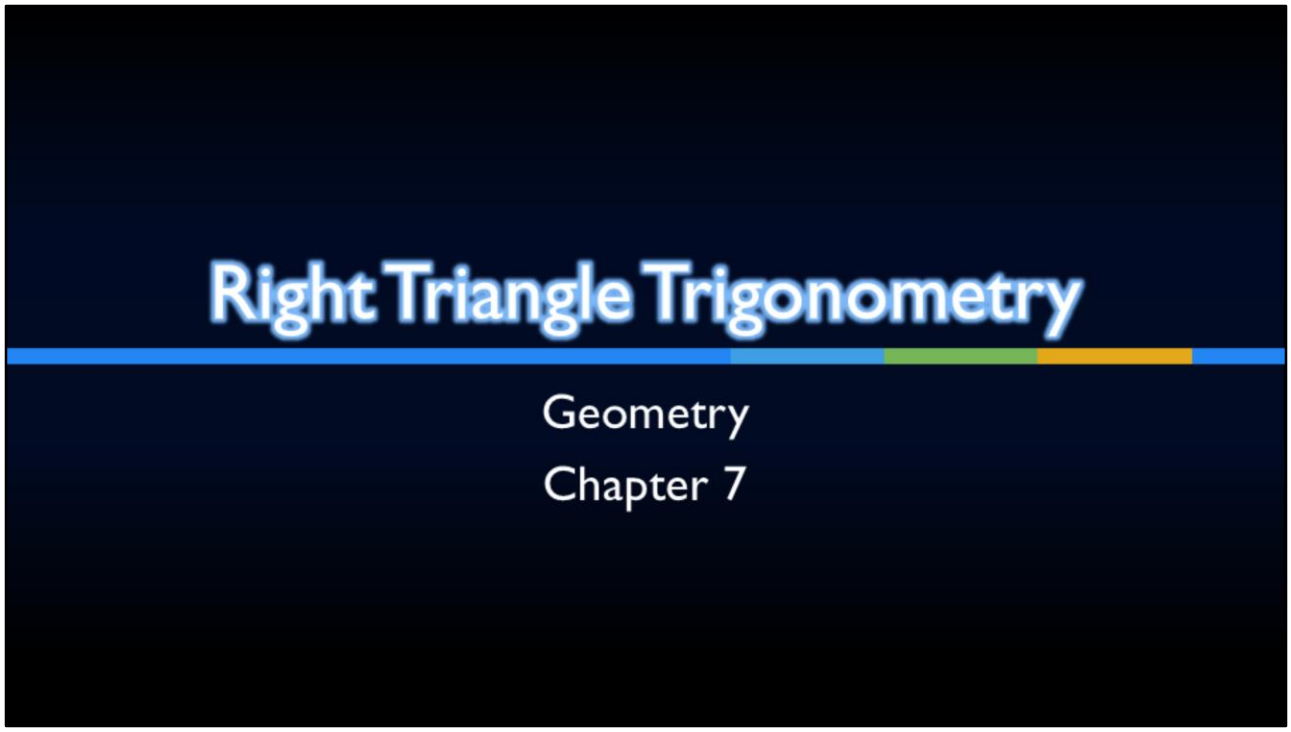



# Geometry 7

- This Slideshow was developed to accompany the textbook
  - *Larson Geometry*
  - *By Larson, R., Boswell, L., Kanold, T. D., & Stiff, L.*
  - *2011 Holt McDougal*
- Some examples and diagrams are taken from the textbook.

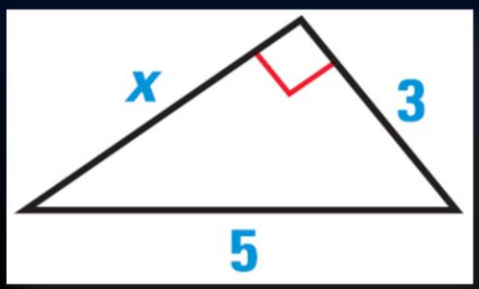
Slides created by
Richard Wright, Andrews Academy
rwright@andrews.edu

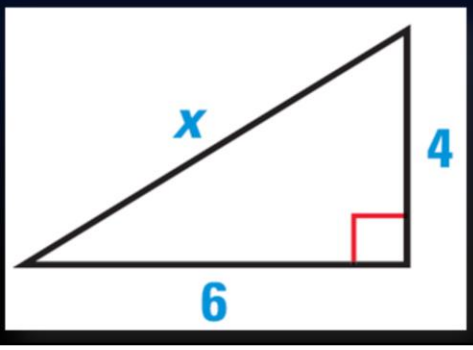
# 7.1 Apply the Pythagorean Theorem

## Pythagorean Theorem

In a right triangle, $a^2 + b^2 = c^2$ where **a and b** are the length of the **legs** and **c** is the length of the **hypotenuse**.

