

CUT & GLUE SORT

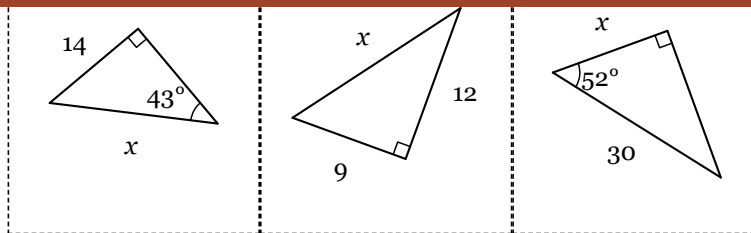


USING TRIG RATIOS TO FIND A SIDE

Trig Ratios: Multiply or Divide?

Twelve right triangles · x on top, x underneath, or no angle at all · three rows

FREE



Row 1. Multiply: $x = \text{the number} \times \text{the ratio}$. x is on top of the fraction.

Row 2. Divide: $x = \text{the number} \div \text{the ratio}$. x is underneath in the fraction.

Row 3. No angle is given, so no ratio can be used. Use the Pythagorean theorem.

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. No calculator is needed.
2. **Say this once:** *“Do not find x . If no acute angle is given, the piece goes in row 3: use the Pythagorean theorem. Otherwise name the sides from the given angle and pick the ratio. If x is on top of the fraction, the last step multiplies. If x is underneath, it divides.”*
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 three ratios on a labeled triangle.

Answers page 5.

Each piece is a right triangle drawn to scale, with an x . Eight pieces give one acute angle and one length. The other four give two lengths and no acute angle. The student decides only how the last step of finding x goes. This is the most common mistake of the lesson: multiplying where the equation divides. When x is on top of the fraction, as in $\sin 43^\circ = x \div 14$, the answer is the number times the ratio. When x is underneath, as in $\sin 43^\circ = 14 \div x$, the answer is the number divided by the ratio.

Rows 1 and 2 cannot be sorted by one shortcut. When x is the hypotenuse, the last step always divides. When the number is on the hypotenuse, it always multiplies. But row 1 has two and row 2 has two pieces with no number on the hypotenuse. There, only the tangent decides: x across from the angle is on top, and x touching the angle is underneath.

Row 3 has no acute angle. The right angle is marked, but a ratio needs one of the other two angles. Two sides are given, so a ratio cannot start. The Pythagorean theorem finds x . Students who reach for a ratio here need an angle the piece never gives. Guessing does not work: a simple guessing rule, such as sorting by the size of the angle, places at most ten 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?

Finding a side

Name _____

Period _____

Date _____

Each piece on the next page is a right triangle with a number and an x . Do not find x . **Name the sides from the given angle. Pick the ratio. Is x on top of the fraction, or underneath? Glue the piece in its row.** If no angle is given, the piece goes in row 3.

Row 1. Multiply: $x = \text{the number} \times \text{the ratio}$. x is on top of the fraction.

Row 2. Divide: $x = \text{the number} \div \text{the ratio}$. x is underneath in the fraction.

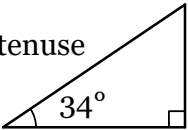
Row 3. No angle is given, so no ratio can be used. Use the Pythagorean theorem.

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. A square in a corner means a right angle.

hypotenuse

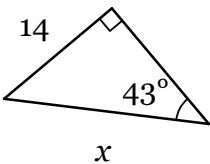
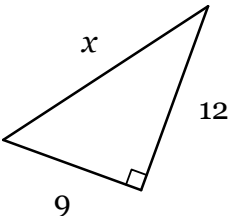
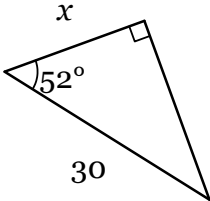
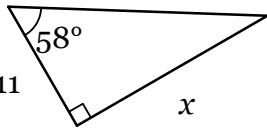
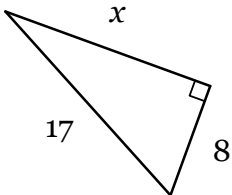
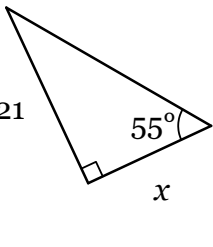
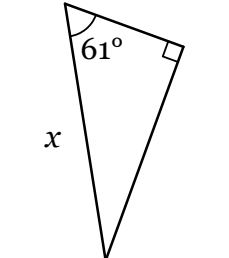
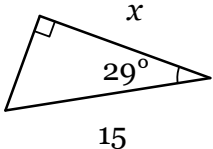
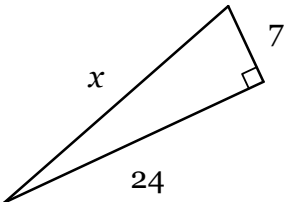
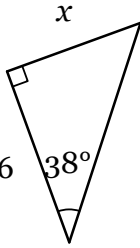
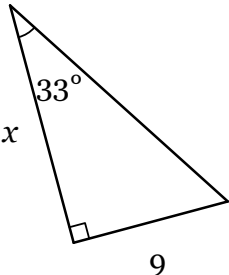
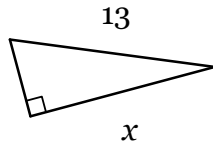


adjacent

Name the sides from the given angle.

