LESSON MAKER PRO

Conic Codebreakers

Turn geometric clues into conic equations, and back again.

HIGH SCHOOL · HSG-GPE.A

CCSS.Math.Content.HSG-GPE.A "Translate between the geometric description and the equation for a conic section"

NAME _____ DATE _____

USE THE KEY FEATURES

Use the center or vertex to fill a standard form. Circles use $(x-h)^2 + (y-k)^2 = r^2$, and vertical parabolas use $(x-h)^2 = 4p(y-k)$, where p is the directed distance from the vertex to the focus. Ellipses and hyperbolas use squared x and y terms divided by a^2 and b^2, with + for an ellipse and - for a hyperbola.

WORKED EXAMPLE

Write an equation for the circle with center (9,-8) and radius 7.

1. Start with $(x-h)^2 + (y-k)^2 = r^2$.
2. Substitute h = 9, k = -8, and r = 7.
3. Simplify the radius squared.

Answer: $(x-9)^2 + (y+8)^2 = 49$

PRACTICE 6 problems

1 Write an equation for the circle with center (-3,2) and radius 5.

ANSWER _____

2 For the ellipse $(x-1)^2/25 + (y+4)^2/4 = 1$, give the center, vertices, and co-vertices.

ANSWER _____

3 Write an equation for the parabola with vertex (-2,1) and focus (-2,4).

ANSWER _____

4 For the parabola $(y+1)^2 = -12(x-2)$, give the vertex, focus, and directrix.

ANSWER _____

5 Write an equation for the ellipse centered at (-4,2) with a vertical major axis of length 12 and a minor axis of length 4.

ANSWER _____

6 For the hyperbola $(x-1)^2/25 - (y+2)^2/4 = 1$, give the center, vertices, foci, and asymptotes.

ANSWER _____

APPLY IT Show your work

1 A student design crew is planning a skate park ramp. The ramp's cross-section is a parabola with vertex (3,-2) and focus (3,1). Write an equation for the parabola.

WORK SPACE

ANSWER _____

2 A music club is designing an elliptical stage border. Its horizontal endpoints are (-4,2) and (6,2), and its vertical endpoints are (1,0) and (1,4). Write an equation for the border.

WORK SPACE

ANSWER _____

CHALLENGE One step up

An ellipse has foci (-5,1) and (5,1), and vertices (-6,1) and (6,1). Write its equation. Then explain why the denominator under the y-term is 11.

WORK SPACE AND ANSWER

ANSWER KEY # Conic Codebreakers

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write an equation for the circle with center (-3,2) and radius 5.	**$(x+3)^2 + (y-2)^2 = 25$**
2	For the ellipse $(x-1)^2/25 + (y+4)^2/4 = 1$, give the center, vertices, and co-vertices.	**Center: (1,-4); vertices: (-4,-4) and (6,-4); co-vertices: (1,-6) and (1,-2)**
3	Write an equation for the parabola with vertex (-2,1) and focus (-2,4).	**$(x+2)^2 = 12(y-1)$**
4	For the parabola $(y+1)^2 = -12(x-2)$, give the vertex, focus, and directrix.	**Vertex: (2,-1); focus: (-1,-1); directrix: x =5**
5	Write an equation for the ellipse centered at (-4,2) with a vertical major axis of length 12 and a minor axis of length 4.	**$(x+4)^2/4 + (y-2)^2/36 = 1$**
6	For the hyperbola $(x-1)^2/25 - (y+2)^2/4 = 1$, give the center, vertices, foci, and asymptotes.	**Center: (1,-2); vertices: (-4,-2) and (6,-2); foci: (1-sqrt(29),-2) and (1+sqrt(29),-2); asymptotes: y+2 = 2/5(x-1) and y+2 = -2/5(x-1)**

PART 2 · APPLY IT

1. **$(x-3)^2 = 12(y+2)$** The focus is 3 units above the vertex, so p = 3. Substitute the vertex and 4p = 12 into the vertical-parabola form.
2. **$(x-1)^2/25 + (y-2)^2/4 = 1$** The midpoint of both endpoint pairs is (1,2). The horizontal semi-axis is 5 and the vertical semi-axis is 2.

CHALLENGE

$x^2/36 + (y-1)^2/11 = 1$. The center is (0,1), a = 6, and c = 5, so $b^2 = a^2 - c^2 = 36 - 25 = 11$.

Accept equivalent equations with terms reordered or both sides multiplied by the same nonzero constant. For feature questions, accept coordinates in either order within each pair.