- Find the value of x




$$3^2 + x^2 = 5^2$$
$$9 + x^2 = 25$$
$$x^2 = 16$$
$$x = 4$$

$$6^2 + 4^2 = x^2$$
$$36 + 16 = x^2$$
$$52 = x^2$$
$$x = 2\sqrt{13}$$

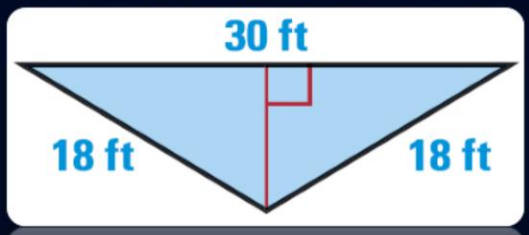
# 7.1 Apply the Pythagorean Theorem

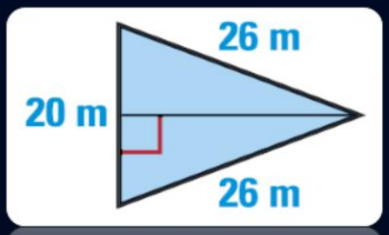
- The top of a ladder rests against a wall, 23 ft above the ground. The base of the ladder is 6 ft away from the wall. What is the length of the ladder.

$$23^2 + 6^2 = x^2$$
$$529 + 36 = x^2$$
$$565 = x^2$$
$$x = 23.77\ ft$$

# 7.1 Apply the Pythagorean Theorem

- Find the area of the triangle




Use pythagorean theorem to find height: $15^2 + h^2 = 18^2$

$$225 + h^2 = 324$$
$$h^2 = 99$$
$$h = 3\sqrt{11}$$
$$A = \frac{1}{2}bh = \frac{1}{2}(30)\left(3\sqrt{11}\right) = 45\sqrt{11} = 149ft^2$$

Find height: $10^2 + h^2 = 26^2$

$$100 + h^2 = 676$$
$$h^2 = 576$$
$$h = 24$$
$$A = \frac{1}{2}(20)(24) = 240m^2$$

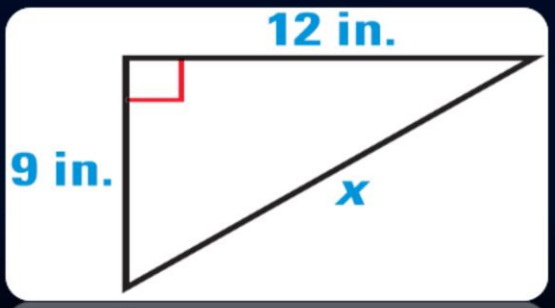
# 7.1 Apply the Pythagorean Theorem

- Pythagorean Triples
  - A set of three positive integers that satisfy the Pythagorean Theorem

| **3, 4, 5** | **5, 12, 13** | **8, 15, 17** | **7, 24, 25** |
|---|---|---|---|
| 6, 8, 10 | 10, 24, 26 | 16, 30, 34 | 14, 48, 50 |
| 9, 12, 15 | 15, 36, 39 | 24, 45, 51 | 21, 72, 75 |
| 30, 40, 50 | 50, 120, 130 | 80, 150, 170 | 70, 240, 250 |
| $3x, 4x, 5x$ | $5x, 12x, 13x$ | $8x, 15x, 17x$ | $7x, 24x, 25x$ |

# 7.1 Apply the Pythagorean Theorem

- Use a Pythagorean Triple to solve




- *436 #4-34 even, 40-50 even = 22*

Triple is 9, 12, 15
x = 15

# Answers and Quiz

- 7.1 Answers
- 7.1 Homework Quiz

# 7.2 Use the Converse of the Pythagorean Theorem

## Converse of the Pythagorean Theorem

If $a^2 + b^2 = c^2$ where **a and b** are the length of the short sides and **c** is the length of the **longest side**, then it is a right triangle.

