

MYSTERY PICTURE

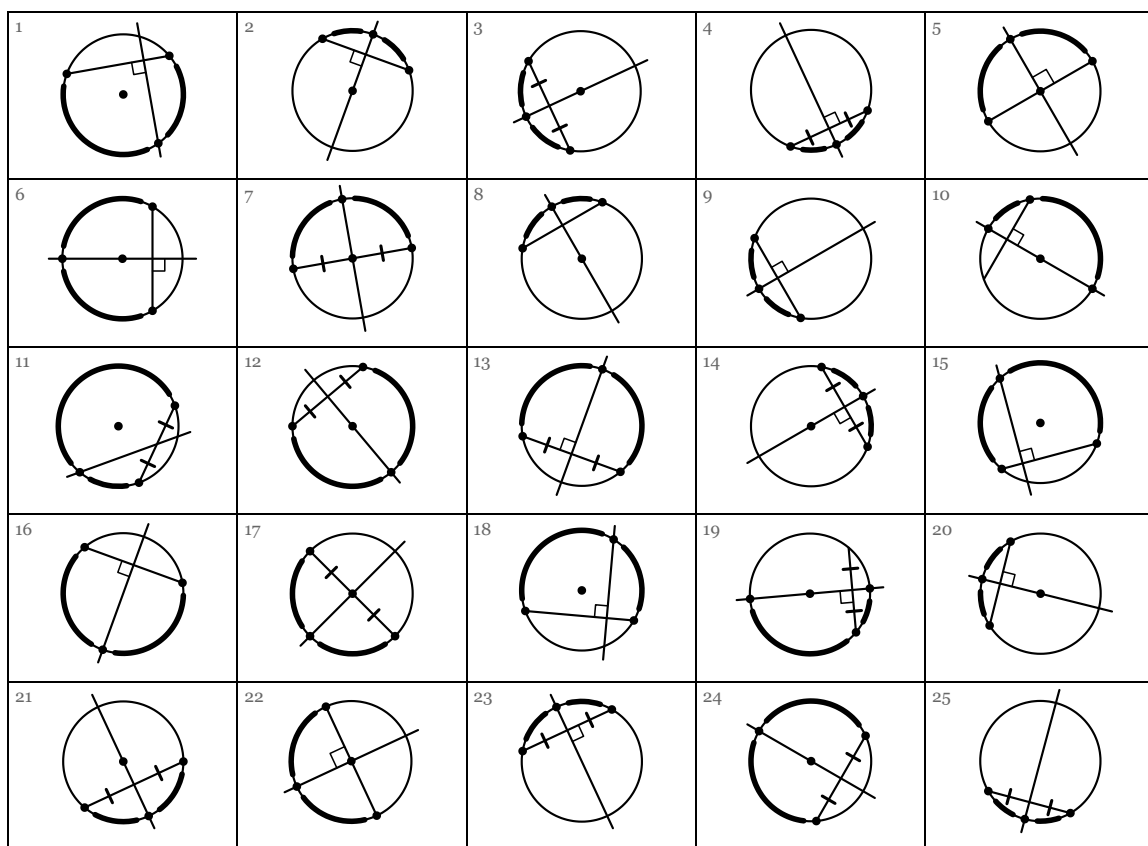


PERPENDICULAR BISECTORS OF CHORDS

Perpendicular Bisectors of Chords

25 circles · do the marks prove it? · no calculator · a picture appears

FREE



1. **Give each student page 3** and a pencil. No calculator is needed.
2. **Say this once:** *“In every square, decide one thing: do the marks prove that the two thick arcs are congruent? If they do, fill the square with slanted lines. If they do not, leave it white. Use the marks, not how the drawing looks.”*
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 top shows what each mark means and the three rules.
Answers	pages 4–5, for you.

The rules: a line through the center that is perpendicular to a chord cuts the chord and both of its arcs in half. A line through the center that cuts a chord in half is perpendicular to it, if the chord is not a diameter. The perpendicular bisector of a chord passes through the center. Thirteen squares are filled.

