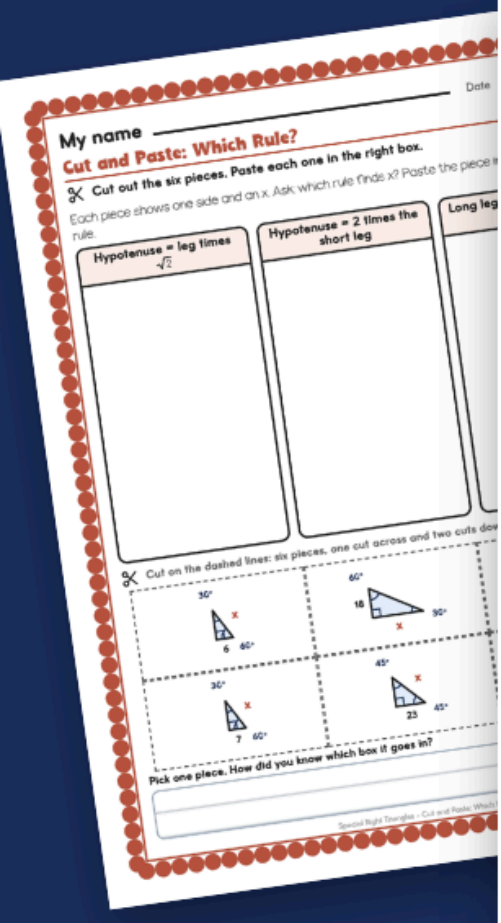
SPECIAL RIGHT TRIANGLES

45-45-90 AND 30-60-90 · GRADES 9-10


My name _____ Date _____

Cut and Paste: Which Rule?

Cut out the six pieces. Paste each one in the right box.

Each piece shows one side and an x. Ask: which rule finds x? Paste the piece in the rule.

Hypotenuse = leg times $\sqrt{2}$	Hypotenuse = 2 times the short leg	Long leg

Cut on the dashed lines: six pieces, one cut across and two cuts down.

