

MYSTERY PICTURE



DERIVING THE EQUATION OF A CIRCLE

Do They Match? The Equation of a Circle

25 circles · equation, center and radius · nothing to calculate · a picture appears

FREE

1 $(x - 3)^2 + (y - 2)^2 = 25$ Center (3, 2) Radius 5	2 Center (-4, 1) Radius 6 $(x + 4)^2 + (y - 1)^2 = 36$	3 $(x - 2)^2 + (y + 5)^2 = 9$ Center (2, -5) Radius 3	4 Center (0, 0) Radius 9 $x^2 + y^2 = 81$	5 $(x - 6)^2 + (y + 2)^2 = 1$ Center (6, -2) Radius 1
6 Center (-2, 7) Radius $\sqrt{5}$ $(x + 2)^2 + (y - 7)^2 = 5$	7 $(x + 3)^2 + (y - 2)^2 = 16$ Center (3, -2) Radius 4	8 Center (-5, -1) Radius 6 $(x - 5)^2 + (y - 1)^2 = 36$	9 $(x - 4)^2 + (y + 7)^2 = 9$ Center (4, 7) Radius 3	10 $x^2 + (y + 3)^2 = 16$ Center (0, -3) Radius 4
11 Center (-1, -6) Radius 2 $(x + 1)^2 + (y + 6)^2 = 4$	12 $(x - 1)^2 + (y + 1)^2 = 7$ Center (1, -1) Radius $\sqrt{7}$	13 Center (5, 0) Radius 7 $(x - 5)^2 + y^2 = 49$	14 $(x + 7)^2 + (y + 3)^2 = 100$ Center (-7, -3) Radius 10	15 Center (4, 4) Radius 8 $(x - 4)^2 + (y - 4)^2 = 64$
16 Center (2, -6) Radius 5 $(x - 2)^2 + (y + 6)^2 = 5$	17 $(x + 1)^2 + (y - 3)^2 = 49$ Center (-1, 3) Radius 49	18 $(x - 7)^2 + (y + 2)^2 = 16$ Center (7, -2) Radius 8	19 $x^2 + (y - 4)^2 = 4$ Center (4, 0) Radius 2	20 $(x + 5)^2 + (y - 2)^2 = 10$ Center (-5, 2) Radius $\sqrt{10}$
21 Center (-3, -4) Radius 5 $(x + 3)^2 + (y + 4)^2 = 25$	22 $x^2 + (y - 6)^2 = 9$ Center (0, 6) Radius 3	23 Center (-6, 0) Radius 2 $(x + 6)^2 + y^2 = 4$	24 $(x - 2)^2 + (y - 9)^2 = 3$ Center (2, 9) Radius $\sqrt{3}$	25 Center (8, -1) Radius 4 $(x - 8)^2 + (y + 1)^2 = 16$

1. **Give each student page 3** and a pencil. No calculator is needed.
2. **Say this once:** *“Each square has an equation and a center and radius. If they match, fill the square with slanted lines. If not, leave it white. Remember: $x + 3$ means the center’s x is -3 , and the right side is r squared.”*
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 the circle, its right triangle, and the rules for the signs and the radius.
Answers	page 4, for you.

Every square tests the two things students most often get wrong in $(x - h)^2 + (y - k)^2 = r^2$. Each bracket is a difference, so $(x + 3)^2$ means $h = -3$. The right side is r^2 , the radius squared, so a right side of 16 means a radius of 4. Some squares give the equation first, and some give the center and radius first. Eighteen squares are filled and seven are white.

The white squares are the usual mistakes. Two copy both signs of the center from the page, one in each direction, and one copies a single sign. One writes the radius on the right without squaring it, one reads the right side as the radius, and one takes a right side of 16 as 8×2 instead of 4×4 . The last one reads $x^2 + (y - 4)^2$ as center $(4, 0)$, with x and y swapped. The filled squares include a center at the origin ($x^2 + y^2 = 81$), a radius of 1, and radii such as $\sqrt{5}$ left as square roots.

If part of a student’s picture looks wrong, ask about that square: *“Write each bracket as x minus a number. What times itself gives the right side?”* Guessing does not work. Every simple guessing rule, such as filling every square with a whole-number radius, 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 they match?

The equation of a circle

Name _____

Period _____

Date _____

Each square gives the equation of a circle and a center and radius. **Does the equation match the center and the radius?** Check both. If both match, fill the square with slanted lines. If either one is wrong, leave the square white. A picture appears. If part of it is missing, or one square does not fit, check that square again.

A circle is every point at the same distance r from its center (h, k) . The right triangle gives the equation:

$$(x - h)^2 + (y - k)^2 = r^2$$

Each bracket is a difference. $(x - 3)^2$ means $h = 3$. $(x + 3)^2$ is $(x - (-3))^2$, so $h = -3$. A lone x^2 means $h = 0$. The same goes for y and k .

The right side is r^2 , the radius times itself. If the right side is 49, then $r = 7$. If the radius is 7, the right side is 49.

Give a radius exactly. If the right side is not a perfect square, write r in simplest radical form: 12 gives $r = \sqrt{12} = \sqrt{4 \cdot 3} = 2\sqrt{3}$.

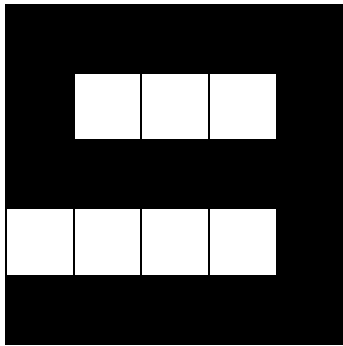
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Mystery Picture — answers

For the teacher



The finished picture is **the number 9**. Eighteen squares are filled.