- Tell whether a triangle with the given sides is a right triangle.
- $4, 4\sqrt{3}, 8$

$$4^2 + \left(4\sqrt{3}\right)^2 = 8^2$$
$$16 + (16)(3) = 64$$
$$16 + 48 = 64$$
$$64 = 64$$

Yes

# 7.2 Use the Converse of the Pythagorean Theorem

If c is the longest side and…

$c^2 < a^2 + b^2$ → acute triangle

$c^2 = a^2 + b^2$ → right triangle

$c^2 > a^2 + b^2$ → obtuse triangle

- Show that the segments with lengths 3, 4, and 6 can form a triangle
- Classify the triangle as acute, right or obtuse.
- *444 #2-30 even, 33, 38, 40, 44-52 even = 23*
- *Extra Credit 447 #2, 8 = +2*

$$3 + 4 > 6$$
$$7 > 6$$

$$3^2 + 4^2 \stackrel{?}{} 6^2$$
$$9 + 16 \stackrel{?}{} 36$$
$$25 < 36$$

obtuse

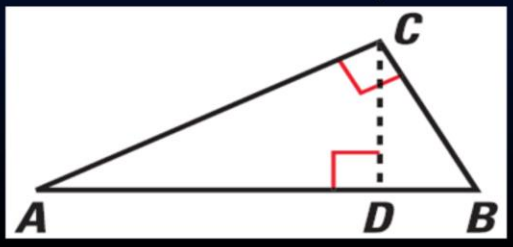
# Answers and Quiz

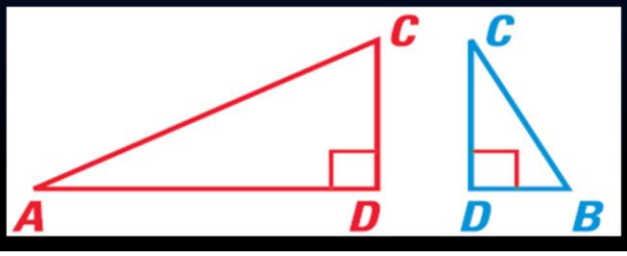
- 7.2 Answers
- 7.2 Homework Quiz

# 7.3 Use Similar Right Triangles

If the altitude is drawn to the hypotenuse of a right triangle, then the two triangles formed are similar to the original triangle and to each other.

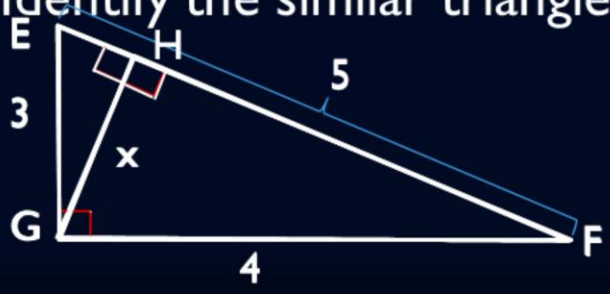
- ΔCBD ~ ΔABC, ΔACD ~ ΔABC, ΔCBD ~ ΔACD



# 7.3 Use Similar Right Triangles

- Identify the similar triangles. Then find x.

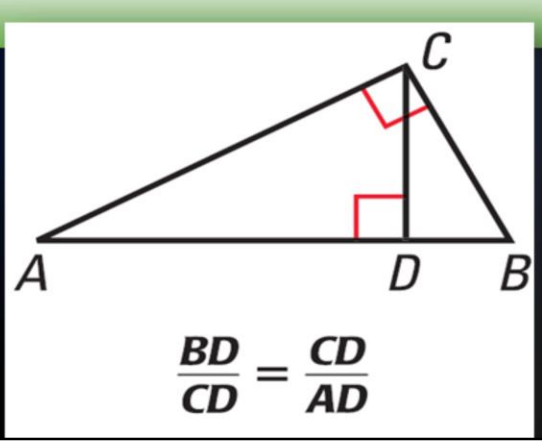



ΔEFG ~ ΔGFH ~ ΔEHG

$$\frac{GH}{EG} = \frac{GF}{EF}$$
$$\frac{x}{3} = \frac{4}{5}$$
$$x = \frac{12}{5}$$