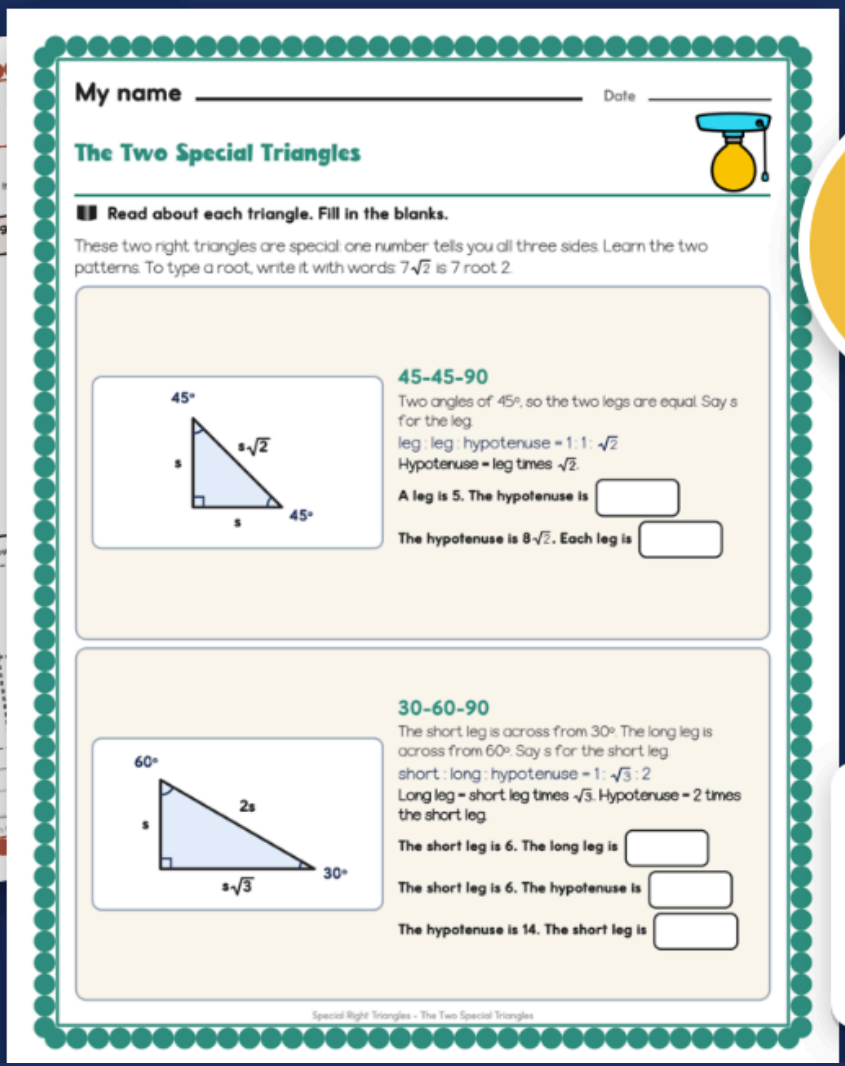
30° x 6 60°

60° 18 90° x

30° x 7 60°

45° x 23 45°

Pick one piece. How did you know which box it goes in?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The Two Special Triangles

Read about each triangle. Fill in the blanks.

These two right triangles are special: one number tells you all three sides. Learn the two patterns. To type a root, write it with words: $7\sqrt{2}$ is 7 root 2.

45° s $s\sqrt{2}$ s 45°

45-45-90

Two angles of 45°, so the two legs are equal. Say s for the leg.

leg : leg : hypotenuse = 1 : 1 : $\sqrt{2}$

Hypotenuse = leg times $\sqrt{2}$.

A leg is 5. The hypotenuse is ____

The hypotenuse is $8\sqrt{2}$. Each leg is ____

60° s 2s $s\sqrt{3}$ 30°

30-60-90

The short leg is across from 30°. The long leg is across from 60°. Say s for the short leg.

short : long : hypotenuse = 1 : $\sqrt{3}$: 2

Long leg = short leg times $\sqrt{3}$. Hypotenuse = 2 times the short leg.

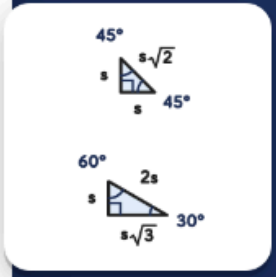
The short leg is 6. The long leg is ____

The short leg is 6. The hypotenuse is ____

The hypotenuse is 14. The short leg is ____

Special Right Triangles · The Two Special Triangles

26 PAGES



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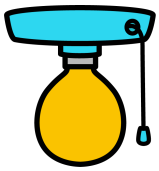
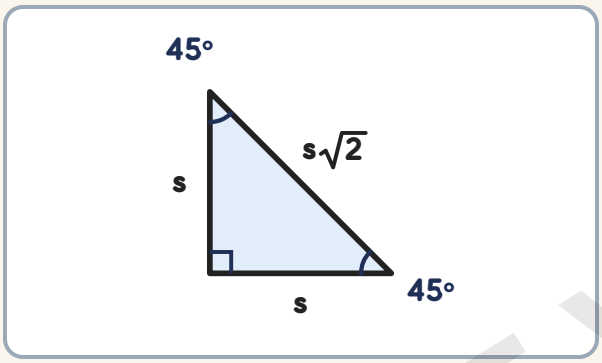


The Two Special Triangles

Read about each triangle. Fill in the blanks.

These two right triangles are special: one number tells you all three sides. Learn the two patterns. To type a root, write it with words: $7\sqrt{2}$ is 7 root 2.