The white squares are of two kinds. In six of them the marks prove the thick arcs are not congruent: a perpendicular line that misses the center, a line through the middle of the chord that misses the center, or one part of the short arc against one part of the long arc. In the other six the marks prove nothing: two diameters with tick marks (two diameters always cut each other in half, so this says nothing about a right angle), a line through the center with nothing marked, or a square or tick marks with no center shown. These look true on purpose.

This sheet calls two arcs congruent when they have the same measure in the same circle. 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: *“Does the line pass through the center? What do the marks show?”* Guessing does not work. Every simple guessing rule, such as filling every square with a small square in it, 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 — do the marks prove it?

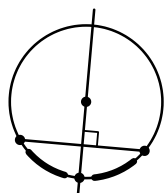
Perpendicular bisectors of chords

Name _____

Period _____

Date _____

In every square, two arcs are drawn thick. Decide: **The two thick arcs are congruent.** Use only the marks and the rules in the box, not how the drawing looks. **If the marks prove it, fill the square with slanted lines. If they do not prove it, leave it white.** Leave it white also when you cannot tell. A picture appears. If part of it is missing, check that square again.



The dot inside the circle is the center. No dot inside means the center is not shown. **A small square** means a right angle. **One tick mark on each part** of the chord means the line cuts the chord in half. **Each thick arc** runs from one dot on the circle to the next. The dot between the two thick arcs is where one ends and the other begins.

Rule 1. A line through the center that is perpendicular to a chord cuts the chord and both of its arcs in half.

Rule 2. A line through the center that cuts a chord in half is perpendicular to it. This is true only when the chord is not a diameter.

Rule 3. The perpendicular bisector of a chord passes through the center.

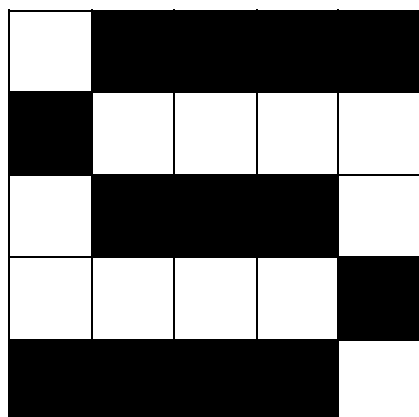
1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25



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Mystery Picture — answers

For the teacher



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

To check a square, ask two things. Does the line pass through the center, or is it the perpendicular bisector of the chord? And are the two thick arcs parts of the same arc? The table gives the reason for every square. It goes on over the page.

	The square	Answer	Why
1	Line misses the center. Square. Thick: the two parts of the long arc.	white	The line is perpendicular to the chord but misses the center. The only perpendicular that cuts the arcs in half passes through the center, so these arcs are not congruent.
2	Line through the center. Square. Thick: the two parts of the short arc.	fill	The line passes through the center and is perpendicular to the chord. So it cuts the chord and both of its arcs in half, and the two parts of the short arc are congruent.
3	Line through the center. Tick marks. Thick: the two parts of the short arc.	fill	The line passes through the center and cuts the chord in half, and the chord is not a diameter. So the line is perpendicular to the chord and cuts the short arc in half.
4	No center shown. Square and tick marks. Thick: the two parts of the short arc.	fill	The square and the tick marks make the line the perpendicular bisector of the chord. The perpendicular bisector of a chord passes through the center, so it cuts the short arc in half.
5	Two diameters. Square. Thick: the two parts of one half circle.	fill	The square shows the two diameters are perpendicular. A diameter perpendicular to a chord cuts its arcs in half, so each thick arc is 90° .
6	Line through the center. Square. Thick: the two parts of the long arc.	fill	The line passes through the center and is perpendicular to the chord. So it cuts the chord and both of its arcs in half, and the two parts of the long arc are congruent.
7	Two diameters. Tick marks. Thick: the two parts of one half circle.	white	The chord is itself a diameter. Two diameters always cut each other in half, so the tick marks say nothing new. Nothing shows a right angle, so the arcs could be unequal.
8	Line through the center. No marks. Thick: the two parts of the short arc.	white	The line passes through the center, but nothing shows it is perpendicular or that it cuts the chord in half. It only looks that way.
9	No center shown. Square. Thick: the two parts of the short arc.	white	The line is perpendicular to the chord, but nothing shows it cuts the chord in half or passes through the center. It only looks that way.
10	Line through the center. Square. Thick: one part of each arc.	white	The line is the perpendicular bisector, so it cuts each arc in half. The chord misses the center, so it is not a diameter and its short arc is smaller than its long arc. Half of one cannot be congruent to half of the other.
11	Line misses the center. Tick marks. Thick: the two parts of the long arc.	white	The line cuts the chord in half but misses the center. A line through the middle of a chord that misses the center is not perpendicular, so it does not cut the arc in half.
12	Line through the center. Tick marks. Thick: the two parts of the long arc.	fill	The line passes through the center and cuts the chord in half, and the chord is not a diameter. So the line is perpendicular to the chord and cuts the long arc in half.

