

SCAVENGER HUNT



45-45-90 SPECIAL RIGHT TRIANGLES

Times $\sqrt{2}$ or Divide by $\sqrt{2}$?

45-45-90 triangles and squares · exact answers · the cards check the answers

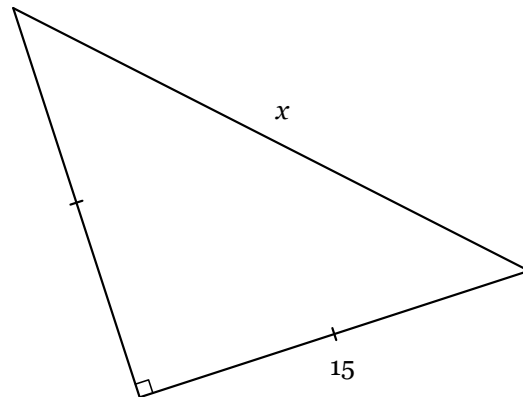
FREE

ANSWER

$10\sqrt{2}$

Find x .

The hypotenuse is longer than a leg and shorter than two legs put together.



J

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Scavenger Hunt — how to run it

a full class period

1. **Tape the 16 cards around the room**, in any order. Each card has a large letter in its bottom left corner. Start each group at a *different* one of these eight cards: *J D K P A G N F*.
2. **Say this once:** “From a leg to the hypotenuse, multiply by $\sqrt{2}$. From the hypotenuse to a leg, divide by $\sqrt{2}$. Write each answer exactly, like the numbers on the cards. Then walk to the card with your answer at the top.”
3. **Each group writes one line per card.** Eight right answers bring the group back to its first card.

16 cards	pages 3–10, one copy. There are two cards on each sheet. Cut the whole stack once.
Record sheet	page 11, one per student. It shows the rule as a small drawing.
Answers	pages 12–13, for you only. Do not put them up in the room.

Every card gives one length and asks for another. Some cards show a marked triangle. Some describe a triangle or a square in words. A square’s diagonal cuts it into two 45-45-90 triangles, so the same rule works. Every answer is exact: a whole number, or a whole number times $\sqrt{2}$. Dividing by $\sqrt{2}$ gives a fraction with $\sqrt{2}$ on the bottom, such as $34 \div \sqrt{2}$. That is the same number as $17\sqrt{2}$, and the record sheet shows how to change it.

Eight of the sixteen cards make the ring. A group reaches the other eight only by a wrong answer, but all the cards look the same. A group that multiplies by $\sqrt{2}$ when it should divide, or doubles a leg to get the hypotenuse, or uses a square’s perimeter as a side, gets the number at the top of another card. That card asks the same kind of question again, and its answer sends the group to the card it got wrong.

The check is the length of the group’s list. A clean run is **eight lines**. Each wrong answer adds two. Every card has a line in small type under the question. It tells a group that arrived by a wrong answer what to check. A group that arrived by a right answer skips it. If a group keeps coming back to the same cards, do not give the answer. Ask: “Which side is the hypotenuse? Is your answer longer or shorter than the side you were given?” No single rule, such as always multiplying by $\sqrt{2}$, gets a group more than six of the sixteen cards right.



This is the free lesson this activity came from. The worksheet, the full answers and the lesson plan are on it, at three levels of difficulty.

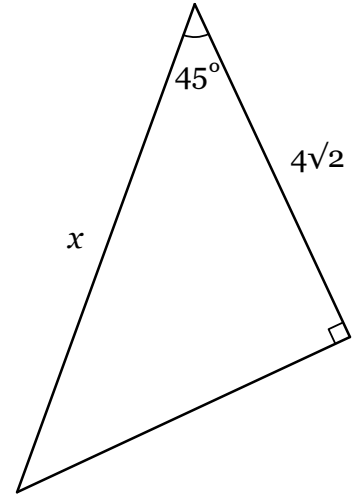
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ANSWER

13

Find x .

A right angle and one 45° angle leave 45° for the third angle.



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A

ANSWER

30

The distance from one corner of a square to the opposite corner is 5.

How far is it all the way around the square?