45-45-90

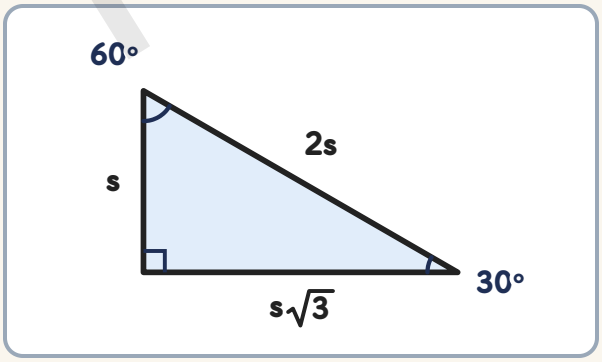
Two angles of 45°, so the two legs are equal. Say s for the leg.

leg : leg : hypotenuse = 1 : 1 : $\sqrt{2}$

Hypotenuse = leg times $\sqrt{2}$.

A leg is 5. The hypotenuse is _____

The hypotenuse is $8\sqrt{2}$. Each leg is _____



30-60-90

The short leg is across from 30°. The long leg is across from 60°. Say s for the short leg.

short : long : hypotenuse = 1 : $\sqrt{3}$: 2

Long leg = short leg times $\sqrt{3}$. Hypotenuse = 2 times the short leg.

The short leg is 6. The long leg is _____

The short leg is 6. The hypotenuse is _____

The hypotenuse is 14. The short leg is _____

PREVIEW

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Warm-Up: Radicals

Write each one with the root outside.

Left: $\sqrt{8}$ is $\sqrt{4}$ times $\sqrt{2}$, which is $2\sqrt{2}$. Right: $\frac{6}{\sqrt{2}} = \frac{6\sqrt{2}}{2} = 3\sqrt{2}$. Multiply top and bottom by the root, then divide. To type a root, write it with words: $7\sqrt{2}$ is 7 root 2.

Take out the biggest square

1. $\sqrt{72} =$ ☐

2. $\sqrt{48} =$ ☐

3. $\sqrt{98} =$ ☐

4. $\sqrt{75} =$ ☐

Divide by the root, root on top

5. $\frac{8}{\sqrt{2}} =$ ☐

6. $\frac{15}{\sqrt{3}} =$ ☐

7. $\frac{18}{\sqrt{2}} =$ ☐

8. $\frac{24}{\sqrt{3}} =$ ☐

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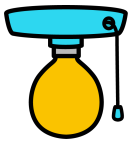
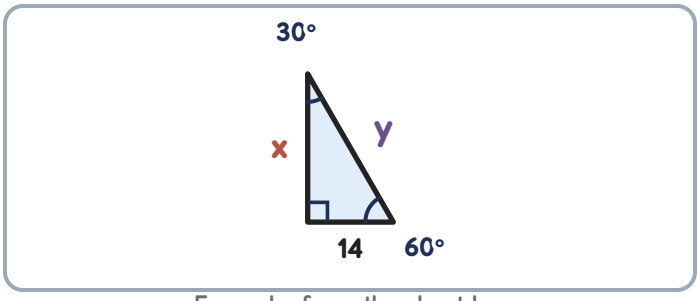
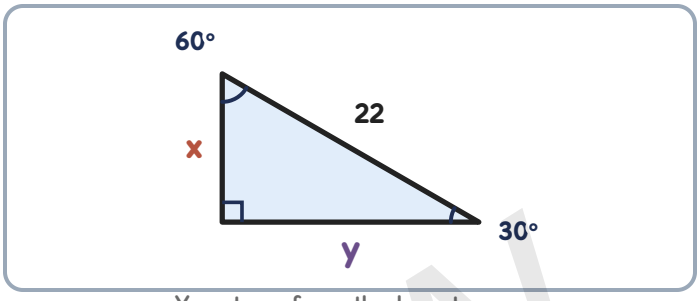


Worked Example: 30-60-90

Read the example. Then fill in the blanks.



Example: from the short leg



Your turn: from the hypotenuse

Example. A 30-60-90 triangle has a short leg of 14. Find x and y. The numbers are made up for practice.