# 7.3 Use Similar Right Triangles

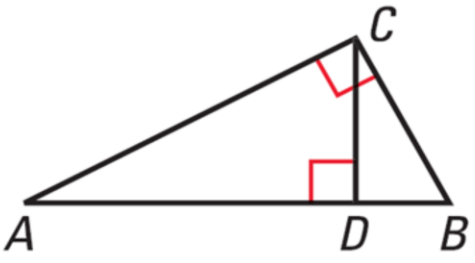
If the altitude is drawn to the hypotenuse of a right triangle, then the altitude is the geometric mean of the two segments of the hypotenuse.




$$\frac{BD}{CD} = \frac{CD}{AD}$$

# 7.3 Use Similar Right Triangles

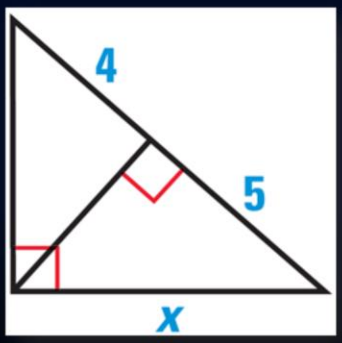
If the altitude is drawn to the hypotenuse of a right triangle, then each leg is the geometric mean of the hypotenuse and the segment of the hypotenuse adjacent to that leg.

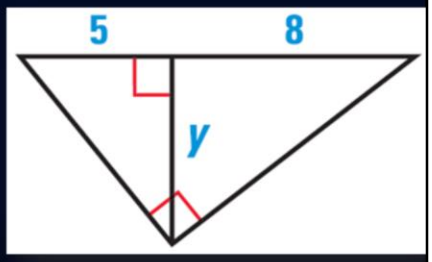



$$\frac{AB}{CB} = \frac{CB}{DB} \text{ and } \frac{AB}{AC} = \frac{AC}{AD}$$

# 7.3 Use Similar Right Triangles

- Find the value of x or y.




- *453 #4-26 even, 30-34 even, 40-48 even = 20*

$$\frac{x}{9} = \frac{5}{x}$$
$$x^2 = 45$$
$$x = 3\sqrt{5} = 6.708$$

$$\frac{y}{5} = \frac{8}{y}$$
$$y^2 = 40$$
$$y = 2\sqrt{10} = 6.325$$

# Answers and Quiz

- 7.3 Answers
- 7.3 Homework Quiz

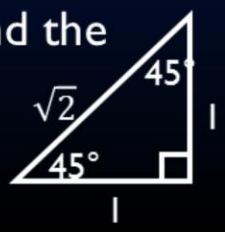
# 7.4 Special Right Triangles

Some triangles have special lengths of sides, thus in life you see these triangles often such as in construction.

# 7.4 Special Right Triangles

45°-45°-90°

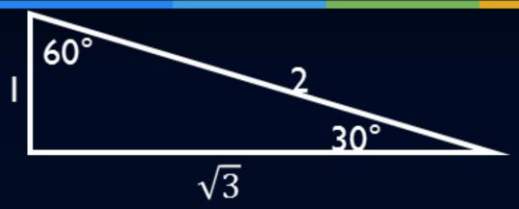
- If you have another 45°-45°-90° triangle, then use the fact that they are similar and use the proportional sides.
- The leg of one 45°-45°-90° triangle is 10. Find the lengths of the other sides.




ANS: other leg is 10, and hypotenuse is found by $10/1 = x/\sqrt{2} \rightarrow x = 10\sqrt{2}$

# 7.4 Special Right Triangles

30°-60°-90°




- The hypotenuse of a 30°-60°-90° is 4. Find the lengths of the other sides.