Mystery Picture — answers, squares 13 to 25

For the teacher

	The square	Answer	Why
13	No center shown. Square and tick marks. Thick: the two parts of the long arc.	fill	The square and the tick marks make the line the perpendicular bisector of the chord. The perpendicular bisector of a chord passes through the center, so it cuts the long arc in half.
14	Line through the center. Square and tick marks. Thick: the two parts of the short arc.	fill	The line passes through the center and is perpendicular to the chord. So it cuts the chord and both of its arcs in half, and the two parts of the short arc are congruent.
15	Line misses the center. Square. Thick: the two parts of the long arc.	white	The line is perpendicular to the chord but misses the center. The only perpendicular that cuts the arcs in half passes through the center, so these arcs are not congruent.
16	No center shown. Square. Thick: the two parts of the long arc.	white	The line is perpendicular to the chord, but nothing shows it cuts the chord in half or passes through the center. It only looks that way.
17	Two diameters. Tick marks. Thick: the two parts of one half circle.	white	The chord is itself a diameter. Two diameters always cut each other in half, so the tick marks say nothing new. Nothing shows a right angle, so the arcs could be unequal.
18	Line misses the center. Square. Thick: the two parts of the long arc.	white	The line is perpendicular to the chord but misses the center. The only perpendicular that cuts the arcs in half passes through the center, so these arcs are not congruent.
19	Line through the center. Square and tick marks. Thick: one part of each arc.	white	The line is the perpendicular bisector, so it cuts each arc in half. The chord misses the center, so it is not a diameter and its short arc is smaller than its long arc. Half of one cannot be congruent to half of the other.
20	Line through the center. Square. Thick: the two parts of the short arc.	fill	The line passes through the center and is perpendicular to the chord. So it cuts the chord and both of its arcs in half, and the two parts of the short arc are congruent.
21	Line through the center. Tick marks. Thick: the two parts of the short arc.	fill	The line passes through the center and cuts the chord in half, and the chord is not a diameter. So the line is perpendicular to the chord and cuts the short arc in half.
22	Two diameters. Square. Thick: the two parts of one half circle.	fill	The square shows the two diameters are perpendicular. A diameter perpendicular to a chord cuts its arcs in half, so each thick arc is 90° .
23	No center shown. Square and tick marks. Thick: the two parts of the short arc.	fill	The square and the tick marks make the line the perpendicular bisector of the chord. The perpendicular bisector of a chord passes through the center, so it cuts the short arc in half.
24	Line through the center. Tick marks. Thick: the two parts of the long arc.	fill	The line passes through the center and cuts the chord in half, and the chord is not a diameter. So the line is perpendicular to the chord and cuts the long arc in half.
25	No center shown. Tick marks. Thick: the two parts of the short arc.	white	The line cuts the chord in half, but nothing shows it is perpendicular or passes through the center. It only looks that way.