Match	short leg = 14 Angles 30, 60 and 90: this is a 30-60-90 triangle. The short leg is across from 30°.
Long leg	x = 14 times $\sqrt{3}$ = $14\sqrt{3}$ The long leg is the short leg times $\sqrt{3}$.
Hypotenuse	y = 2 times 14 = 28 The hypotenuse is 2 times the short leg.
Check	28 is more than $14\sqrt{3}$, about 24.2 The hypotenuse is the longest side. The long leg is the next longest.

Your turn. The hypotenuse is 22. Find the short leg x and the long leg y.

Match	Which angle is 30°? Write the short leg from the picture.	
Short leg	The short leg is half the hypotenuse. Write x.	
Long leg	Short leg times $\sqrt{3}$. Write y.	
Check	Is the hypotenuse the longest side? Write yes or no.	

PREVIEW

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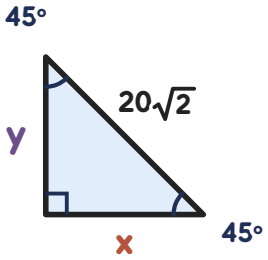
45-45-90: Find the Legs

Find x and y. Show your work.

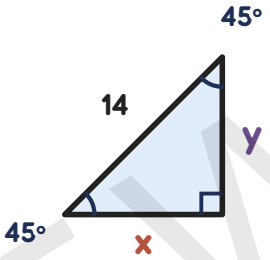
Going back from the hypotenuse, divide by $\sqrt{2}$. If the hypotenuse is a whole number, divide and write the root on top: $\frac{8}{\sqrt{2}} = 4\sqrt{2}$.

1 Find x and y.



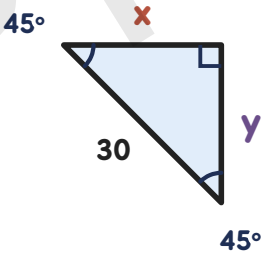
x = ____ y = ____

2 Find x and y.



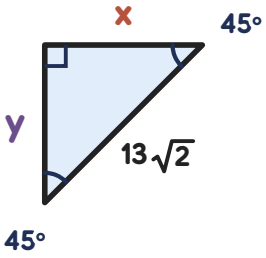
x = ____ y = ____

3 Find x and y.



x = ____ y = ____

4 Find x and y.



x = ____ y = ____

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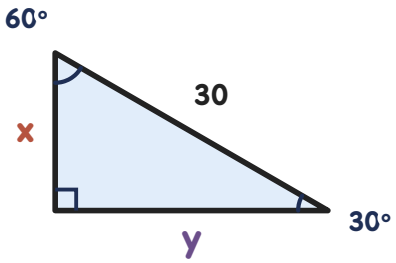
30-60-90: Hypotenuse or Long Leg

Find x and y. Show your work.

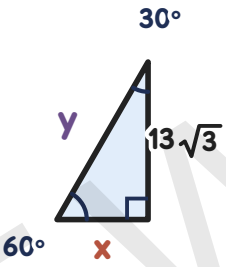
Going back: the short leg is half the hypotenuse, or the long leg divided by $\sqrt{3}$. A long leg of 9 gives $\frac{9}{\sqrt{3}} = 3\sqrt{3}$.

1 Find x and y.



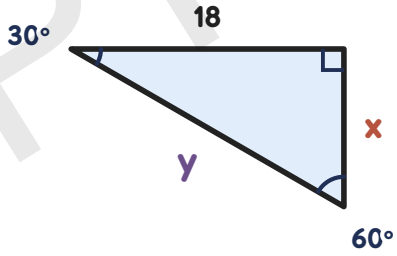
x = _____ y = _____

2 Find x and y.



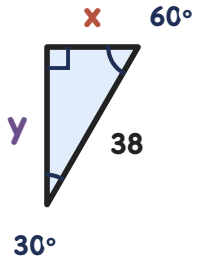
x = _____ y = _____

3 Find x and y.



x = _____ y = _____

4 Find x and y.



x = _____ y = _____

PREVIEW

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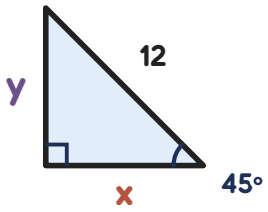
My name _____ Date _____

Which Triangle? B

Pick the triangle. Find x and y.

