

CUT & GLUE SORT

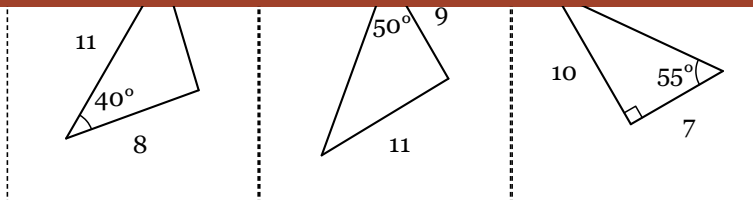


AREA OF A TRIANGLE USING SINE

Area of a Triangle: Which Formula?

Twelve triangles · $\frac{1}{2} \times \text{base} \times \text{height}$, $\frac{1}{2}ab \sin C$, or neither · three rows

FREE



Row 1. Use $\frac{1}{2} \times \text{base} \times \text{height}$. A height is marked: it meets the base at a right angle (a small square).

Row 2. Use $\frac{1}{2}ab \sin C$. No height is marked. The marked angle is between the two sides with numbers.

Row 3. Neither formula works. No height is marked, and no marked angle is between two sides with numbers.

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 the area. Look at what is marked. Is there a height? In a right triangle, one leg is the height to the other. If not, is the marked angle between the two sides with 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 the three rows. Page 4 has the pieces and the formula on a labeled triangle.

Answers page 5.

Each piece is a triangle drawn to scale. The student decides only which formula can find its area from what is marked. $\frac{1}{2} \times \text{base} \times \text{height}$ needs a base and the height to it. $\frac{1}{2}ab \sin C$ needs two sides and the angle *between* them, at the corner where they meet.

Row 1 holds the pieces that tempt students the most. One is a right triangle with an angle marked. A student who thinks “an angle is marked, so use the sine” puts it in row 2. But the two legs are a base and a height, and the angle is not needed. Another has its height outside the triangle, meeting the base line beyond the corner. That is still the height.

Row 3 has no height, and its marked angle is not between two numbered sides. Three pieces give two numbered sides and an angle, as in row 2, but the angle touches only one of those sides. A student who multiplies the two numbers by the sine of that angle gets a wrong area. One piece gives one numbered side and two angles, which is not enough for either formula. Guessing does not work: a simple guessing rule, such as “a degree number means $\frac{1}{2}ab \sin C$,” places 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 — which formula finds the area?

Area of a triangle

Name _____

Period _____

Date _____

Each piece on the next page is a triangle with some parts marked. Do not find the area. **Look at what is marked. Which formula can find the area? Glue the piece in its row.**

Row 1. Use $\frac{1}{2} \times \text{base} \times \text{height}$. A height is marked: it meets the base at a right angle (a small square).

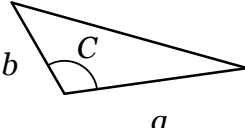
Row 2. Use $\frac{1}{2}ab \sin C$. No height is marked. The marked angle is between the two sides with numbers.

Row 3. Neither formula works. No height is marked, and no marked angle is between two sides with numbers.

Cut & Glue Sort — the pieces

Cut along the dashed lines

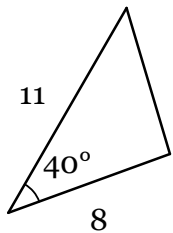
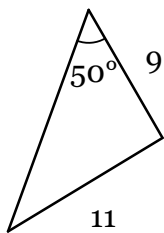
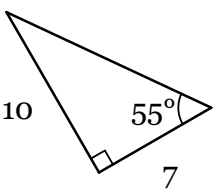
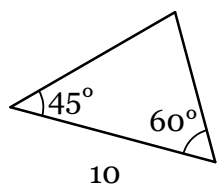
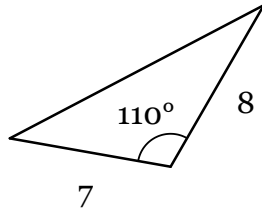
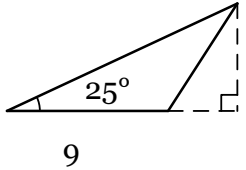
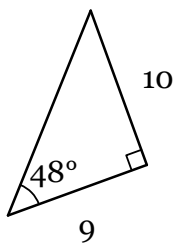
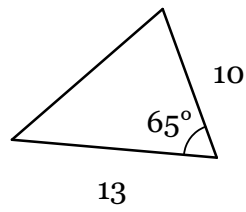
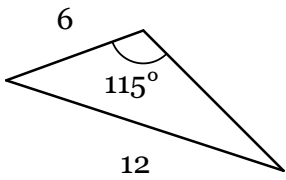
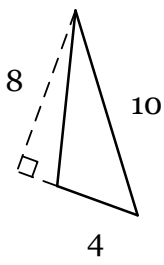
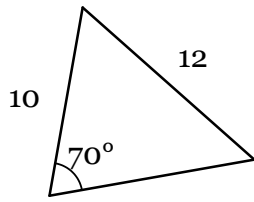
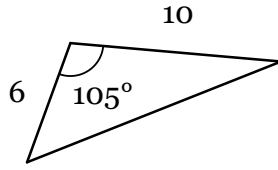
Cut out the twelve pieces. Glue each one in its row on the other sheet. A small square in a corner means a right angle. A dashed line with a number is a height.



