LESSON MAKER PRO

Ellipse Equation Lab

Build each equation from the ellipse's key features.

HIGH SCHOOL · MA.912.GR.7.6

MA.912.GR.7.6 "Given a mathematical or real-world context, derive and create the equation of an ellipse using key features."

NAME _____ DATE _____

BUILD THE EQUATION

For an ellipse with center (h,k), write $(x-h)^2/a^2 + (y-k)^2/b^2 = 1$ when the major axis is horizontal. If the major axis is vertical, place a^2 under the y term and b^2 under the x term. The value a is the center-to-vertex distance, b is the center-to-covertex distance, and $c^2 = a^2 - b^2$ when foci are given.

WORKED EXAMPLE

Write the equation of the ellipse with center (5,-7), horizontal vertices (-4,-7) and (14,-7), and covertices (5,-3) and (5,-11).

1. The center is (h,k) = (5,-7).
2. The horizontal vertex distance is a = 9, so $a^2 = 81$.
3. The vertical covertex distance is b = 4, so $b^2 = 16$.
4. Use the horizontal major-axis form.

Answer: $(x-5)^2/81 + (y+7)^2/16 = 1$

PRACTICE 6 problems

1 Write the equation of the ellipse with center (2,-1), horizontal vertices (-6,-1) and (10,-1), and covertices (2,-4) and (2,2).

ANSWER _____

2 Write the equation of the ellipse with center (-3,5), vertical vertices (-3,-4) and (-3,14), and covertices (-9,5) and (3,5).

ANSWER _____

3 Write the equation of the ellipse with center (0,0), horizontal vertices (-12,0) and (12,0), and covertices (0,-5) and (0,5).

ANSWER _____

4 Write the equation of the ellipse with center (1,2), vertical vertices (1,14) and (1,-10), and foci (1,10) and (1,-6).

ANSWER _____

5 Write the equation of the ellipse with center (-7,-2), a vertical major axis of length 20, and a minor axis of length 16.

ANSWER _____

6 Write the equation of the ellipse with center (3,4), horizontal vertices (-9,4) and (15,4), and foci (-6,4) and (12,4).

ANSWER _____

APPLY IT Show your work

1 A game club is designing an elliptical arena on a coordinate map. The arena is centered at (6,-2), has a horizontal width of 20 units, and has a vertical height of 12 units. Write the equation of its boundary.

WORK SPACE

ANSWER _____

2 A student film crew plans an elliptical light zone for an outdoor scene. The zone has center (-4,3), vertical vertices (-4,12) and (-4,-6), and foci (-4,9) and (-4,-3). Write the equation of the light-zone boundary.

WORK SPACE

ANSWER _____

CHALLENGE One step up

An ellipse is centered at (0,0), has foci (-8,0) and (8,0), and passes through (0,15). Write its equation and explain how you found both denominators.

WORK SPACE AND ANSWER

ANSWER KEY

Ellipse Equation Lab

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Write the equation of the ellipse with center (2,-1), horizontal vertices (-6,-1) and (10,-1), and covertices (2,-4) and (2,2).	**$(x-2)^2/64 + (y+1)^2/9 = 1$**
2	Write the equation of the ellipse with center (-3,5), vertical vertices (-3,-4) and (-3,14), and covertices (-9,5) and (3,5).	**$(x+3)^2/36 + (y-5)^2/81 = 1$**
3	Write the equation of the ellipse with center (0,0), horizontal vertices (-12,0) and (12,0), and covertices (0,-5) and (0,5).	**$x^2/144 + y^2/25 = 1$**
4	Write the equation of the ellipse with center (1,2), vertical vertices (1,14) and (1,-10), and foci (1,10) and (1,-6).	**$(x-1)^2/80 + (y-2)^2/144 = 1$**
5	Write the equation of the ellipse with center (-7,-2), a vertical major axis of length 20, and a minor axis of length 16.	**$(x+7)^2/64 + (y+2)^2/100 = 1$**
6	Write the equation of the ellipse with center (3,4), horizontal vertices (-9,4) and (15,4), and foci (-6,4) and (12,4).	**$(x-3)^2/144 + (y-4)^2/63 = 1$**

PART 2 · APPLY IT

1. **$(x-6)^2/100 + (y+2)^2/36 = 1$** The horizontal semi-major axis is a = 10 and the vertical semi-minor axis is b = 6. Substitute the center and squared axis lengths into the horizontal major-axis form.
2. **$(x+4)^2/45 + (y-3)^2/81 = 1$** The vertical semi-major axis is a = 9, and the focal distance is c = 6. Use $b^2 = a^2 - c^2 = 81 - 36 = 45$, then use the vertical major-axis form.

CHALLENGE

$x^2/289 + y^2/225 = 1$. The point (0,15) is 17 units from each focus, so 2a = 34 and a = 17. Since c = 8, $b^2 = a^2 - c^2 = 289 - 64 = 225$.

Accept equivalent equations with terms reversed, such as placing the y term first. Require squared denominators and correct signs inside each grouped coordinate term.