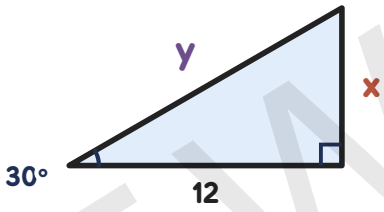
These start with a whole number that needs a root: divide by $\sqrt{2}$ or $\sqrt{3}$ and put the root on top. Decide which triangle first.

1 Find x and y.



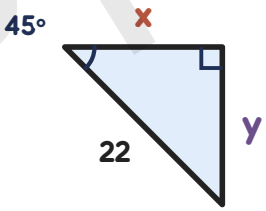
x = _____ y = _____

2 Find x and y.



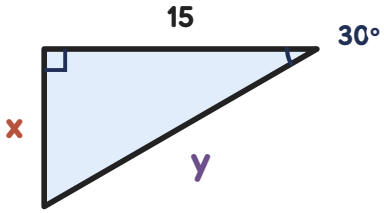
x = _____ y = _____

3 Find x and y.



x = _____ y = _____

4 Find x and y.



x = _____ y = _____

PREVIEW

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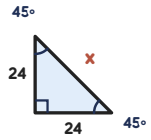
Find the Mistake

Find the mistake. Then fix it.

Sam is made up for practice. Each problem has one mistake.

1 Find x in this 45-45-90 triangle.



Sam solved it like this:

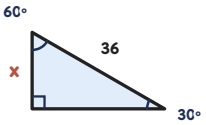
1	Hypotenuse = leg times 2
2	24 x 2 = 48
3	x = 48

The mistake is on line

☐ 1 ☐ 2 ☐ 3

Fix it. Write the right answer:

2 Find x in this 30-60-90 triangle.



Sam solved it like this:

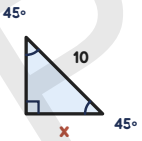
1	Hypotenuse = 2 times short leg
2	2 times x = 36
3	x = 36 x 2 = 72

The mistake is on line

☐ 1 ☐ 2 ☐ 3

Fix it. Write the right answer:

3 Find x in this 45-45-90 triangle.



Sam solved it like this:

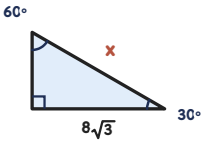
1	Hypotenuse = leg times $\sqrt{2}$
2	Divide: x = 10 / 2
3	x = 5

The mistake is on line

☐ 1 ☐ 2 ☐ 3

Fix it. Write the right answer:

4 Find x in this 30-60-90 triangle.



Sam solved it like this:

1	Short leg = 8, long leg = $8\sqrt{3}$
2	Hypotenuse = long leg times 2
3	x = 2 times $8\sqrt{3}$ = $16\sqrt{3}$

The mistake is on line

☐ 1 ☐ 2 ☐ 3

Fix it. Write the right answer:

PREVIEW

My name _____ Date _____

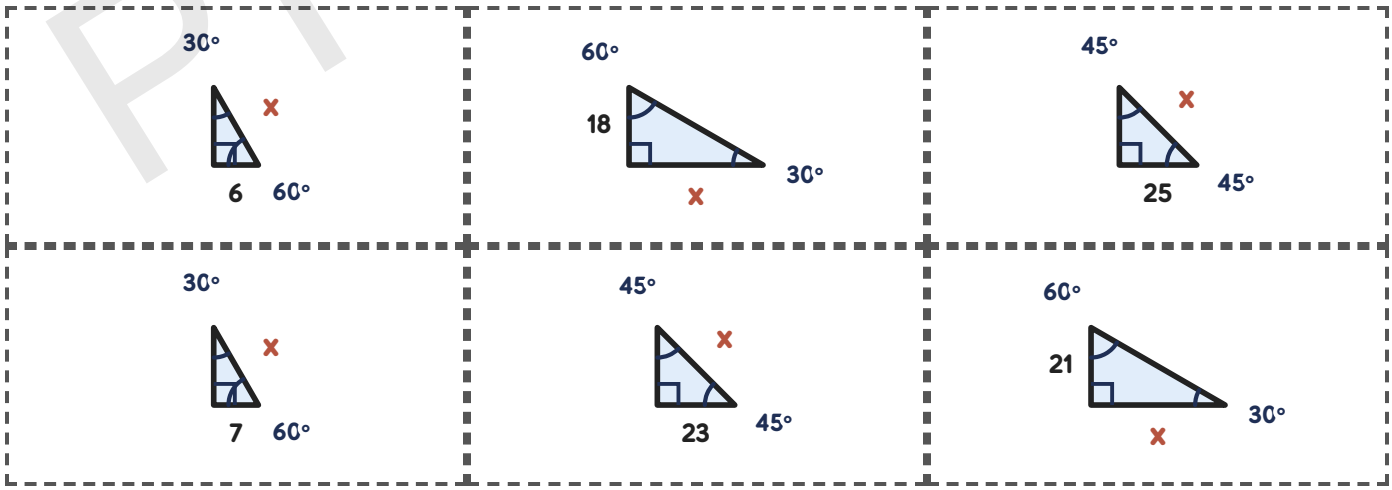
Cut and Paste: Which Rule?

Cut out the six pieces. Paste each one in the right box.

Each piece shows one side and an x. Ask: which rule finds x? Paste the piece in the box with that rule.

Hypotenuse = leg times $\sqrt{2}$	Hypotenuse = 2 times the short leg	Long leg = short leg times $\sqrt{3}$

Cut on the dashed lines: six pieces, one cut across and two cuts down.



Pick one piece. How did you know which box it goes in?

PREVIEW

Answer Key: Mixed, Words, Quiz, Sort, Mistakes

Sam, in the Find the Mistake problems, is invented. Pieces are named by row and column in the cutting grid, left to right and top to bottom.

Which Triangle? pages 12, 13

Item	Given	Answer
12.1	45-45-90, leg 16	$x = 16, y = 16\sqrt{2}$
12.2	30-60-90, short leg 16	$x = 16\sqrt{3}, y = 32$
12.3	30-60-90, hypotenuse 34	$x = 17, y = 17\sqrt{3}$
12.4	45-45-90, hypotenuse $15\sqrt{2}$	$x = 15, y = 15$
13.1	45-45-90, hypotenuse 12	$x = 6\sqrt{2}, y = 6\sqrt{2}$
13.2	30-60-90, long leg 12	$x = 4\sqrt{3}, y = 8\sqrt{3}$
13.3	45-45-90, hypotenuse 22	$x = 11\sqrt{2}, y = 11\sqrt{2}$
13.4	30-60-90, long leg 15	$x = 5\sqrt{3}, y = 10\sqrt{3}$

Quiz page 17

Item	Given	Answer
17.1	45-45-90, hypotenuse 18	$x = 9\sqrt{2}, y = 9\sqrt{2}$
17.2	30-60-90, long leg $15\sqrt{3}$	$x = 15, y = 30$
17.3	30-60-90, short leg 19	$x = 19\sqrt{3}, y = 38$
17.4	45-45-90, hypotenuse 28	$x = 14\sqrt{2}$ cm

Word Problems pages 14, 15

Item	Triangle	Answer
14.1	45-45-90, leg 18	$x = 18\sqrt{2}$ ft
14.2	30-60-90, hypotenuse 18	$x = 9, y = 9\sqrt{3}$ ft
14.3	45-45-90, hypotenuse 26	$x = 13\sqrt{2}$ in
14.4	30-60-90, hypotenuse 16	$x = 8\sqrt{3}$ in
15.1	30-60-90, hypotenuse 14	$x = 7, y = 7\sqrt{3}$ ft
15.2	45-45-90, leg 21	$x = 21\sqrt{2}$ ft
15.3	30-60-90, long leg $6\sqrt{3}$	$x = 6, y = 12$ m
15.4	30-60-90, long leg 21	$x = 7\sqrt{3}, y = 14\sqrt{3}$ ft