Is the diagonal a side or a hypotenuse? Each side of the square is a leg.

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B

ANSWER

$$22\sqrt{2}$$

An isosceles right triangle has two legs of $4\sqrt{2}$.

How long is its hypotenuse?

The number $\sqrt{2}$ times $\sqrt{2}$ is 2. Multiply, then write the answer simply.

C

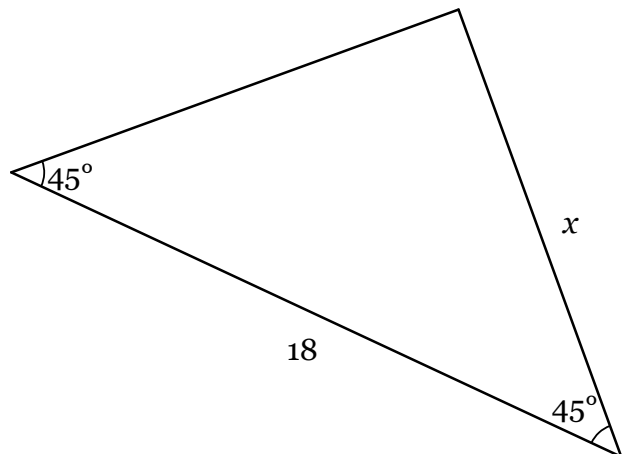
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ANSWER

$$15\sqrt{2}$$

Find x .

*Two 45° angles leave 90° for the third angle.
Which side is across from it?*



D

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ANSWER

$$12\sqrt{2}$$

A square has a diagonal of 18.

How long is each side?

The diagonal cuts the square into two 45-45-90 triangles. Which side is the hypotenuse?

E

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ANSWER

$$14\sqrt{2}$$

A square has a diagonal of 5.

What is its perimeter?

The diagonal is the hypotenuse of half the square. Each side is a leg.

F

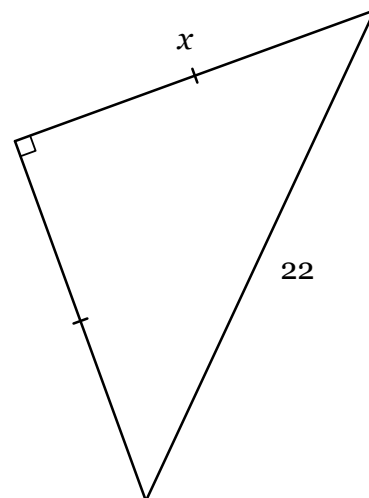
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ANSWER

8

Find x .

From the hypotenuse to a leg, divide by $\sqrt{2}$. Write the answer with $\sqrt{2}$ on top.



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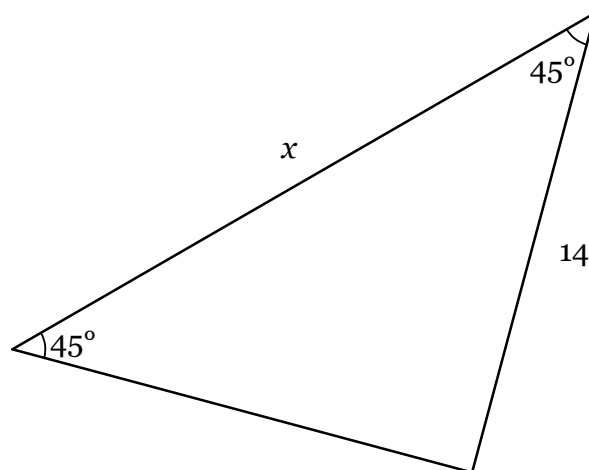
G

ANSWER

$20\sqrt{2}$

Find x .

