

# Conics - Parabola

We are starting a new series this week, a study of Conics, using the powerful Conics application. We start with parabolas, putting examples in standard form and finding the different parts, like focus, vertex, and directrix. See how easy it is to graph and use features like G-Solve in the Conics application. Don't miss the last eActivity with animation of a light source and parabola. This ends with a challenge for you to construct your own example. Watch for continuing explorations of Conics in all their many forms.

This file includes eActivities on:

**Parabola 1 UD (0,0)** Examine the standard form of a parabola that opens upward or downward with vertex at the origin.

**Parabola 2 RL (0,0)** This parabola opens to the right or left, and is symmetric about the x-axis. Find the standard form for this parabola.

**Parabola 3 UD (h,k)** No longer is the vertex on the origin, but that shouldn't slow you down. The vertex is (h,k) and the axis of symmetry is  $x=h$ .

**Parabola 4 RL (h,k)** Parabolas in this "standard form" have a vertex point at (h,k) and are symmetric about  $y=k$ .

**Parabola 5 Reflective Property** Check out this fascinating example of light and parabolas. Then try to construct the television rays coming into your Satellite dish.

## Parabola 1

Examine the standard form of a parabola that opens upward or downward with vertex at the origin.

**Parabola 1 with Vertex (0,0)**  
**Opens Upward or Downward**  
 $x^2=4py$   
 Focus (0,p)  
 Directrix  $y=-p$   
 Axis y-axis  
 Focal length p  
 Focal width  $|4p|$   
**<Example-1>**  
 When  $y=-\frac{1}{2}x^2$ , the standard form is

**<Example-2>**  
 Find the standard form for the parabola whose directrix is  $y=2$ .  
 From the directrix,  $p=-2$ .  
 Then the equation is,  
 $x^2=4(-2)y$   
 $x^2=-8y$

## Parabola 2

This parabola opens to the right or left, and is symmetric about the x-axis. Find the standard form for this parabola.

**Parabola 2 with Vertex (0,0)**  
**Opens to the right or left**  
 $y^2=4px$   
 Focus (p,0)  
 Directrix  $x=-p$   
 Axis x-axis  
 Focal length p  
 Focal width  $|4p|$   
**<Example-1>**  
 When  $x=-\frac{1}{2}y^2$ , the standard form is

**<Example-2>**  
 Find the standard form for the parabola whose directrix is  $x=2$ .  
 From the directrix,  $p=-2$ .  
 Then the equation is,  
 $y^2=4(-2)x$   
 $y^2=-8x$

### Parabola 3

No longer is the vertex on the origin, but that shouldn't slow you down. The vertex is (h,k) and the axis of symmetry is x=h.

File Edit Insert Action

**Parabola 3 with Vertex(h,k)**

Opens Upward or Downward

$$(x-h)^2=4p(y-k)$$

Focus (h,k+p)  
 Directrix y=k-p  
 Axis x=h  
 Focal length p  
 Focal width |4p|

**<Example-1>**  
 Find the vertex, focus, and directrix for  $x^2-6y+2x+13=0$ .

Alg Standard Real Deg

Edit Zoom Analysis

Change the form.

Calculator   
 Conics Graph

$$(x+1)^2=6 \cdot (y-2)$$

Then h=-1, k=2, p= $\frac{3}{2}$ .

Deg Real

File Edit Insert Action

Find the equation with vertex A(3,2) and focus B(3,4).

A(3,2) and B(3,4)

The standard form is  $(x-h)^2=4p(y-k)$ .

h=3, k=2 because of the vertex A(3,2).  
 k+p=4 because of the focus B(3,4).  
 Finally we have  $(x-3)^2=8(y-2)$ .

Conics Graph

Alg Standard Real Deg

### Parabola 4

Parabolas in this "standard form" have a vertex point at (h,k) and are symmetric about y=k.

File Edit Insert Action

**Parabola 4 with Vertex(h,k)**

Opens to the right or left

$$(y-k)^2=4p(x-h)$$

Focus (h+p,k)  
 Directrix x=h-p  
 Axis y=k  
 Focal length p  
 Focal width |4p|

**<Example-1>**  
 Find the vertex, focus, and directrix for  $y^2-6x+2y+13=0$ .

Alg Standard Real Deg

File Edit Insert Action

Change the form.

Calculator   
 Conics Graph

$$(y+1)^2=6 \cdot (x-2)$$

Then k=-1, h=2, p= $\frac{3}{2}$ .

Vertex: (2,-1)  
 Focus: ( $\frac{7}{2}$ , -1)  
 Directrix:  $x=\frac{1}{2}$

Calculator

**<Example-2>**

Alg Standard Real Deg

Edit Zoom Analysis

Change the form.

Calculator   
 Conics Graph

$$(y+1)^2=6 \cdot (x-2)$$

Then k=-1, h=2, p= $\frac{3}{2}$ .

Deg Real

### Parabola 5

Check out this fascinating example of light and parabolas. Then try to construct the television rays coming into your Satellite dish.

File Edit Insert Action

**Parabola 5 Reflective Property**

When the light source is at focus, the outgoing rays are parallel.

**Try to construct the outgoing rays!**

Parabola:  $x^2=4y$   
 Focus:  $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$

The light from the focus reflects at the point A.

Light from focus   
 Outgoing ray 1

Alg Standard Real Deg

File Edit View Draw

Parabola:  $x^2=4y$   
 Focus:  $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$

The light from the focus reflects at the point A.

Light from focus   
 Outgoing ray 1

Deg Real

File Edit View Draw

The light from the focus reflects at the point A.

Light from focus   
 Outgoing ray 1   
 Outgoing ray 2

Animation

Deg Real