Cut and Paste page 18

Piece	Given	Box
r1 c1	30-60-90, short leg 6	Hypotenuse = 2 times the short leg
r1 c2	30-60-90, short leg 18	Long leg = short leg times $\sqrt{3}$
r1 c3	45-45-90, leg 25	Hypotenuse = leg times $\sqrt{2}$
r2 c1	30-60-90, short leg 7	Hypotenuse = 2 times the short leg
r2 c2	45-45-90, leg 23	Hypotenuse = leg times $\sqrt{2}$
r2 c3	30-60-90, short leg 21	Long leg = short leg times $\sqrt{3}$

Item	Mistake	What went wrong	Right answer
16.1	Line 1	In a 45-45-90 triangle the hypotenuse is a leg times $\sqrt{2}$, not times 2. So $x = 24\sqrt{2}$.	$x = 24\sqrt{2}$
16.2	Line 3	Line 2 says $2x = 36$, so divide 36 by 2. The short leg is half the hypotenuse: $x = 18$.	$x = 18$
16.3	Line 2	To undo times $\sqrt{2}$, divide by $\sqrt{2}$, not by 2. 10 divided by $\sqrt{2}$ is $5\sqrt{2}$.	$x = 5\sqrt{2}$
16.4	Line 2	The hypotenuse is 2 times the SHORT leg. The short leg is 8, so $x = 16$.	$x = 16$

PREVIEW

Class Progress Grid

Every student on one grid: items right by page type.

Class or group _____ Month _____

Student	Radicals (of 8)	45-45-90 (of 8)	30-60-90 (of 8)	Mixed (of 8)	Word problems (of 8)	Mistakes (of 4)	Quiz (of 4)	Sort (of 6)

PREVIEW

How to fill this in

For each column, add up how many items that student has right with no prompt (the tracker rows). One glance across a row shows which skill is easiest and which is next.

Grouping for small-group time

Students low in Radicals need the warm-up and the reference page (pages 5 and 4). Students low in Mixed need the worked examples (pages 6 and 7) and one triangle at a time first. Students near full marks can move to the mistakes and the quiz (pages 16 and 17).

Maya's Tracker (Invented Student)

Maya R. is invented; nothing on this page describes a real student. The blank tracker is on page 21.

Student: Maya R. (an invented student)

Teacher: Mr. Okafor (invented)

Month: October

Page	Page type and set	Items	Right	Date	Notes
5	Warm-Up: Radicals	8	6	10/6	Slipped on two radicals
8	45-45-90: Find the Hypotenuse	4	4	10/8	-
9	45-45-90: Find the Legs	4	3	10/10	Did not divide by root 2 once
10	30-60-90: Start With the Short Leg	4	4	10/13	-
11	30-60-90: Hypotenuse or Long Leg	4	2	10/15	Used the long leg as the short leg
12	Which Triangle? A	4	3	10/17	Picked the wrong triangle once
13	Which Triangle? B	4	-	-	-
14	Word Problems A	4	-	-	-
15	Word Problems B	4	-	-	-
16	Find the Mistake	4	3	10/20	Found the line, one fix not finished
17	Quiz	4	-	-	-
18	Cut and Paste: Which Rule?	6	-	-	-

How to read it

Maya R. has done **7 of 12** scored pages and got **25 of 32** items right with no prompt. **2** pages were all right and **5** carry a note. Every number comes from the table.

What the table points to

The lowest pages are 30-60-90: Hypotenuse or Long Leg (2 of 4). Those are where the next practice goes. The 5 pages left blank are not tried yet, never wrong.

PREVIEW