*Which side is across from the corner with no mark?
That side is the hypotenuse.*



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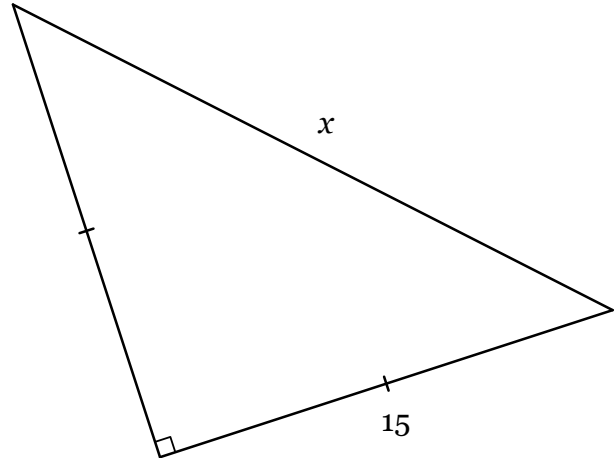
H

ANSWER

$$10\sqrt{2}$$

Find x .

The hypotenuse is longer than a leg and shorter than two legs put together.



J

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ANSWER

$$9\sqrt{2}$$

A square has a perimeter of 12.

How long is its diagonal?

A perimeter is four sides. Find one side before the diagonal.

K

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ANSWER

28

A 45-45-90 triangle has a hypotenuse of 22.

How long is each leg?

The hypotenuse is the longest side. Is the answer shorter than it?

L

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ANSWER

26

The four sides of a square add up to 12.

How long is the square's diagonal?

Four equal sides make the perimeter. How long is one side?

M

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ANSWER

$$11\sqrt{2}$$

An isosceles right triangle has two legs of 14.

How long is its hypotenuse?

The number $\sqrt{2}$ is about 1.4, not 2. Is the hypotenuse less than two legs?

N

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ANSWER

$$3\sqrt{2}$$

A 45-45-90 triangle has a hypotenuse of $13\sqrt{2}$.

How long is each leg?

A leg is shorter than the hypotenuse. Does the answer fit that?

P

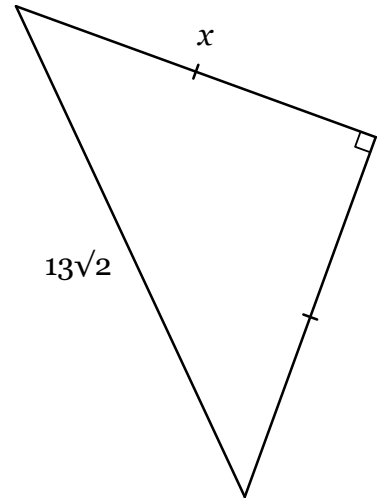
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ANSWER

$$8\sqrt{2}$$

Find x .

The number $\sqrt{2}$ times $\sqrt{2}$ is 2. Use that to divide a length with $\sqrt{2}$ in it.



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Q

ANSWER

$$18\sqrt{2}$$

A square has sides of 15.

How long is its diagonal?

A square's diagonal is longer than one side and shorter than two sides.

R

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Scavenger Hunt — where I went

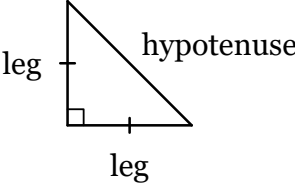
45-45-90 triangles

Name _____

Period _____

Date _____

Find the length the card asks for. Write it exactly, as a whole number or a whole number times $\sqrt{2}$. Then find the card with your answer at the top. A clean run is eight lines. Each card has a line in small type under the question. **If you are on a card because you went wrong, its line says what to check. If you were right, skip it.**



leg

hypotenuse

leg

45-45-90 triangle: a right angle and two equal legs. Its acute angles are 45° and 45° .
 $\text{leg} \times \sqrt{2} = \text{hypotenuse}$ $\text{hypotenuse} \div \sqrt{2} = \text{leg}$
 Check: the hypotenuse is longer than a leg, and shorter than two legs put together.

To divide by $\sqrt{2}$, put $\sqrt{2}$ on top: $34 \div \sqrt{2} = 34\sqrt{2} \div 2 = 17\sqrt{2}$. Both forms are the same number. The cards use the second form.

Card letter	My work	My answer
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

What does a 45-45-90 triangle stand on?

