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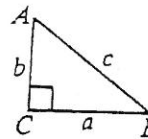
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9.2 The Pythagorean Theorem

Objective: State and apply the Pythagorean Theorem.

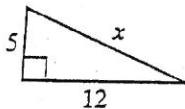
Pythagorean Theorem In a right triangle, the square of the hypotenuse is equal to the sum of the squares of the legs.

If $\angle C$ in $\triangle ABC$ is a right angle, then $a^2 + b^2 = c^2$.

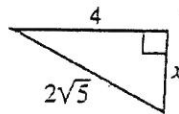


Example 1 Find the value of x . (Remember that the length must be a positive number, so you are only interested in positive roots.)

a.



b.



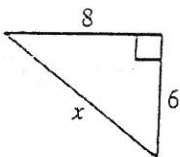
Solution

$$\begin{aligned} \text{a. } x^2 &= 5^2 + 12^2 \\ &= 25 + 144 = 169 \\ x &= \sqrt{169} = 13 \end{aligned}$$

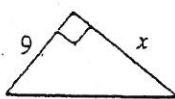
$$\begin{aligned} \text{b. } (2\sqrt{3})^2 &= x^2 + 4^2 \\ 20 &= x^2 + 16 \\ 4 &= x^2 \\ 2 &= x \end{aligned}$$

Find the value of x . Give exact answers.

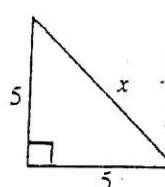
1. $8^2 + 6^2 = x^2$
 $64 + 36 = x^2$
 $\sqrt{100} = \sqrt{x^2}$
 $10 = x$



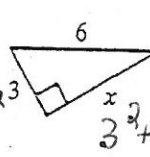
2. $9^2 + x^2 = 15^2$
 $81 + x^2 = 225$
 $-81 \quad -81$
 $x^2 = 144$
 $x = 12$



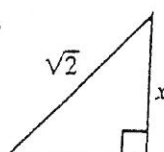
3. $5^2 + 5^2 = x^2$
 $25 + 25 = x^2$
 $\sqrt{50} = \sqrt{x^2}$
 $5\sqrt{2} = x$



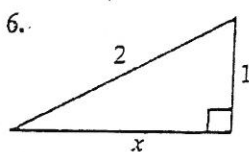
6. $3^2 + x^2 = 6^2$
 $9 + x^2 = 36$
 $-9 \quad -9$
 $\sqrt{x^2} = \sqrt{27}$
 $x = \sqrt{9 \cdot 3}$
 $x = 3\sqrt{3}$



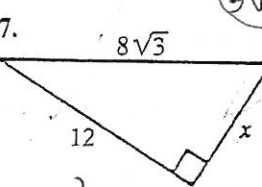
5. $1^2 + x^2 = (\sqrt{2})^2$
 $1 + x^2 = 2$
 $-1 \quad -1$
 $\sqrt{x^2} = \sqrt{1}$
 $x = 1$



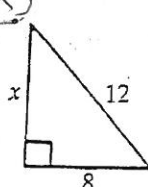
6. $1^2 + x^2 = 2^2$
 $1 + x^2 = 4$
 $-1 \quad -1$
 $\sqrt{x^2} = \sqrt{3}$
 $x = \sqrt{3}$



7. $12^2 + x^2 = (8\sqrt{3})^2$
 $144 + x^2 = 64 \cdot 3$
 $144 + x^2 = 192$
 $-144 \quad -144$
 $\sqrt{x^2} = \sqrt{48}$
 $x = \sqrt{16 \cdot 3}$
 $x = 4\sqrt{3}$

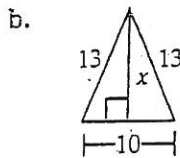
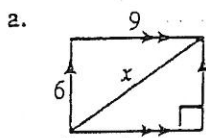


8. $x^2 + 8^2 = 12^2$
 $x^2 + 64 = 144$
 $-64 \quad -64$
 $\sqrt{x^2} = \sqrt{80}$
 $x = \sqrt{16 \cdot 5}$
 $x = 4\sqrt{5}$

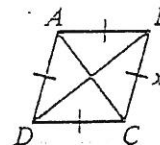


The Pythagorean Theorem (continued)

Example 2 Find the value of x .



c. $AC = 12; BD = 16$



Solution

a. The figure is a rectangle, so opposite angles are \cong .

$$\begin{aligned} x^2 &= 6^2 + 9^2 \\ &= 36 + 81 \\ &= 117 \\ x &= 3\sqrt{13} \end{aligned}$$

b. The altitude drawn to the base of an isosceles triangle is \perp to and bisects the base.

