

CUT & GLUE SORT

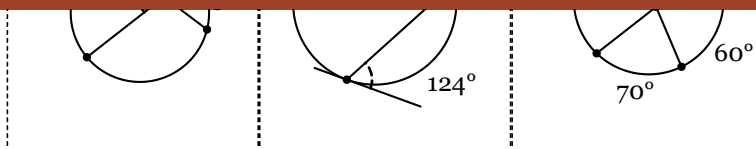


ANGLES FORMED BY CHORDS, SECANTS AND TANGENTS

Angles from Chords & Tangents: Which Rule, and Is It Enough?

Twelve pieces · inside or on the circle? · can you tell? · three rows

FREE



Row 1. Vertex inside the circle. The marked angle is half the SUM of two arcs, and both arcs are known.

Row 2. Vertex on the circle. The marked angle is half of the arc inside it, and that arc is known.

Row 3. Cannot tell. An arc the marked angle needs has no number, and the other numbers cannot find it.

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:** *“First say where the vertex is. Then find the arcs the marked angle needs. If an arc has no number, try 360° . If you still cannot find it, the piece goes in row 3.”*
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 a box with the rules.
Answers	page 5.

The rules: when two chords cross inside a circle, the angle is half the sum of the arc inside it and the arc inside the angle across from it. When a tangent and a chord meet on the circle, the angle is half the arc inside it. All the arcs of a circle make 360° , so one missing arc can be found from the others.

Row 3 holds the pieces where the numbers are not enough. On three of them two chords cross, but the numbers are on the wrong arcs, and two arcs are unknown. On one, a tangent and a chord meet, but only part of the arc inside the angle has a number. A student who looks only at the vertex puts these in rows 1 and 2. In rows 1 and 2, some pieces give the needed arc only through 360° . That is the step students skip on tests.

This sheet calls a line a tangent when it touches the circle at exactly one point. The arcs an angle intercepts are the arcs inside the angle. Some textbooks use other definitions, so tell the class which ones this sheet uses. This sheet has no vertex outside the circle. Guessing does not work: a simple guessing rule, such as sorting by how many numbers a piece has, 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 rule, and is it enough?

Angles from chords and tangents

Name _____

Period _____

Date _____

Each piece on the next page has one marked angle. Some arcs have their measure printed beside them. First find the vertex: inside the circle or on it. Then find the arcs the marked angle needs. **Are those arcs known? All the arcs of a circle make 360° . Glue the piece in its row.** You do not need to find the angle.

Row 1. Vertex inside the circle. The marked angle is half the SUM of two arcs, and both arcs are known.

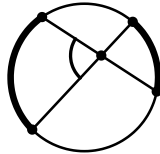
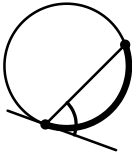
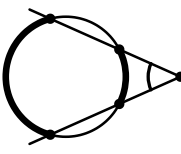
Row 2. Vertex on the circle. The marked angle is half of the arc inside it, and that arc is known.

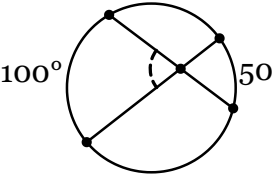
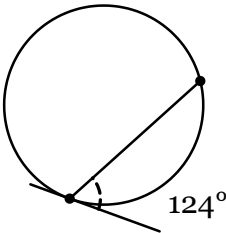
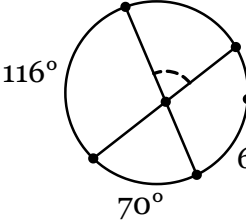
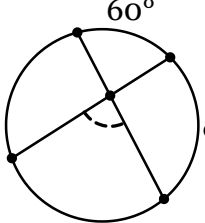
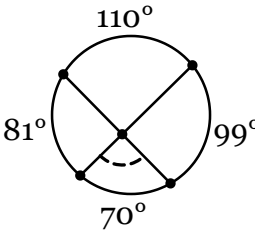
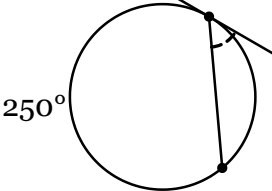
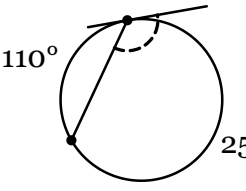
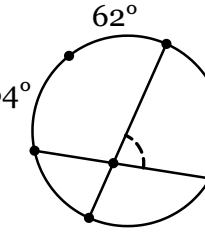
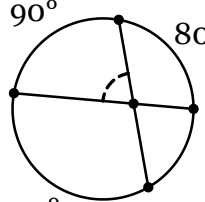
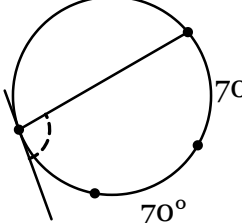
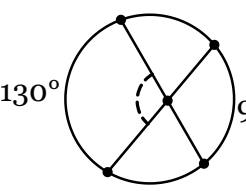
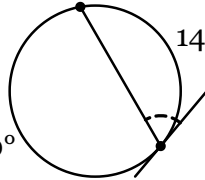
Row 3. Cannot tell. An arc the marked angle needs has no number, and the other numbers cannot find it.

