

MYSTERY PICTURE

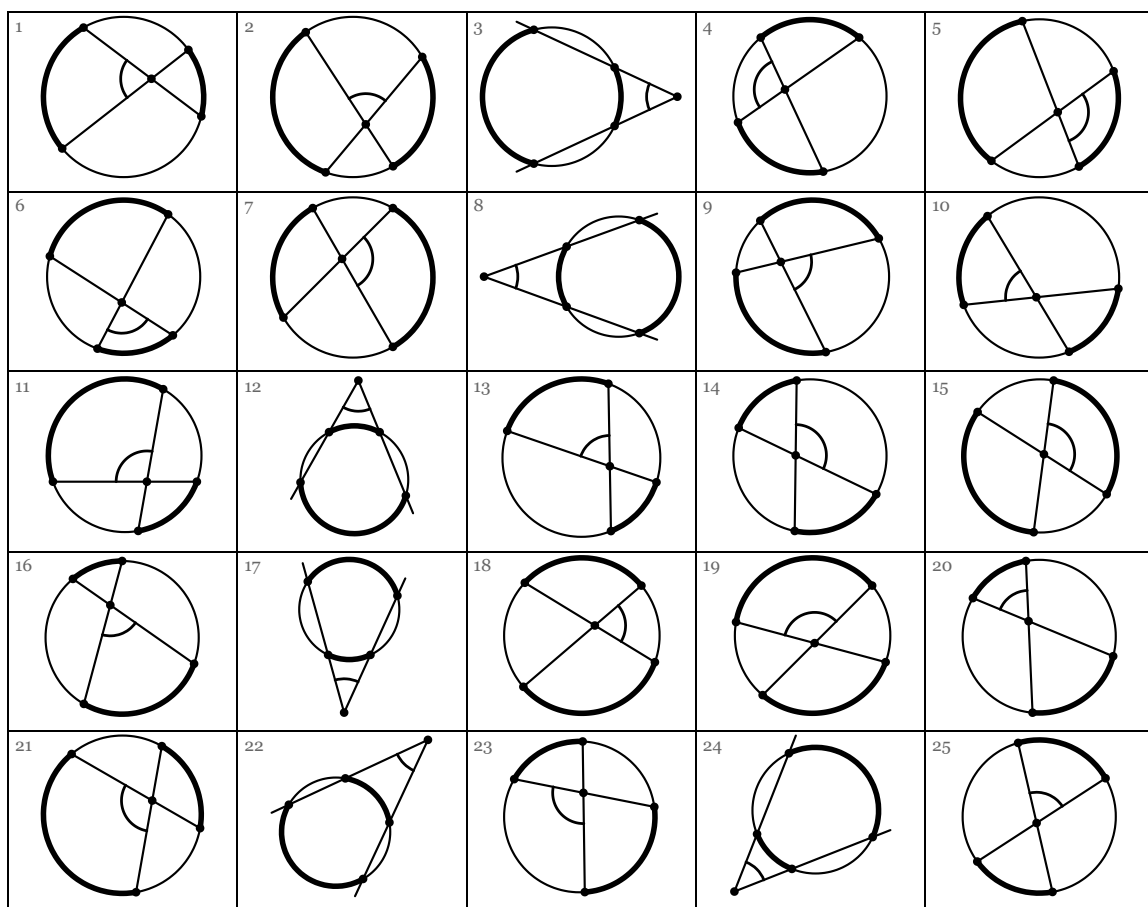


ANGLES FORMED BY CHORDS, SECANTS AND TANGENTS

Angles from Chords & Secants: Half the Sum?

25 circles · inside or outside? · no calculator · a picture appears

FREE



1. **Give each student page 3** and a pencil. No calculator is needed.
2. **Say this once:** *“In each square, one angle is marked and two arcs are thick. Is the marked angle half the SUM of the two thick arcs? If yes, fill the square with slanted lines. If no, leave it white.”*
3. **Let them work.** The picture shows when they are right. Nothing else is needed.

Student sheet	page 3, one per student. A box at the bottom shows the three rules.
Answers	pages 4–5, for you.

The rule: 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 the vertex is outside the circle, the angle is half the difference of the far arc and the near arc. Thirteen squares are filled. In each, two chords cross and the thick arcs are the right pair.

The white squares are of two kinds. In six of them two chords cross, but the thick arcs are the other pair: the marked angle opens onto the two thin arcs. This is the mistake of mixing up the two angles at the crossing. In the other six, two secants meet outside the circle, so the angle is half the difference, not half the sum. No number is printed anywhere, so the square is decided by where the vertex is and which arcs are inside the angle.

This sheet calls a line a secant when it cuts the circle at two points. 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.

