Solving Word Problems on Right Triangles: SOHCAHTOA

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Name: ______________________ Date: ______________ Score: / 10

Learning Objectives

- Apply the trigonometric ratios sine, cosine, and tangent (SOHCAHTOA) to find missing sides and angles of right triangles
- Differentiate between angle of elevation and angle of depression in real-world contexts
- Translate word problems into right-triangle diagrams and solve for unknown measures

Read each word problem carefully, sketch a right triangle with the given information, and use the appropriate trigonometric ratio to solve; round answers to two decimal places.

1. A 15-foot ladder leans against a wall and makes an angle of 65° with the ground. How high up the wall does the ladder reach? Use the equation shown.

$$\sin(65^\circ) = \frac{h}{15}$$

Answer: ______________________

2. From a point 50 meters from the base of a tower, the angle of elevation to the top of the tower is 38°. How tall is the tower? Use the equation shown.

$$\tan(38^\circ) = \frac{h}{50}$$

Answer: ______________________

3. A kite is flying at the end of a 120 ft string that makes a 52° angle with the horizontal ground. How high above the ground is the kite? Use the equation shown.

$$\sin(52^\circ) = \frac{h}{120}$$

Answer: ______________________

4. From the top of a lighthouse 85 ft above sea level, the angle of depression to a boat is 27°. How far is the boat from the base of the lighthouse? Use the equation shown.

$$\tan(27^\circ) = \frac{85}{d}$$

Answer: ______________________

5. A ramp 24 ft long rises to a loading dock that is 6 ft above the ground. What angle does the ramp make with the ground? Use the equation shown.

$$\sin(\theta) = \frac{6}{24}$$

Answer: ______________________

6. An airplane is flying at an altitude of 2,500 ft. The angle of depression from the plane to a runway marker is 18°. What is the straight-line distance from the plane to the marker? Use the equation shown.

$$\sin(18^\circ) = \frac{2500}{d}$$

Answer: ____

7. A guy wire is attached to the top of a 40 ft pole and anchored to the ground 18 ft from the base of the pole. What angle does the wire make with the ground? Use the equation shown.

$$\tan(\theta) = \frac{40}{18}$$

Answer: ____

8. A surveyor stands 200 ft from the base of a building. The angle of elevation to the top of the building is 42°. How tall is the building? Use the equation shown.

$$\tan(42^\circ) = \frac{h}{200}$$

Answer: ____

9. A slide on a playground is 12 ft long and makes a 35° angle with the horizontal ground. How high is the top of the slide above the ground? Use the equation shown.

$$\sin(35^\circ) = \frac{h}{12}$$

Answer: ____

10. From the roof of a building 60 m tall, the angle of depression to a car parked on the street is 24°. How far is the car from the base of the building? Use the equation shown.

$$\tan(24^\circ) = \frac{60}{d}$$

Answer: ____

Encourage students to label the diagram with opposite, adjacent, and hypotenuse relative to the given angle before selecting sin, cos, or tan.

Solutions

1. A 15-foot ladder leans against a wall and makes an angle of 65° with the ground. How high up the wall does the ladder reach? Use the equation shown.

$$\sin(65^\circ) = \frac{h}{15}$$

→ *The 15 ft ladder is the hypotenuse and the height h is opposite the 65° angle, so use sine.*
→ *Multiply both sides by 15: h = 15 × sin(65°).*
→ *Compute sin(65°) ≈ 0.9063, so h ≈ 15 × 0.9063 ≈ 13.59 ft.*

Answer: $h \approx 13.59\ \text{ft}$

2. From a point 50 meters from the base of a tower, the angle of elevation to the top of the tower is 38°. How tall is the tower? Use the equation shown.

$$\tan(38^\circ) = \frac{h}{50}$$

→ *The 50 m horizontal distance is adjacent and the tower height h is opposite the 38° angle, so use tangent.*
→ *Multiply both sides by 50: h = 50 × tan(38°).*
→ *Compute tan(38°) ≈ 0.7813, so h ≈ 50 × 0.7813 ≈ 39.06 m.*

Answer: $h \approx 39.06\ \text{m}$

3. A kite is flying at the end of a 120 ft string that makes a 52° angle with the horizontal ground. How high above the ground is the kite? Use the equation shown.

