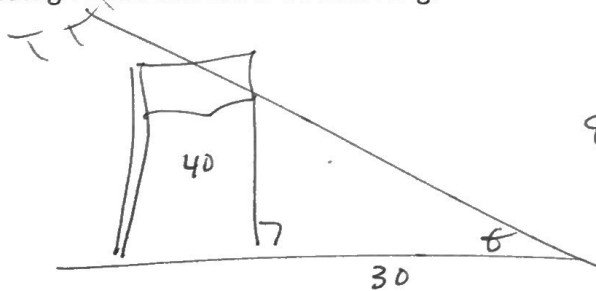
$$\theta = \tan \frac{40}{30}$$

$$\theta = \tan^{-1}\left(\frac{40}{30}\right) \approx 53.13 \approx \boxed{53°}$$

14

**13.** During its approach to Earth, the space shuttle's glide angle changes. When the shuttle's altitude is about 15.7 miles, its horizontal distance to the runway is about 59 miles. What is its glide angle? <u>Round your answer to the nearest tenth.</u>
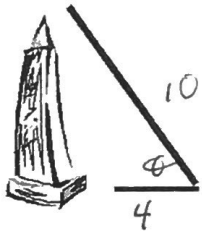
$$\theta = \tan^{-1}\left(\frac{15.7}{59}\right)$$

$$\boxed{\theta \approx 14.9°}$$


Not drawn to scale
altitude 15.7
glide angle
59
distance to runway
runway

## Skills Practice Applications of Trigonometry

1. A ladder is leaning against a building. The ladder is 10m long and it is sitting on the ground 4m out from the building. What is the angle that the ladder makes with the ground?


10
$\theta$
4

$$\theta = \cos^{-1}\left(\frac{4}{10}\right) \approx \boxed{66.4°}$$
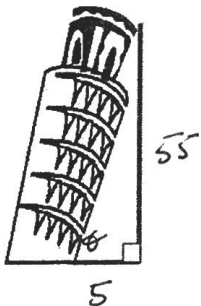
2. A sailboat's main sail is shaped like a right triangle and the base is 18m long. If it makes an angle of 60°, as marked, how tall is the sail?


60°
X
60°
18
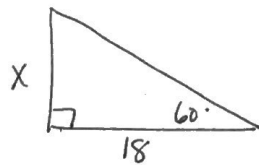
$$\tan 60° = \frac{x}{18}$$

$$x = 18 \cdot \tan 60 \approx \boxed{31.18\,m}$$

3. The Leaning Tower of Pisa is 55m tall. The top edge of the tower is 5m out from the bottom edge. What is the angle created between the ground and the tower?


55
5

$$\tan \theta = \frac{55}{5} \approx \boxed{84.8°}$$