- *461 #2-20 even, 24, 28, 30, 36-38 all, 40, 42-44 all = 20*
- *Extra Credit 464 #2, 4 = +2*

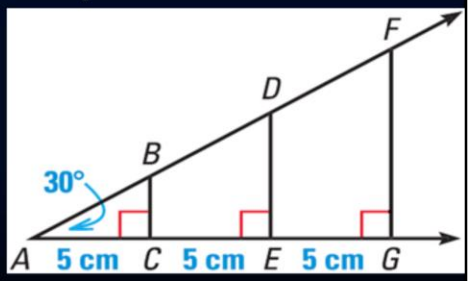
ANS: 2 and $2\sqrt{3}$

# Answers and Quiz

- 7.4 Answers
- 7.4 Homework Quiz

# 7.5 Apply the Tangent Ratio

- Draw a large 30° angle.
- On one side, draw a perpendicular lines every 5 cm.
- Fill in the table



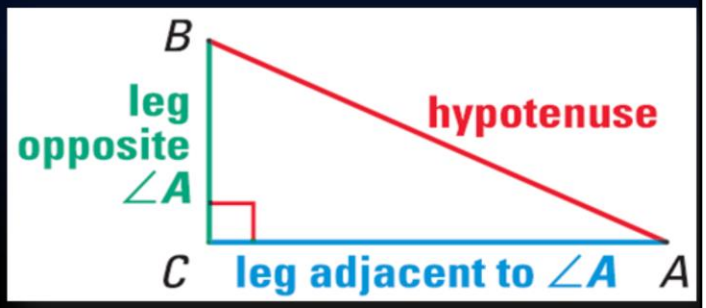

| Triangle | Adjacent leg | Opposite leg | $\frac{\text{Opposite leg}}{\text{Adjacent leg}}$ |
|---|---|---|---|
| $\triangle ABC$ | 5 cm | ? | ? |
| $\triangle ADE$ | 10 cm | ? | ? |
| $\triangle AFG$ | 15 cm | ? | ? |

- Why are $\frac{BC}{DE} = \frac{AC}{AE}$ and $\frac{BC}{AC} = \frac{DE}{AE}$?

The triangles are similar by AA similarity

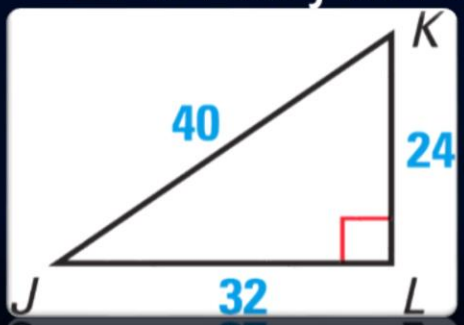
# 7.5 Apply the Tangent Ratio

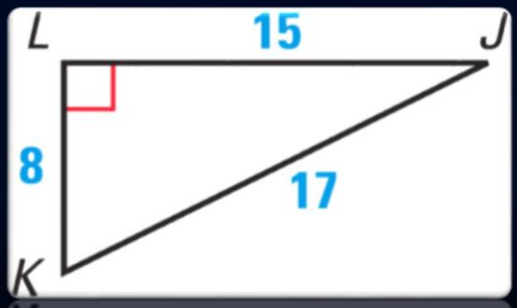
- Tangent ratio
- $\tan A = \dfrac{\text{opposite leg}}{\text{adjacent leg}}$



# 7.5 Apply the Tangent Ratio

- Find tan J and tan K.



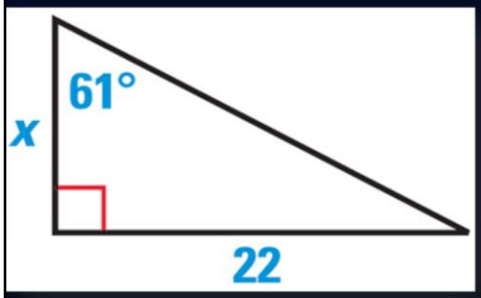



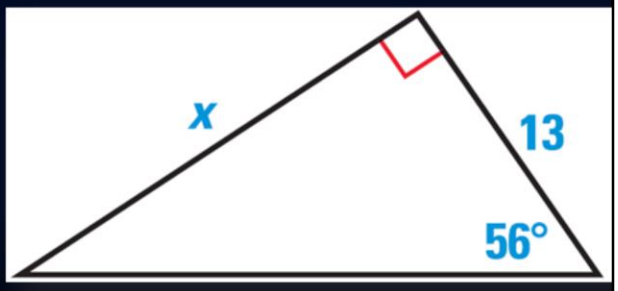

$$\tan J = \frac{24}{32} = \frac{3}{4}$$
$$\tan K = \frac{32}{24} = \frac{4}{3}$$

$$\tan J = \frac{8}{15}$$
$$\tan K = \frac{15}{8}$$

# 7.5 Apply the Tangent Ratio

- Find the value of x. Round to the nearest tenth.