$$\sin(52^\circ) = \frac{h}{120}$$

→ *The 120 ft string is the hypotenuse and the kite's height h is opposite the 52° angle.*
→ *Use sine: h = 120 × sin(52°).*
→ *Compute sin(52°) ≈ 0.7880, so h ≈ 120 × 0.7880 ≈ 94.56 ft.*

Answer: $h \approx 94.56\ \text{ft}$

4. From the top of a lighthouse 85 ft above sea level, the angle of depression to a boat is 27°. How far is the boat from the base of the lighthouse? Use the equation shown.

$$\tan(27^\circ) = \frac{85}{d}$$

→ *The angle of depression equals the angle of elevation from the boat, so the 85 ft height is opposite that 27° angle and the distance d is adjacent.*
→ *Solve for d: d = 85 ÷ tan(27°).*
→ *Compute tan(27°) ≈ 0.5095, so d ≈ 85 ÷ 0.5095 ≈ 166.83 ft.*

Answer: $d \approx 166.83\ \text{ft}$

5. A ramp 24 ft long rises to a loading dock that is 6 ft above the ground. What angle does the ramp make with the ground? Use the equation shown.

$$\sin(\theta) = \frac{6}{24}$$

→ *The 6 ft rise is opposite the unknown angle θ and the 24 ft ramp is the hypotenuse, so use sine.*
→ *Take the inverse sine: θ = sin■¹(6 ÷ 24) = sin■¹(0.25).*
→ *Compute sin■¹(0.25) ≈ 14.48°.*

Answer: $\theta \approx 14.48^{\circ}$

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6. An airplane is flying at an altitude of 2,500 ft. The angle of depression from the plane to a runway marker is 18°. What is the straight-line distance from the plane to the marker? Use the equation shown.

$$\sin(18^{\circ}) = \frac{2500}{d}$$

→ *The 2,500 ft altitude is opposite the 18° angle of depression and d (line of sight) is the hypotenuse.*
→ *Solve for d: d = 2500 ÷ sin(18°).*
→ *Compute sin(18°) ≈ 0.3090, so d ≈ 2500 ÷ 0.3090 ≈ 8,090.62 ft.*

Answer: $d \approx 8090.62$ ft

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7. A guy wire is attached to the top of a 40 ft pole and anchored to the ground 18 ft from the base of the pole. What angle does the wire make with the ground? Use the equation shown.

$$\tan(\theta) = \frac{40}{18}$$

→ *The 40 ft pole is opposite the angle θ at the ground and the 18 ft distance is adjacent, so use tangent.*
→ *Take the inverse tangent: θ = tan■¹(40 ÷ 18) ≈ tan■¹(2.2222).*
→ *Compute tan■¹(2.2222) ≈ 65.77°.*

Answer: $\theta \approx 65.77^{\circ}$

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8. A surveyor stands 200 ft from the base of a building. The angle of elevation to the top of the building is 42°. How tall is the building? Use the equation shown.

$$\tan(42^{\circ}) = \frac{h}{200}$$

→ *The 200 ft horizontal distance is adjacent and the building height h is opposite the 42° angle.*
→ *Multiply both sides by 200: h = 200 × tan(42°).*
→ *Compute tan(42°) ≈ 0.9004, so h ≈ 200 × 0.9004 ≈ 180.10 ft.*

Answer: $h \approx 180.10$ ft

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9. A slide on a playground is 12 ft long and makes a 35° angle with the horizontal ground. How high is the top of the slide above the ground? Use the equation shown.

$$\sin(35^{\circ}) = \frac{h}{12}$$

→ *The 12 ft slide is the hypotenuse and the height h is opposite the 35° angle.*
→ *Use sine: h = 12 × sin(35°).*
→ *Compute sin(35°) ≈ 0.5736, so h ≈ 12 × 0.5736 ≈ 6.88 ft.*

Answer: $h \approx 6.88$ ft

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10. From the roof of a building 60 m tall, the angle of depression to a car parked on the street is 24°. How far is the car from the base of the building? Use the equation shown.

$$\tan(24^\circ) = \frac{60}{d}$$

→ The angle of depression from the roof equals the angle of elevation from the car, so 60 m is opposite the 24° angle and d is adjacent.

→ Solve for d: d = 60 ÷ tan(24°).

→ Compute tan(24°) ≈ 0.4452, so d ≈ 60 ÷ 0.4452 ≈ 134.74 m.

Answer: $d \approx 134.74$ m