Area = $\frac{1}{2} \times a \times b \times \sin C$.

C is the angle between the sides a and b: the corner where the two sides meet.

Area = $\frac{1}{2} \times \text{base} \times \text{height}$. The height meets the base line at a right angle.

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. Where an area can be found, it is given in square units to the nearest tenth, though the students do not find it.

- 1 **Use $\frac{1}{2} \times \text{base} \times \text{height}$. A height is marked: it meets the base at a right angle (a small square).**
 3. A right triangle with legs 7 and 10. A 55° angle is marked at the end of the 7 leg. *Why:* The two legs meet at the right angle, so one leg is the height to the other. Area = $\frac{1}{2} \times 7 \times 10 = 35.0$. The marked angle is not needed.
 6. A base of 9 and a dashed height of 6 that meets the base line outside the triangle. A 25° angle is marked at one end of the base. *Why:* The dashed height meets the base line at a right angle, outside the triangle. Area = $\frac{1}{2} \times 9 \times 6 = 27.0$. The marked angle is not needed.
 7. A right triangle with legs 9 and 10. A 48° angle is marked at the end of the 9 leg. *Why:* The two legs meet at the right angle, so one leg is the height to the other. Area = $\frac{1}{2} \times 9 \times 10 = 45.0$. The marked angle is not needed.
 10. A base of 4 and a dashed height of 8 that meets the base line outside the triangle, and a slanted side of 10. *Why:* The dashed height meets the base line at a right angle, outside the triangle. Area = $\frac{1}{2} \times 4 \times 8 = 16.0$. The slanted side is not the height.
- 2 **Use $\frac{1}{2}ab \sin C$. No height is marked. The marked angle is between the two sides with numbers.**
 1. Sides 8 and 11, with the 40° angle between them. *Why:* The 40° angle is between the sides 8 and 11. Area = $\frac{1}{2} \times 8 \times 11 \times \sin 40^\circ = 28.3$.
 5. Sides 7 and 8, with the 110° angle between them. *Why:* The 110° angle is between the sides 7 and 8. Area = $\frac{1}{2} \times 7 \times 8 \times \sin 110^\circ = 26.3$.
 8. Sides 10 and 13, with the 65° angle between them. *Why:* The 65° angle is between the sides 10 and 13. Area = $\frac{1}{2} \times 10 \times 13 \times \sin 65^\circ = 58.9$.
 12. Sides 6 and 10, with the 105° angle between them. *Why:* The 105° angle is between the sides 6 and 10. Area = $\frac{1}{2} \times 6 \times 10 \times \sin 105^\circ = 29.0$.
- 3 **Neither formula works. No height is marked, and no marked angle is between two sides with numbers.**
 2. Sides 9 and 11, and a 50° angle. The angle touches the 9 but not the 11. *Why:* The 50° angle touches only one of the two numbered sides, and no height is marked. Using it gives a wrong area.
 4. One side of 10 with a 45° angle and a 60° angle at its two ends. *Why:* Only one side has a number, and no height is marked. Neither formula can start. (The triangle is fixed, but finding its area needs methods beyond this lesson.)
 9. Sides 6 and 12, and a 115° angle. The angle touches the 6 but not the 12. *Why:* The 115° angle touches only one of the two numbered sides, and no height is marked. Using it gives a wrong area.
 11. Sides 10 and 12, and a 70° angle. The angle touches the 10 but not the 12. *Why:* The 70° angle touches only one of the two numbered sides, and no height is marked. Using it gives a wrong area.

To check a piece with a student, ask: “Is a height marked? If not, put a finger on the arc. Do both sides that touch it have numbers?”