- *469 #4-28 even, 32, 36-46 even = 20*

$$\tan 61° = \frac{22}{x}$$
$$x \tan 61° = 22$$
$$x = \frac{22}{\tan 61°} = 12.2$$

$$\tan 56° = \frac{x}{13}$$
$$13 \tan 56° = x = 19.3$$

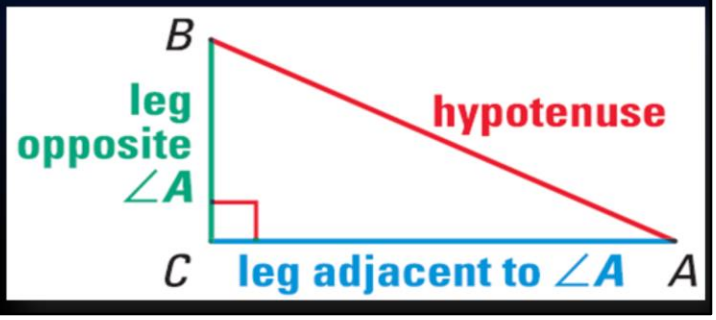
# Answers and Quiz

- 7.5 Answers
- 7.5 Homework Quiz

# 7.6 Apply the Sine and Cosine Ratios

- $\sin A = \frac{\text{opposite leg}}{\text{hypotenuse}}$
- $\cos A = \frac{\text{adjacent leg}}{\text{hypotenuse}}$

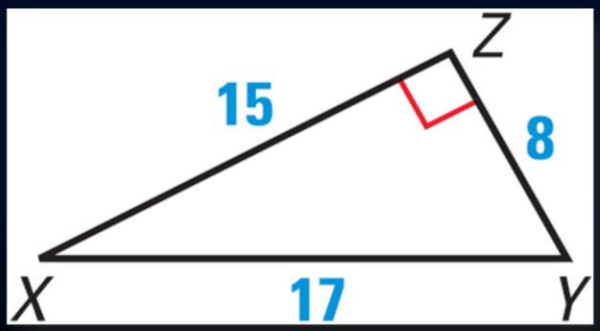
S O H
C A H
T O A




SOH = Sine Opposite Hypotenuse
CAH = Cosine Adjacent Hypotenuse
TOA = Tangent Opposite Adjacent

# 7.6 Apply the Sine and Cosine Ratios

- Find sin X, cos X, and tan X



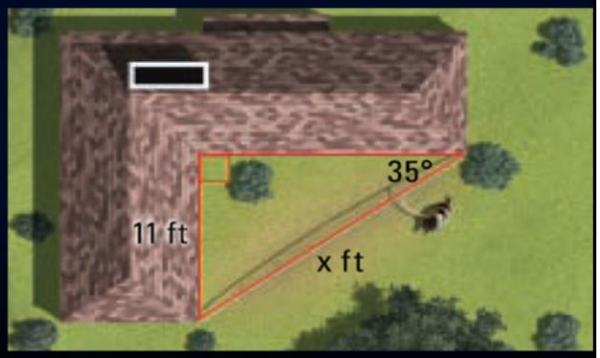

$$\sin X = \frac{8}{17}$$

$$\cos X = \frac{15}{17}$$

$$\tan X = \frac{8}{15}$$

# 7.6 Apply the Sine and Cosine Ratios

- Find the length of the dog run (x).



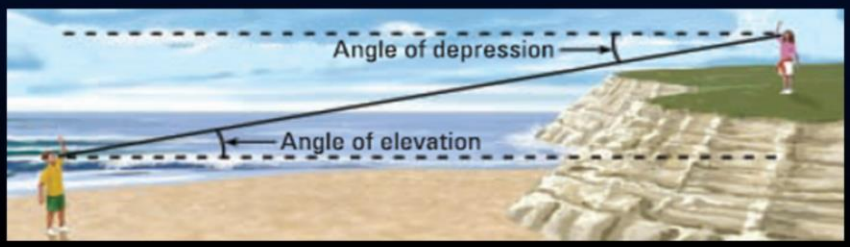

$$\sin 35° = \frac{11}{x}$$

$$x \cdot \sin 35° = 11$$

$$x = \frac{11}{\sin 35°} = 19.2\ ft$$

# 7.6 Apply the Sine and Cosine Ratios

- Angle of Elevation and Depression
  - Both are measured from the horizontal
  - Since they are measured to || lines, they are ≅



# 7.6 Apply the Sine and Cosine Ratios

- The angle of elevation of a plane as seen from the airport is 50°. If the plane's 1000 ft away, how high is plane?