A square is filled when the center and the radius both match the equation. This sheet writes the equation as $(x - h)^2 + (y - k)^2 = r^2$ and gives a radius exactly, as a whole number or a square root. Some textbooks use other definitions, so tell the class which ones this sheet uses.

The square	Answer	Why
1 $(x - 3)^2 + (y - 2)^2 = 25$. Center (3, 2), radius 5.	fill	The center is (3, 2) and $r^2 = 25$, so $r = 5$.
2 Center (-4, 1), radius 6. $(x + 4)^2 + (y - 1)^2 = 36$.	fill	The center is (-4, 1) and $r^2 = 36$, so $r = 6$.
3 $(x - 2)^2 + (y + 5)^2 = 9$. Center (2, -5), radius 3.	fill	The center is (2, -5) and $r^2 = 9$, so $r = 3$.
4 Center (0, 0), radius 9. $x^2 + y^2 = 81$.	fill	The center is (0, 0) and $r^2 = 81$, so $r = 9$.
5 $(x - 6)^2 + (y + 2)^2 = 1$. Center (6, -2), radius 1.	fill	The center is (6, -2) and $r^2 = 1$, so $r = 1$.
6 Center (-2, 7), radius $\sqrt{5}$. $(x + 2)^2 + (y - 7)^2 = 5$.	fill	The center is (-2, 7) and $r^2 = 5$, so $r = \sqrt{5}$.
7 $(x + 3)^2 + (y - 2)^2 = 16$. Center (3, -2), radius 4.	white	Both signs are copied from the page. $(x + 3)^2$ means $h = -3$, and $(y - 2)^2$ means $k = 2$. The center is (-3, 2).
8 Center (-5, -1), radius 6. $(x - 5)^2 + (y - 1)^2 = 36$.	white	The signs of the center are copied into the brackets. Center (-5, -1) gives $(x + 5)^2 + (y + 1)^2 = 36$.
9 $(x - 4)^2 + (y + 7)^2 = 9$. Center (4, 7), radius 3.	white	One sign is copied from the page. $(y + 7)^2$ means $k = -7$, so the center is (4, -7).
10 $x^2 + (y + 3)^2 = 16$. Center (0, -3), radius 4.	fill	The center is (0, -3) and $r^2 = 16$, so $r = 4$.
11 Center (-1, -6), radius 2. $(x + 1)^2 + (y + 6)^2 = 4$.	fill	The center is (-1, -6) and $r^2 = 4$, so $r = 2$.
12 $(x - 1)^2 + (y + 1)^2 = 7$. Center (1, -1), radius $\sqrt{7}$.	fill	The center is (1, -1) and $r^2 = 7$, so $r = \sqrt{7}$.
13 Center (5, 0), radius 7. $(x - 5)^2 + y^2 = 49$.	fill	The center is (5, 0) and $r^2 = 49$, so $r = 7$.
14 $(x + 7)^2 + (y + 3)^2 = 100$. Center (-7, -3), radius 10.	fill	The center is (-7, -3) and $r^2 = 100$, so $r = 10$.
15 Center (4, 4), radius 8. $(x - 4)^2 + (y - 4)^2 = 64$.	fill	The center is (4, 4) and $r^2 = 64$, so $r = 8$.
16 Center (2, -6), radius 5. $(x - 2)^2 + (y + 6)^2 = 5$.	white	The radius is written on the right without squaring. Radius 5 gives a right side of 25.
17 $(x + 1)^2 + (y - 3)^2 = 49$. Center (-1, 3), radius 49.	white	The right side is read as the radius. The right side is $r^2 = 49$, so $r = 7$.
18 $(x - 7)^2 + (y + 2)^2 = 16$. Center (7, -2), radius 8.	white	Squaring is taken as doubling. $r^2 = 16$ means $r \times r = 16$, so $r = 4$, not 8.
19 $x^2 + (y - 4)^2 = 4$. Center (4, 0), radius 2.	white	The y-bracket is read as the x-coordinate. A lone x^2 means $h = 0$, and $(y - 4)^2$ means $k = 4$. The center is (0, 4).
20 $(x + 5)^2 + (y - 2)^2 = 10$. Center (-5, 2), radius $\sqrt{10}$.	fill	The center is (-5, 2) and $r^2 = 10$, so $r = \sqrt{10}$.
21 Center (-3, -4), radius 5. $(x + 3)^2 + (y + 4)^2 = 25$.	fill	The center is (-3, -4) and $r^2 = 25$, so $r = 5$.
22 $x^2 + (y - 6)^2 = 9$. Center (0, 6), radius 3.	fill	The center is (0, 6) and $r^2 = 9$, so $r = 3$.
23 Center (-6, 0), radius 2. $(x + 6)^2 + y^2 = 4$.	fill	The center is (-6, 0) and $r^2 = 4$, so $r = 2$.
24 $(x - 2)^2 + (y - 9)^2 = 3$. Center (2, 9), radius $\sqrt{3}$.	fill	The center is (2, 9) and $r^2 = 3$, so $r = \sqrt{3}$.
25 Center (8, -1), radius 4. $(x - 8)^2 + (y + 1)^2 = 16$.	fill	The center is (8, -1) and $r^2 = 16$, so $r = 4$.