

CUT & GLUE SORT

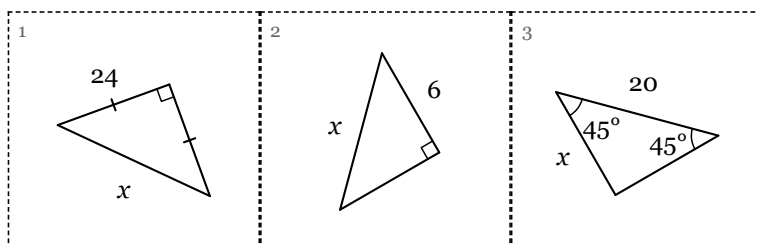


45-45-90 SPECIAL RIGHT TRIANGLES

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

Twelve marked triangles and squares · find the hypotenuse · three rows

FREE



Row 1. x is the hypotenuse. Multiply the given leg by $\sqrt{2}$.

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Row 2. x is a leg. Divide the given hypotenuse by $\sqrt{2}$.

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Row 3. The marks do not show a 45-45-90 triangle. Neither rule can be used.

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Cut & Glue Sort — how to run it

25 minutes, including the cutting

1. **Hand out pages 3 and 4**, one of each per student, with scissors and glue. Nothing else is needed.
2. **Say this once:** *“First ask: do the marks show a 45-45-90 triangle? If they do not, the piece goes in row 3. If they do, find the hypotenuse. Is x the hypotenuse, or a leg?”*
3. **Check a sheet in ten seconds:** every row gets four pieces.

Student sheets	pages 3 and 4, one of each per student. Page 3 has the three rows. Page 4 has the pieces and the rule as a small drawing.
Answers	page 5.

Each piece gives one length and calls another x . Most pieces are marked triangles. A few are a square or a triangle in words. The student does not need to find x , only the way to find it. Row 1 holds pieces where x is the hypotenuse, so the leg is multiplied by $\sqrt{2}$. Row 2 holds pieces where x is a leg, so the hypotenuse is divided by $\sqrt{2}$. A square counts too: its diagonal is the hypotenuse of half the square.

The last row is the most important. The rule works only for a 45-45-90 triangle. In two of the four row-3 pieces the drawing looks exactly like one, but the marks do not prove it. For example, only the right angle is marked. Another piece has a 40° angle. One says only “a right triangle” in words. Many students sort by the look of the drawing. That student places at most eight pieces correctly, because every row-3 piece then lands in row 1 or row 2. Ask: *“Which marks tell you the two legs are equal?”* Guessing rules place at most six pieces correctly.



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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Cut & Glue Sort — multiply or divide by $\sqrt{2}$?

45-45-90 triangles

Name _____

Period _____

Date _____

Each piece on the next page gives one length and calls another length x . **Look at the marks. Decide which row the piece belongs in, and glue it there.** Use only the marks and the words, not how the drawing looks.

Row 1. x is the hypotenuse. Multiply the given leg by $\sqrt{2}$.

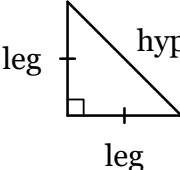
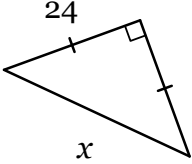
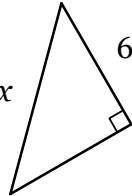
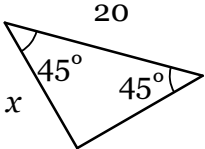
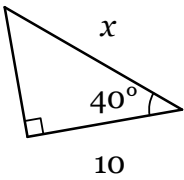
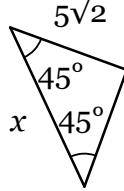
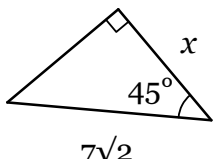
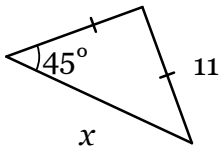
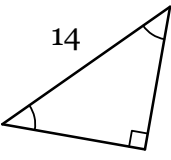
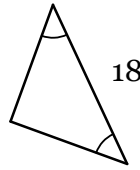
Row 2. x is a leg. Divide the given hypotenuse by $\sqrt{2}$.

Row 3. The marks do not show a 45-45-90 triangle. Neither rule can be used.

Cut & Glue Sort — the pieces

Cut along the dashed lines

Cut out the twelve pieces. Glue each one in its row on the other sheet.