- *477 #2-30 even, 34, 36, 42-48 even = 21*

$$\sin 50° = \frac{x}{1000}$$
$$1000 \cdot \sin 50° = x$$
$$x = 766ft$$

# Answers and Quiz

- 7.6 Answers
- 7.6 Homework Quiz

# 7.7 Solve Right Triangles

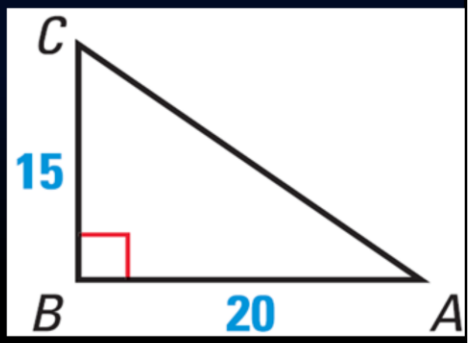
- Solve a triangle means to find all the unknown angles and sides.
  - Can be done for a right triangle if you know
    - 2 sides
    - 1 side and 1 acute angle
  - Use sin, cos, tan, Pythagorean Theorem, and Angle Sum Theorem

# 7.7 Solve Right Triangles

- Inverse Trigonometric Ratios
  - Used to find measures of angles when you know the sides.
  - $\sin^{-1}\frac{opp}{hyp} = \theta$
  - $\cos^{-1}\frac{adj}{hyp} = \theta$
  - $\tan^{-1}\frac{opp}{adj} = \theta$

# 7.7 Solve Right Triangles

- Find $m\angle D$ to the nearest tenth if $\sin D = 0.54$
- Find $m\angle C$ to the nearest tenth.

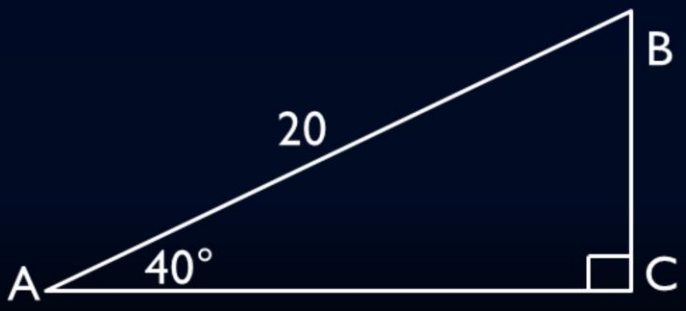



$$D = \sin^{-1} 0.54 = 32.7$$

$$C = \tan^{-1} \frac{20}{15} = 53.1$$

# 7.7 Solve Right Triangles

- Solve a right triangle that has a 40° angle and a 20 inch hypotenuse.




- *485 #2-28 even, 32-38 even, 43, 44-48 even = 22*
- *Extra Credit 489 #2, 4 = +2*

$$40° + B + 90° = 180°$$
$$B = 50°$$

$$\cos 40° = \frac{AC}{20}$$
$$AC = 20 \cos 40° = 15.3$$

$$\sin 40° = \frac{BC}{20}$$
$$BC = 20 \sin 40° = 12.9$$

# Answers and Quiz

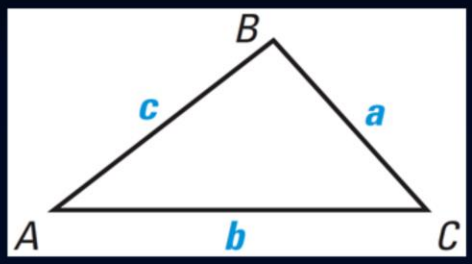
- 7.7 Answers
- 7.7 Homework Quiz

# 7.Extension Law of Sines and Law of Cosines

- Tangent, Sine, and Cosine are only for right triangles
- Law of Sines and Law of Cosines are for any triangle

# 7.Extension Law of Sines and Law of Cosines

- Law of Sines
- $\frac{\sin A}{a} = \frac{\sin B}{b} = \frac{\sin C}{c}$

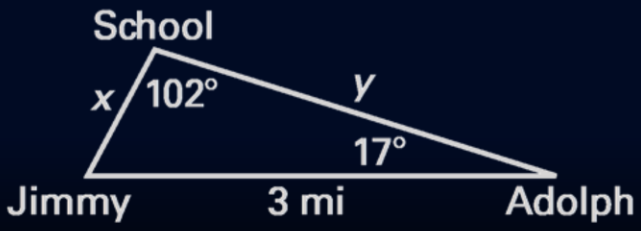



- Used if you know
  - AAS, ASA, SSA

Only use two of the ratios at a time.

