

CUT & GLUE SORT



PYTHAGOREAN THEOREM APPLICATIONS AND TRIPLES

Add, Subtract, or Neither?

Twelve situations in words · three rows

FREE

¹ Lia walks due east across a flat field. Then Lia turns and walks due north. Lia walks 12 ft east. Lia walks 15 ft north. How far is Lia from the starting point?	² A straight ramp goes up from level ground to a flat platform. The platform is 5 ft above the ground. Along the ground, the ramp covers 13 ft. How long is the ramp?	³ Zoe flies a kite over level ground and holds the string tight at ground level. The kite is straight above a point on the ground. The string is 26 ft long. That point is 10 ft from Zoe. How high is the kite?
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Row 1. Add the squares. The length asked for is the hypotenuse.

Row 2. Subtract the squares. The length asked for is a leg.

Row 3. The Pythagorean theorem cannot be used. The triangle has no right angle.

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:** *“For each piece, first ask: does the situation make a right angle? If yes, ask: is the length asked for the hypotenuse or a leg? Do not work out any numbers.”*
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 a right triangle with its sides named and the three rows. Page 4 has the pieces.
Answers	page 5.

Each piece is a situation in words, such as a ladder against a wall or a walk east and then north, with two lengths and a question. Nothing is calculated. Row 1 holds the pieces where both given lengths are legs, so the hypotenuse is asked for and the squares are added. Row 2 holds the pieces where the hypotenuse is given, so a leg is asked for and the squares are subtracted.

The numbers are a test too. In three row-1 pieces the two numbers look like part of a known triple, with the bigger number in the place of the hypotenuse. Piece 1 gives 12 ft and 15 ft, and both are legs. A student who decides from the numbers instead of the situation puts it in row 2.

The last row is the most important. Its pieces look like the others. But the words say there is no right angle: a wall that leans back, a pole on a hillside, a tree that grows at a slant, a kite over a sloping hill. The Pythagorean theorem works only in a right triangle. In real problems the right angle often comes from one word, such as “level” or “straight up”, and students use it without noticing. This row makes them look for it.

A student who never checks for the right angle places at most eight pieces correctly. Ask that student: *“Which words in the situation tell you there is a right angle?”* 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 — add, subtract, or neither?

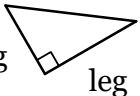
Pythagorean applications

Name _____

Period _____

Date _____

Each piece on the next page tells a situation with two lengths and a question. **Picture the triangle. Is there a right angle? If yes, is the length asked for the hypotenuse or a leg? Glue the piece in its row.** Do not work out any numbers.

hypotenuse  leg leg	The hypotenuse is across from the right angle. It is the longest side. The other two sides are the legs. To find the hypotenuse, add the squares: $c^2 = a^2 + b^2$. To find a leg, subtract them: $b^2 = c^2 - a^2$. The theorem works only when the triangle has a right angle. Triples to know: 3, 4, 5 · 5, 12, 13 · 8, 15, 17 · 7, 24, 25, and their multiples, like 6, 8, 10. Most right triangles do not have whole-number sides. Legs of 2 and 7 give a hypotenuse of $\sqrt{53}$, about 7.28. That is normal.
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Row 1. Add the squares. The length asked for is the hypotenuse.

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Row 2. Subtract the squares. The length asked for is a leg.

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Row 3. The Pythagorean theorem cannot be used. The triangle has no right angle.

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Cut & Glue Sort — the situations

Cut along the dashed lines

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

1 Lia walks due east across a flat field. Then Lia turns and walks due north. Lia walks 12 ft east. Lia walks 15 ft north. How far is Lia from the starting point?	2 A straight ramp goes up from level ground to a flat platform. The platform is 5 ft above the ground. Along the ground, the ramp covers 13 ft. How long is the ramp?	3 Zoe flies a kite over level ground and holds the string tight at ground level. The kite is straight above a point on the ground. The string is 26 ft long. That point is 10 ft from Zoe. How high is the kite?	4 Max leans a ladder against a wall. The wall leans back from the level ground. It does not stand straight up. The ladder is 13 ft long. The foot of the ladder is 5 ft from the wall. How high up the wall does the ladder reach?
5 A pole stands straight up on level ground. A tight wire runs from the top of the pole to a stake in the ground. The stake is 7 ft from the foot of the pole. The wire is 25 ft long. How tall is the pole?	6 Noor leans a ladder against a wall. The wall stands straight up from level ground. The top of the ladder touches the wall 16 ft above the ground. The foot of the ladder is 12 ft from the wall. How long is the ladder?	7 A tree grows at a slant. The sun makes a shadow on the level ground. Its shadow is 5 ft long. The tree is 12 ft tall. How far is it from the top of the tree to the tip of its shadow?	8 Raj walks due east across a flat field. Then Raj turns and walks due north. Raj ends up 17 ft from the starting point. Raj walks 8 ft north. How far does Raj walk east?
9 A pole stands on a steep hillside. A tight wire runs from the top of the pole to a stake in the slope. The wire is 17 ft long. The stake is 8 ft from the foot of the pole. How tall is the pole?	10 A straight ramp goes up from level ground to a flat platform. The platform is 6 ft above the ground. The ramp is 10 ft long. How far along the ground does the ramp go?	11 A tree stands straight up on level ground. The sun makes a shadow on the ground. Its shadow is 17 ft long. The tree is 8 ft tall. How far is it from the top of the tree to the tip of its shadow?	12 Kai flies a kite over a sloping hill and holds the string tight at ground level. The kite is straight above a point on the slope. The kite is 12 ft above the ground. The string is 20 ft long. How far is that point from Kai?