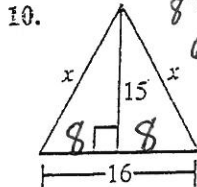
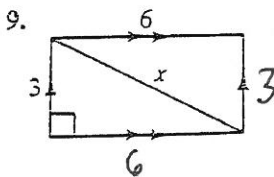
$$\begin{aligned} x^2 + 5^2 &= 13^2 \\ x^2 &= 144 \\ x &= 12 \end{aligned}$$

c. The diagonals of a rhombus are \perp bisectors of each other.

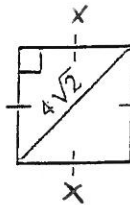
$$\begin{aligned} x^2 &= 6^2 + 8^2 \\ x^2 &= 100 \\ x &= 10 \end{aligned}$$

Find the value of x . Give exact answers.

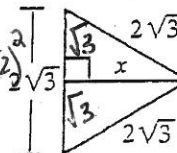
$$\begin{aligned} 3^2 + 6^2 &= x^2 \\ 9 + 36 &= x^2 \\ \sqrt{45} &= \sqrt{x^2} \\ \sqrt{9 \cdot 5} &= x \\ 3\sqrt{5} &= x \end{aligned}$$



$$\begin{aligned} 8^2 + 15^2 &= x^2 \\ 64 + 225 &= x^2 \\ \sqrt{289} &= \sqrt{x^2} \\ 17 &= x \end{aligned}$$

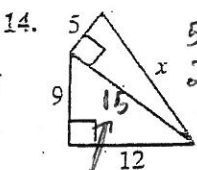
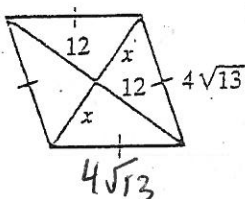


12. $x^2 + x^2 = (4\sqrt{2})^2$
 $2x^2 = 16 \cdot 2$
 $\frac{2x^2}{2} = \frac{32}{2}$
 $x^2 = 16$
 $x = 4$

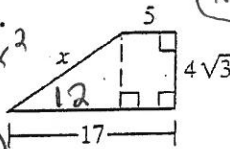


$$\begin{aligned} \sqrt{3} + x^2 &= (2\sqrt{3})^2 \\ 3 + x^2 &= 12 \\ -3 & \quad -3 \\ \sqrt{x^2} &= \sqrt{9} \\ x &= 3 \end{aligned}$$

13. $x^2 + 12^2 = (4\sqrt{13})^2$
 $x^2 + 144 = 16 \cdot 13$
 $x^2 + 144 = 208$
 $-144 \quad -144$
 $\sqrt{x^2} = \sqrt{64}$
 $x = 8$

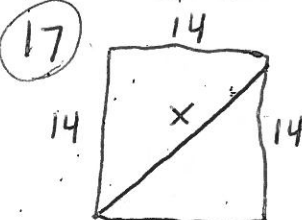


14. $5^2 + 12^2 = x^2$
 $25 + 144 = x^2$
 $\sqrt{169} = \sqrt{x^2}$
 $13 = x$

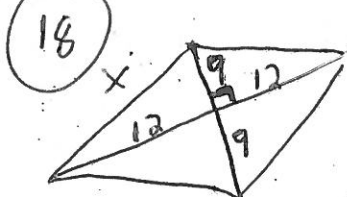


15. $12^2 + (4\sqrt{3})^2 = x^2$
 $144 + 16 \cdot 3 = x^2$
 $\sqrt{192} = \sqrt{x^2}$
 $\sqrt{64 \cdot 3} = x$
 $8\sqrt{3} = x$

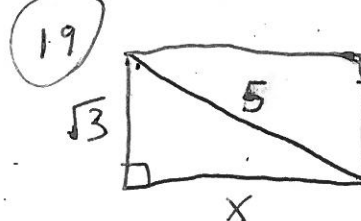
- Find the length of the diagonals of a square with perimeter 56.
- The diagonals of a rhombus have lengths 18 and 24. Find the perimeter of the rhombus.
- A rectangle has diagonals of 5 cm and its width is $\sqrt{3}$ cm. Find the length of the rectangle.



17. $14^2 + 14^2 = x^2$
 $196 + 196 = x^2$
 $\sqrt{392} = \sqrt{x^2}$
 $\sqrt{196 \cdot 2} = x$
 $14\sqrt{2} = x$



18. $x^2 = 9^2 + 12^2$
 $x^2 = 81 + 144$
 $\sqrt{x^2} = \sqrt{225}$
 $x = 15$
 $P = 4 \cdot 15 = 60$



19. $\sqrt{3}^2 + x^2 = 5^2$
 $3 + x^2 = 25$
 $-3 \quad -3$
 $\sqrt{x^2} = \sqrt{22}$
 $x = \sqrt{22}$