	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.		
1 	2 	3 	4 A square has a diagonal of 12. x is the length of each side.
5 A square has sides of 8. x is the length of its diagonal.	6 	7 A right triangle has a leg of 26. x is its hypotenuse.	8 
9 	10 	11 	12 



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Each row holds four pieces. Every piece is described again here, with the reason. The value of x is given for rows 1 and 2, in case a student finds it.

1 x is the hypotenuse. Multiply the given leg by $\sqrt{2}$.

1. A triangle with a right-angle mark and ticks on the two short sides. The side across from the right angle is x . A short side is 24. *Why:* The right angle and the two equal legs make it a 45-45-90 triangle. x is the hypotenuse, so multiply: $x = 24 \times \sqrt{2} = 24\sqrt{2}$.

5. A square has sides of 8. x is the length of its diagonal. *Why:* A square's diagonal cuts it into two 45-45-90 triangles. The diagonal is the hypotenuse and each side is a leg. x is the hypotenuse, so multiply: $x = 8 \times \sqrt{2} = 8\sqrt{2}$.

8. A triangle with two angles marked 45° . The side across from the unmarked corner is x . A short side is $5\sqrt{2}$. *Why:* Two 45° angles leave 90° for the third angle, so it is a 45-45-90 triangle. x is the hypotenuse, so multiply: $x = 5\sqrt{2} \times \sqrt{2} = 10$.

10. A triangle with ticks on two sides and one angle marked 45° , at the end of one ticked side, not between them. The side across from the unmarked corner is x . A short side is 11. *Why:* Equal sides give equal angles across from them, so both are 45° and the third angle is 90° . x is the hypotenuse, so multiply: $x = 11 \times \sqrt{2} = 11\sqrt{2}$.

2 x is a leg. Divide the given hypotenuse by $\sqrt{2}$.

3. A triangle with two angles marked 45° . The side next to the unmarked corner is x . The longest side is 20. *Why:* Two 45° angles leave 90° for the third angle, so it is a 45-45-90 triangle. x is a leg, so divide: $x = 20 \div \sqrt{2} = 20\sqrt{2} \div 2 = 10\sqrt{2}$. To get there, multiply the top and the bottom by $\sqrt{2}$, because $\sqrt{2} \times \sqrt{2} = 2$.

4. A square has a diagonal of 12. x is the length of each side. *Why:* A square's diagonal cuts it into two 45-45-90 triangles. The diagonal is the hypotenuse and each side is a leg. x is a leg, so divide: $x = 12 \div \sqrt{2} = 12\sqrt{2} \div 2 = 6\sqrt{2}$. To get there, multiply the top and the bottom by $\sqrt{2}$, because $\sqrt{2} \times \sqrt{2} = 2$.

9. A triangle with a right-angle mark and one angle marked 45° . The side next to the right angle is x . The longest side is $7\sqrt{2}$. *Why:* A right angle and a 45° angle leave 45° for the third angle, so it is a 45-45-90 triangle. x is a leg, so divide: $x = 7\sqrt{2} \div \sqrt{2} = 7$.

11. A triangle with a right-angle mark and matching arcs on the other two angles. The side next to the right angle is x . The longest side is 14. *Why:* The other two angles are equal and add to 90° , so each is 45° . x is a leg, so divide: $x = 14 \div \sqrt{2} = 14\sqrt{2} \div 2 = 7\sqrt{2}$. To get there, multiply the top and the bottom by $\sqrt{2}$, because $\sqrt{2} \times \sqrt{2} = 2$.

3 The marks do not show a 45-45-90 triangle. Neither rule can be used.

2. A triangle with a right-angle mark only. The side across from the right angle is x . A short side is 6. *Why:* Only the right angle is marked. Nothing shows the legs are equal, even though they look equal. Neither rule can be used.

6. A triangle with a right-angle mark and one angle marked 40° . The side across from the right angle is x . A short side is 10. *Why:* The marked angle is 40° , not 45° , so it is not a 45-45-90 triangle. Neither rule can be used.

7. A right triangle has a leg of 26. x is its hypotenuse. *Why:* A right triangle with one leg given: nothing says the two legs are equal, so it may not be a 45-45-90 triangle. Neither rule can be used.

12. A triangle with matching arcs on two angles and no other mark. The side next to the unmarked corner is x . The longest side is 18. *Why:* The arcs show two equal angles, but nothing shows a right angle or gives their size. Neither rule can be used.

To check a piece with a student, ask two questions. First: do the marks show a 45-45-90 triangle? A right angle with two equal legs does, and so do two 45° angles, or a right angle with one 45° angle. If not, the piece goes in row 3. Second: is x across from the right angle? If yes, it is the hypotenuse and the piece goes in row 1. If no, it is a leg and the piece goes in row 2.