$\sin = \text{opposite} \div \text{hypotenuse}$ · $\cos = \text{adjacent} \div \text{hypotenuse}$ · $\tan = \text{opposite} \div \text{adjacent}$

x on top of the fraction: multiply. x underneath: divide. The hypotenuse is the longest side.

1 	2 	3 	4 
5 	6 	7 	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 too, rounded to the nearest tenth, though the students do not find it.

1 Multiply: $x = \text{the number} \times \text{the ratio}$. x is on top of the fraction.

3. A 52° angle is given. The hypotenuse is 30. x is the leg that touches the 52° angle. *Why:* The 30 is across from the right angle, so it is the hypotenuse. x touches the 52° angle and is not the hypotenuse, so it is the adjacent leg. $\cos = \text{adjacent} \div \text{hypotenuse}$, so $\cos 52^\circ = x \div 30$. x is on top, so multiply: $30 \times 0.6157 = 18.5$. So $x = 30 \times \cos 52^\circ$.

4. A 58° angle is given. The leg that touches the 58° angle is 11. x is the leg across from the 58° angle. *Why:* The 11 touches the 58° angle and is not the hypotenuse, so it is the adjacent leg. x is across from the 58° angle, so it is the opposite leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 58^\circ = x \div 11$. x is on top, so multiply: $11 \times 1.6003 = 17.6$. So $x = 11 \times \tan 58^\circ$.

8. A 29° angle is given. The hypotenuse is 15. x is the leg that touches the 29° angle. *Why:* The 15 is across from the right angle, so it is the hypotenuse. x touches the 29° angle and is not the hypotenuse, so it is the adjacent leg. $\cos = \text{adjacent} \div \text{hypotenuse}$, so $\cos 29^\circ = x \div 15$. x is on top, so multiply: $15 \times 0.8746 = 13.1$. So $x = 15 \times \cos 29^\circ$.

10. A 38° angle is given. The leg that touches the 38° angle is 16. x is the leg across from the 38° angle. *Why:* The 16 touches the 38° angle and is not the hypotenuse, so it is the adjacent leg. x is across from the 38° angle, so it is the opposite leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 38^\circ = x \div 16$. x is on top, so multiply: $16 \times 0.7813 = 12.5$. So $x = 16 \times \tan 38^\circ$.

2 Divide: $x = \text{the number} \div \text{the ratio}$. x is underneath in the fraction.

1. A 43° angle is given. The leg across from the 43° angle is 14. x is the hypotenuse. *Why:* The 14 is across from the 43° angle, so it is the opposite leg. x is across from the right angle, so it is the hypotenuse. $\sin = \text{opposite} \div \text{hypotenuse}$, so $\sin 43^\circ = 14 \div x$. x is underneath, so divide: $14 \div 0.6820 = 20.5$. So $x = 14 \div \sin 43^\circ$.

6. A 55° angle is given. The leg across from the 55° angle is 21. x is the leg that touches the 55° angle. *Why:* The 21 is across from the 55° angle, so it is the opposite leg. x touches the 55° angle and is not the hypotenuse, so it is the adjacent leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 55^\circ = 21 \div x$. x is underneath, so divide: $21 \div 1.4281 = 14.7$. So $x = 21 \div \tan 55^\circ$.

7. A 61° angle is given. The leg that touches the 61° angle is 8. x is the hypotenuse. *Why:* The 8 touches the 61° angle and is not the hypotenuse, so it is the adjacent leg. x is across from the right angle, so it is the hypotenuse. $\cos = \text{adjacent} \div \text{hypotenuse}$, so $\cos 61^\circ = 8 \div x$. x is underneath, so divide: $8 \div 0.4848 = 16.5$. So $x = 8 \div \cos 61^\circ$.

11. A 33° angle is given. The leg across from the 33° angle is 9. x is the leg that touches the 33° angle. *Why:* The 9 is across from the 33° angle, so it is the opposite leg. x touches the 33° angle and is not the hypotenuse, so it is the adjacent leg. $\tan = \text{opposite} \div \text{adjacent}$, so $\tan 33^\circ = 9 \div x$. x is underneath, so divide: $9 \div 0.6494 = 13.9$. So $x = 9 \div \tan 33^\circ$.

3 No angle is given, so no ratio can be used. Use the Pythagorean theorem.

2. No acute angle is given. A leg is 12 and a leg is 9. x is the hypotenuse. *Why:* Two legs are given and no acute angle, so no ratio can start. The Pythagorean theorem: $x = \sqrt{9^2 + 12^2} = 15$.

5. No acute angle is given. The hypotenuse is 17 and a leg is 8. x is the other leg. *Why:* The hypotenuse and one leg are given and no acute angle, so no ratio can start. The Pythagorean theorem: $x = \sqrt{17^2 - 8^2} = 15$.

9. No acute angle is given. A leg is 7 and a leg is 24. x is the hypotenuse. *Why:* Two legs are given and no acute angle, so no ratio can start. The Pythagorean theorem: $x = \sqrt{7^2 + 24^2} = 25$.

12. No acute angle is given. The hypotenuse is 13 and a leg is 5. x is the other leg. *Why:* The hypotenuse and one leg are given and no acute angle, so no ratio can start. The Pythagorean theorem: $x = \sqrt{13^2 - 5^2} = 12$.

To check a piece with a student, ask: “Which corner has the angle? Which side is across from it? Which ratio uses the number and x ? Is x on top of that fraction, or underneath?”