# 7.Extension Law of Sines and Law of Cosines

- How much closer to school does Jimmy live than Adolph?




Find x: $\frac{\sin 102°}{3} = \frac{\sin 17°}{x}$

$$x \cdot \sin 102° = 3 \cdot \sin 17°$$

$$x = \frac{3 \cdot \sin 17°}{\sin 102°} = 0.897$$

Find $\angle J$: $\angle J = 180° - 102° - 17° = 61°$

Find y: $\frac{\sin 102°}{3} = \frac{\sin 61°}{y}$

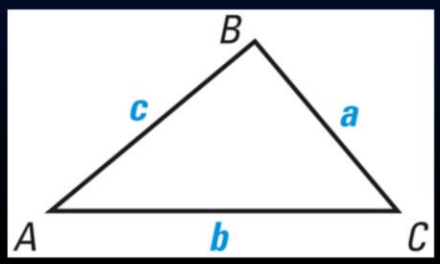
$$y \cdot \sin 102° = 3 \cdot \sin 61°$$

$$y = \frac{3 \cdot \sin 61°}{\sin 102°} = 2.682$$

Subtract: $2.682 - 0.897 = 1.785\ miles$

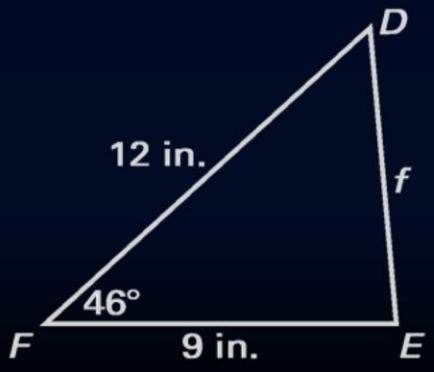
# 7.Extension Law of Sines and Law of Cosines

- Law of Cosines
  - $a^2 = b^2 + c^2 - 2bc\cos A$
  - $b^2 = a^2 + c^2 - 2ac\cos B$
  - $c^2 = a^2 + b^2 - 2ab\cos C$
- Use when you know
  - SSS, SAS



# 7.Extension Law of Sines and Law of Cosines

- Find f to the nearest hundredth.




- 491 #1-7 = 7

$$f^2 = 9^2 + 12^2 - 2 \cdot 9 \cdot 12 \cdot \cos 46°$$
$$f^2 = 74.9538$$
$$f = 8.66\ in$$

# Answers

- 7.Extension Answers

# 7.Review

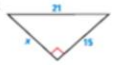
- 498 #1-17 = 17

## 7 CHAPTER TEST

**Find the value of $x$. Write your answer in simplest radical form.**

1. 


2. 


3. 

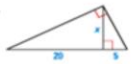

**Classify the triangle as *acute*, *right*, or *obtuse*.**

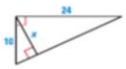
4. 5, 15, $5\sqrt{10}$

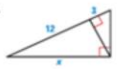
5. 4.3, 6.7, 8.2

6. 5, 7, 8

**Find the value of $x$. Round decimal answers to the nearest tenth.**

7. 

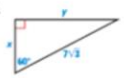

8. 


9. 


**Find the value of each variable. Write your answer in simplest radical form.**

10. 

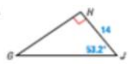

11. 


12. 


**Solve the right triangle. Round decimal answers to the nearest tenth.**

13. 


14. 


15. 


16. **FLAGPOLE** Julie is 6 feet tall. If she stands 15 feet from the flagpole and holds a cardboard square, the edges of the square line up with the top and bottom of the flagpole. Approximate the height of the flagpole.

17. **HILLS** The length of a hill in your neighborhood is 2000 feet. The height of the hill is 750 feet. What is the angle of elevation of the hill?