If part of a student’s picture looks wrong, the mistake is in that square. Ask: *“Where is the vertex? Which arcs are inside the marked angle?”* Guessing does not work. Every simple guessing rule, such as filling every square where the vertex is inside the circle, gets at least six squares wrong.



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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Mystery Picture — half the sum?

Angles from chords and secants

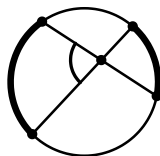
Name _____

Period _____

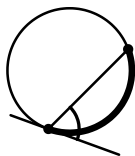
Date _____

Each square has one marked angle and two thick arcs. **Is the marked angle half the SUM of the two thick arcs? If yes, fill the square with slanted lines. If no, leave it white.** First find the vertex. Then find the arcs inside the angle. A picture appears. If part of it is missing, check that square again.

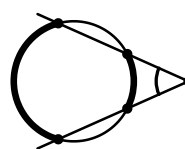
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25



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.



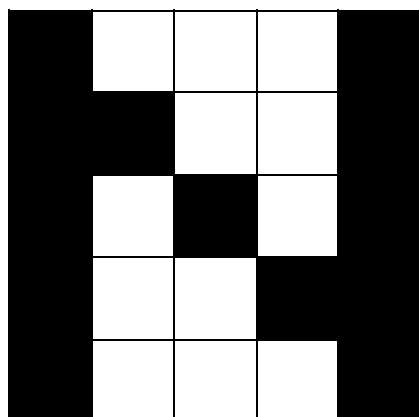
Vertex outside: the angle is **half the DIFFERENCE**, far arc minus near arc.



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Mystery Picture — answers

For the teacher



The finished picture is **the letter N**. Thirteen squares are filled.

To check a square, ask two things. Where is the vertex: inside the circle or outside it? Which arcs are inside the marked angle and the angle across from it? The table gives the reason for every square. It goes on over the page.

	The square	Answer	Why
1	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (75°).
2	Two chords. The thick arcs are inside the other two angles.	white	The vertex is inside the circle, but the marked angle opens onto the two thin arcs. It is half of their sum (73°), not half of the thick ones (107°).
3	Two secants from a point outside. The thick arcs are the near arc and the far arc.	white	The vertex is outside the circle. The thick arcs are the far arc and the near arc, so the angle is half their difference (50°), not half their sum (100°).
4	Two chords. The thick arcs are inside the other two angles.	white	The vertex is inside the circle, but the marked angle opens onto the two thin arcs. It is half of their sum (100°), not half of the thick ones (80°).
5	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (105°).
6	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (85°).
7	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (105°).
8	Two secants from a point outside. The thick arcs are the near arc and the far arc.	white	The vertex is outside the circle. The thick arcs are the far arc and the near arc, so the angle is half their difference (40°), not half their sum (100°).
9	Two chords. The thick arcs are inside the other two angles.	white	The vertex is inside the circle, but the marked angle opens onto the two thin arcs. It is half of their sum (77°), not half of the thick ones (103°).
10	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (65°).
11	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (100°).
12	Two secants from a point outside. The thick arcs are the near arc and the far arc.	white	The vertex is outside the circle. The thick arcs are the far arc and the near arc, so the angle is half their difference (52°), not half their sum (108°).

Mystery Picture — answers, squares 13 to 25

For the teacher

	The square	Answer	Why
13	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (70°).
14	Two chords. The thick arcs are inside the other two angles.	white	The vertex is inside the circle, but the marked angle opens onto the two thin arcs. It is half of their sum (115°), not half of the thick ones (65°).
15	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (115°).
16	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (70°).
17	Two secants from a point outside. The thick arcs are the near arc and the far arc.	white	The vertex is outside the circle. The thick arcs are the far arc and the near arc, so the angle is half their difference (40°), not half their sum (90°).
18	Two chords. The thick arcs are inside the other two angles.	white	The vertex is inside the circle, but the marked angle opens onto the two thin arcs. It is half of their sum (72°), not half of the thick ones (108°).
19	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (120°).
20	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (65°).
21	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (110°).
22	Two secants from a point outside. The thick arcs are the near arc and the far arc.	white	The vertex is outside the circle. The thick arcs are the far arc and the near arc, so the angle is half their difference (40°), not half their sum (110°).
23	Two chords. The thick arcs are inside the other two angles.	white	The vertex is inside the circle, but the marked angle opens onto the two thin arcs. It is half of their sum (102°), not half of the thick ones (78°).
24	Two secants from a point outside. The thick arcs are the near arc and the far arc.	white	The vertex is outside the circle. The thick arcs are the far arc and the near arc, so the angle is half their difference (47°), not half their sum (93°).
25	Two chords. The thick arcs are inside the marked angle and the angle across from it.	fill	The vertex is inside the circle. The thick arcs are the arc inside the marked angle and the arc inside the angle across from it, so the angle is half their sum (70°).