Every number stands for a letter. Write the letter for each answer in the box above its number. Read the boxes you filled, left to right. **If they do not spell the answer, one of your answers is wrong.**

$3\sqrt{2} = T$ $8 = W$ $8\sqrt{2} = G$ $9\sqrt{2} = I$ $13 = N$ $10\sqrt{2} = L$ $11\sqrt{2} = E$ $12\sqrt{2} = L$ $14\sqrt{2} = G$ $15\sqrt{2} = S$ $18\sqrt{2} = E$ $26 = W$
 $28 = S$ $20\sqrt{2} = T$ $30 = I$ $22\sqrt{2} = N$

$3\sqrt{2}$	8	$8\sqrt{2}$	$9\sqrt{2}$	13	$10\sqrt{2}$	$11\sqrt{2}$	$12\sqrt{2}$	$14\sqrt{2}$	$15\sqrt{2}$	$18\sqrt{2}$	26	28	$20\sqrt{2}$	30	$22\sqrt{2}$



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Scavenger Hunt — answers

For the teacher

The ring in order, with the answer found on each card. A group may begin anywhere on it. Wherever it begins, eight right answers bring it back to that card.

J ($15\sqrt{2}$) → D ($9\sqrt{2}$) → K ($3\sqrt{2}$) → P (13) → A (8) → G ($11\sqrt{2}$) → N ($14\sqrt{2}$) → F ($10\sqrt{2}$) → J

What does a 45-45-90 triangle stand on? The answer is *TWIN LEGS!* It is read along the boxes of the record sheet, which run from the smallest number to the largest.

Card	The question on the card	Answer, and why	The wrong answer that leads to the next card off the ring	Letter of its top
1 J	A triangle with a right-angle mark and one tick on each short side. One leg is 15. Find the hypotenuse, x .	$15\sqrt{2}$. The right angle and the two equal legs make it a 45-45-90 triangle. The hypotenuse is a leg $\times \sqrt{2}$: $15 \times \sqrt{2} = 15\sqrt{2}$.	30. The student adds the two legs, or uses $\times 2$ instead of $\times \sqrt{2}$.	L
2 D	A triangle with two angles marked 45° and no right-angle mark. The hypotenuse is 18. Find a leg, x .	$9\sqrt{2}$. Two 45° angles leave 90° for the third corner, so it is a 45-45-90 triangle. The side across from that corner is the hypotenuse. A leg is the hypotenuse $\div \sqrt{2}$: $18 \div \sqrt{2} = 18\sqrt{2} \div 2 = 9\sqrt{2}$.	$18\sqrt{2}$. The student multiplies by $\sqrt{2}$ instead of dividing.	S
3 K	A square has a perimeter of 12. How long is its diagonal?	$3\sqrt{2}$. Each side is $12 \div 4 = 3$. The diagonal is $3 \times \sqrt{2} = 3\sqrt{2}$.	$12\sqrt{2}$. The student uses the perimeter as if it were one side.	I
4 P	A 45-45-90 triangle has a hypotenuse of $13\sqrt{2}$. How long is each leg?	13. A leg is the hypotenuse $\div \sqrt{2}$: $13\sqrt{2} \div \sqrt{2} = 13$.	26. The student multiplies by $\sqrt{2}$ instead of dividing.	T
5 A	A triangle with a right-angle mark and one angle marked 45° . One leg is $4\sqrt{2}$. Find the hypotenuse, x .	8. A right angle and a 45° angle leave 45° for the third corner, so it is a 45-45-90 triangle. The hypotenuse is a leg $\times \sqrt{2}$: $4\sqrt{2} \times \sqrt{2} = 4 \times 2 = 8$.	$8\sqrt{2}$. The student adds the two legs, or uses $\times 2$ instead of $\times \sqrt{2}$.	N
6 G	A triangle with a right-angle mark and one tick on each short side. The hypotenuse is 22. Find a leg, x .	$11\sqrt{2}$. The right angle and the two equal legs make it a 45-45-90 triangle. A leg is the hypotenuse $\div \sqrt{2}$: $22 \div \sqrt{2} = 22\sqrt{2} \div 2 = 11\sqrt{2}$.	$22\sqrt{2}$. The student multiplies by $\sqrt{2}$ instead of dividing.	W
7 N	An isosceles right triangle has two legs of 14. How long is its hypotenuse?	$14\sqrt{2}$. The hypotenuse is a leg $\times \sqrt{2}$: $14 \times \sqrt{2} = 14\sqrt{2}$.	28. The student adds the two legs, or uses $\times 2$ instead of $\times \sqrt{2}$.	E
8 F	A square has a diagonal of 5. What is its perimeter?	$10\sqrt{2}$. Each side is $5 \div \sqrt{2} = 5\sqrt{2} \div 2$. The perimeter is four sides: $4 \times 5\sqrt{2} \div 2 = 10\sqrt{2}$.	$20\sqrt{2}$. The student multiplies by $\sqrt{2}$ instead of dividing.	G

