

**10.3. Parabolas**

For a focus point and a directrix:  
Parabola is collection of points whose distances to the focus point and the directrix are equal.

Vertex is at  $(0,0)$

- ① Axis of symmetry is  $x$ -axis  
 $P > 0$ : Focus  $(0, p)$ , Directrix  $y = -p$ . Points  $(p, 2p)$ ,  $(p, p)$ ,  $(p, 0)$ ,  $(p, -p)$ ,  $(p, -2p)$ . Equation:  $y^2 = 4px$
- ② Axis of symmetry is  $y$ -axis  
 $P < 0$ : Focus  $(0, -p)$ , Directrix  $y = p$ . Points  $(-p, 2p)$ ,  $(-p, p)$ ,  $(-p, 0)$ ,  $(-p, -p)$ ,  $(-p, -2p)$ . Equation:  $x^2 = 4py$

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Vertex is at  $(h, k)$

$P > 0$        $(y-k)^2 = 4p(x-h)$

$P < 0$        $(x-h)^2 = 4p(y-k)$

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Determine whether the given equation represents a parabola.

$y = 8x^2$  is a parabola.

$x^2 = \frac{1}{8}y$  is not a parabola.

$x^2 = 4px$

$x^2 = 4py$

If the equation does represent a parabola, write in standard form. (If it does not represent a parabola, enter DNE.)

$x^2 = \frac{1}{8}y$  is a parabola.

Use the method of completing the square to rewrite the equation in the standard form of an equation of a parabola.

$4x^2 - 40x - y + 93 = 0$

$4x^2 - 40x = y - 93$

Rewrite the given equation in standard form:

$y^2 - 32x + 12y - 80 = 0$

$4((x-8)^2 - 64 + 12y + 9) = 0$

$4((x-8)^2 - 64 + 12y + 9) = 0$

Determine the vertex, focus, and directrix of the parabola.

A parabolic antenna has a cross section of 12 meters and a depth of 3 meters. The incoming signal of its receiver will be concentrated at the focus.

(a) For best reception, how many meters away should the receiver be placed from the vertex?

(b) Find an equation to represent the antenna. (Align the vertex at the origin and use a vertical axis.)

act 1 of 2

(a) For best reception, how many meters away should the receiver be placed from the vertex?

$\frac{x^2}{144} + \frac{y^2}{36} = 1$

Find the distance from the vertex to the focus.

$x^2 = 12y$

Recall that the equation for a vertical parabola with vertex at  $(0, 0)$  is  $y^2 = 4px$ , where  $p$  is the directed distance from the vertex to the focus.

Interpret the given information. We are given that the parabolic antenna has a cross-section of 12 meters and a depth of 3 meters. This means that if the vertex of the vertical parabola is placed at  $(x, y) = (0, 0)$ , the points  $(x, y) = (-6, 3)$  and  $(x, y) = (6, 3)$  are on the parabola, as shown below.

$x = 6$ ;  $y = 3$

$3^2 = 4p(6)$

$9 = 24p$

$p = \frac{9}{24}$

$x^2 = 4py$

$x^2 = 4(\frac{9}{24})y$

$x^2 = \frac{9}{6}y$

$x^2 = \frac{3}{2}y$

$x^2 = 1.5y$

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Write the equation for the hyperbola in standard form.  
 $4x^2 - 24x - 3y^2 - 72y = 144$

Identify the vertices and foci.

vertices:  $(x, y) = \begin{pmatrix} \text{ } \\ \text{ } \end{pmatrix}$  (smaller  $y$ -value)  
 $(x, y) = \begin{pmatrix} \text{ } \\ \text{ } \end{pmatrix}$  (larger  $y$ -value)

foci:  $(x, y) = \begin{pmatrix} \text{ } \\ \text{ } \end{pmatrix}$  (smaller  $y$ -value)  
 $(x, y) = \begin{pmatrix} \text{ } \\ \text{ } \end{pmatrix}$  (larger  $y$ -value)

Write equations of the asymptotes. (Enter your answers as a comma-separated list of equations.)

Additional Materials

- [eBook](#)
- [Conic Sections: The Hyperbola Part 2 of 2](#)
- [Conic Sections: A Hyperbola with Center not at Origin](#)

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