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Each row holds four pieces. Every piece is printed again here, with the reason.

1 Add the squares. The length asked for is the hypotenuse.

- 1.** Lia walks due east across a flat field. Then Lia turns and walks due north. Lia walks 12 ft east. Lia walks 15 ft north. How far is Lia from the starting point? *Why:* Both given lengths meet at the right angle, so both are legs. The length asked for is the straight distance from the start, the hypotenuse. The numbers look like part of a triple, but both are legs.
- 2.** A straight ramp goes up from level ground to a flat platform. The platform is 5 ft above the ground. Along the ground, the ramp covers 13 ft. How long is the ramp? *Why:* Both given lengths meet at the right angle, so both are legs. The length asked for is the ramp, the hypotenuse. The numbers look like part of a triple, but both are legs.
- 6.** Noor leans a ladder against a wall. The wall stands straight up from level ground. The top of the ladder touches the wall 16 ft above the ground. The foot of the ladder is 12 ft from the wall. How long is the ladder? *Why:* Both given lengths meet at the right angle, so both are legs. The length asked for is the ladder, the hypotenuse.
- 11.** A tree stands straight up on level ground. The sun makes a shadow on the ground. Its shadow is 17 ft long. The tree is 8 ft tall. How far is it from the top of the tree to the tip of its shadow? *Why:* Both given lengths meet at the right angle, so both are legs. The length asked for is the distance from the top of the tree to the tip of the shadow, the hypotenuse. The numbers look like part of a triple, but both are legs.

2 Subtract the squares. The length asked for is a leg.

- 3.** Zoe flies a kite over level ground and holds the string tight at ground level. The kite is straight above a point on the ground. The string is 26 ft long. That point is 10 ft from Zoe. How high is the kite? *Why:* The string is across from the right angle, so it is the hypotenuse, and it is given. The length asked for is a leg.
- 5.** A pole stands straight up on level ground. A tight wire runs from the top of the pole to a stake in the ground. The stake is 7 ft from the foot of the pole. The wire is 25 ft long. How tall is the pole? *Why:* The wire is across from the right angle, so it is the hypotenuse, and it is given. The length asked for is a leg.
- 8.** Raj walks due east across a flat field. Then Raj turns and walks due north. Raj ends up 17 ft from the starting point. Raj walks 8 ft north. How far does Raj walk east? *Why:* The straight distance from the start is across from the right angle, so it is the hypotenuse, and it is given. The length asked for is a leg.
- 10.** A straight ramp goes up from level ground to a flat platform. The platform is 6 ft above the ground. The ramp is 10 ft long. How far along the ground does the ramp go? *Why:* The ramp is across from the right angle, so it is the hypotenuse, and it is given. The length asked for is a leg.

3 The Pythagorean theorem cannot be used. The triangle has no right angle.

- 4.** Max leans a ladder against a wall. The wall leans back from the level ground. It does not stand straight up. The ladder is 13 ft long. The foot of the ladder is 5 ft from the wall. How high up the wall does the ladder reach? *Why:* The wall leans back, so it does not meet the ground at a right angle. The theorem works only in a right triangle.
- 7.** A tree grows at a slant. The sun makes a shadow on the level ground. Its shadow is 5 ft long. The tree is 12 ft tall. How far is it from the top of the tree to the tip of its shadow? *Why:* The tree leans, so it does not meet the level ground at a right angle. The theorem works only in a right triangle.
- 9.** A pole stands on a steep hillside. A tight wire runs from the top of the pole to a stake in the slope. The wire is 17 ft long. The stake is 8 ft from the foot of the pole. How tall is the pole? *Why:* The ground under the pole slopes, so the pole does not meet the ground at a right angle. The theorem works only in a right triangle.
- 12.** Kai flies a kite over a sloping hill and holds the string tight at ground level. The kite is straight above a point on the slope. The kite is 12 ft above the ground. The string is 20 ft long. How far is that point from Kai? *Why:* The point under the kite is on a slope, so the kite's height does not meet the ground at a right angle. The theorem works only in a right triangle.

To check a piece with a student, ask two questions. First: do the words make a right angle, such as a wall that stands straight up from level ground, or a walk due east and then due north? If no, it goes in row 3. If yes, find the side across from the right angle. That is the hypotenuse. If it is asked for, the piece goes in row 1. If it is given, the piece goes in row 2.