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. The box below shows the rules.

 Vertex inside: the angle is half the SUM of the arc inside it and the arc across from it.	 Vertex on the circle (a tangent and a chord): the angle is half the arc inside it.	 Vertex outside: the angle is half the DIFFERENCE, far arc minus near arc.
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1 	2 	3 	4 
5 	6 	7 	8 
9 	10 	11 	12 



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Every piece is listed by the number printed on its corner, with the reason. Each row holds four pieces.

- 1 **Vertex inside the circle. The marked angle is half the SUM of two arcs, and both arcs are known.**
 1. Two chords cross inside the circle. Numbers on the circle: 100° , 50° . *Why:* The two arcs inside the marked angle and the angle across from it both have numbers. The angle is half their sum, 75° .
 5. Two chords cross inside the circle. Numbers on the circle: 70° , 81° , 110° , 99° . *Why:* The two arcs inside the marked angle and the angle across from it both have numbers. The angle is half their sum, 90° .
 9. Two chords cross inside the circle. Numbers on the circle: 90° , 130° , 80° . *Why:* One arc the angle needs has no number, but the other three arcs do, and all four make 360° . So it is known, and the angle is 75° .
 11. Two chords cross inside the circle. Numbers on the circle: 130° , 90° . *Why:* The two arcs inside the marked angle and the angle across from it both have numbers. The angle is half their sum, 110° .
- 2 **Vertex on the circle. The marked angle is half of the arc inside it, and that arc is known.**
 2. A tangent and a chord meet on the circle. Numbers on the circle: 124° . *Why:* The arc inside the marked angle has its number. The angle is half of it, 62° .
 6. A tangent and a chord meet on the circle. Numbers on the circle: 250° . *Why:* Only the other arc has a number, but the two arcs make 360° . So the arc inside the angle is known, and the angle is 55° .
 7. A tangent and a chord meet on the circle. Numbers on the circle: 250° , 110° . *Why:* The arc inside the marked angle has its number. The angle is half of it, 125° .
 12. A tangent and a chord meet on the circle. Numbers on the circle: 140° , 220° . *Why:* The arc inside the marked angle has its number. The angle is half of it, 70° .
- 3 **Cannot tell. An arc the marked angle needs has no number, and the other numbers cannot find it.**
 3. Two chords cross inside the circle. Numbers on the circle: 116° , 70° , 60° . *Why:* A fifth point cuts one arc into two parts, so the circle has five arcs. Three have numbers and two do not. The angle needs the arc inside it and the arc inside the angle across from it. At least one of them has no number, and the numbers given do not find it: two unknown arcs share what is left of 360° .
 4. Two chords cross inside the circle. Numbers on the circle: 95° , 60° . *Why:* The angle needs the arc inside it and the arc inside the angle across from it. At least one of them has no number, and the numbers given do not find it: two unknown arcs share what is left of 360° .
 8. Two chords cross inside the circle. Numbers on the circle: 96° , 62° , 64° . *Why:* A fifth point cuts one arc into two parts, so the circle has five arcs. Three have numbers and two do not. The angle needs the arc inside it and the arc inside the angle across from it. At least one of them has no number, and the numbers given do not find it: two unknown arcs share what is left of 360° .
 10. A tangent and a chord meet on the circle. Numbers on the circle: 70° , 70° . *Why:* The angle needs the whole arc inside it. Only part of that arc has a number, and the rest of the circle has none.

To check a piece with a student, ask: “Where is the vertex? Which arcs does the marked angle need? Do they have numbers, or can 360° give them?”