Scavenger Hunt — the cards off the ring

For the teacher

A group reaches these eight cards only by a wrong answer. The number at the top of each one is the wrong answer from one ring card. Its right answer is the number at the top of that ring card, so the group goes to the card it got wrong and tries it again. If the group makes the same mistake here, it goes to another card off the ring. So a second wrong answer never moves a group forward.

Card	The question on the card	Answer, and why	The wrong answer that leads to the next card off the ring	Letter of its top
B	The distance from one corner of a square to the opposite corner is 5. How far is it all the way around the square?	10√2. Each side is $5 \div \sqrt{2} = 5\sqrt{2} \div 2$. The perimeter is four sides: $4 \times 5\sqrt{2} \div 2 = 10\sqrt{2}$.	20√2. The student multiplies by √2 instead of dividing.	I
R	A square has sides of 15. How long is its diagonal?	15√2. The hypotenuse is a leg $\times \sqrt{2}$: $15 \times \sqrt{2} = 15\sqrt{2}$.	30. The student adds the two legs, or uses $\times 2$ instead of $\times \sqrt{2}$.	E
E	A square has a diagonal of 18. How long is each side?	9√2. A leg is the hypotenuse $\div \sqrt{2}$: $18 \div \sqrt{2} = 18\sqrt{2} \div 2 = 9\sqrt{2}$.	18√2. The student multiplies by √2 instead of dividing.	L
M	The four sides of a square add up to 12. How long is the square's diagonal?	3√2. Each side is $12 \div 4 = 3$. The diagonal is $3 \times \sqrt{2} = 3\sqrt{2}$.	12√2. The student uses the perimeter as if it were one side.	W
Q	A triangle with a right-angle mark and one tick on each short side. The hypotenuse is $13\sqrt{2}$. Find a leg, x.	13. The right angle and the two equal legs make it a 45-45-90 triangle. A leg is the hypotenuse $\div \sqrt{2}$: $13\sqrt{2} \div \sqrt{2} = 13$.	26. The student multiplies by √2 instead of dividing.	G
C	An isosceles right triangle has two legs of $4\sqrt{2}$. How long is its hypotenuse?	8. The hypotenuse is a leg $\times \sqrt{2}$: $4\sqrt{2} \times \sqrt{2} = 4 \times 2 = 8$.	8√2. The student adds the two legs, or uses $\times 2$ instead of $\times \sqrt{2}$.	N
L	A 45-45-90 triangle has a hypotenuse of 22. How long is each leg?	11√2. A leg is the hypotenuse $\div \sqrt{2}$: $22 \div \sqrt{2} = 22\sqrt{2} \div 2 = 11\sqrt{2}$.	22√2. The student multiplies by √2 instead of dividing.	S
H	A triangle with two angles marked 45° and no right-angle mark. One leg is 14. Find the hypotenuse, x.	14√2. Two 45° angles leave 90° for the third corner, so it is a 45-45-90 triangle. The side across from that corner is the hypotenuse. The hypotenuse is a leg $\times \sqrt{2}$: $14 \times \sqrt{2} = 14\sqrt{2}$.	28. The student adds the two legs, or uses $\times 2$ instead of $\times \sqrt{2}$.	T

Other mistakes lead to no card. A group might divide by √2 when it should multiply, halve the hypotenuse, copy the given length, or stop at a square's side. Its answer is then not the number at the top of any card.