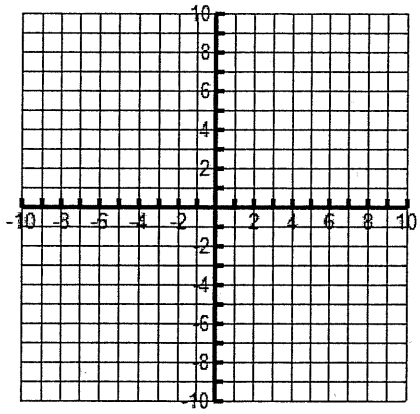
CCGPS Analytic Geometry – Parabola Notes Day 3

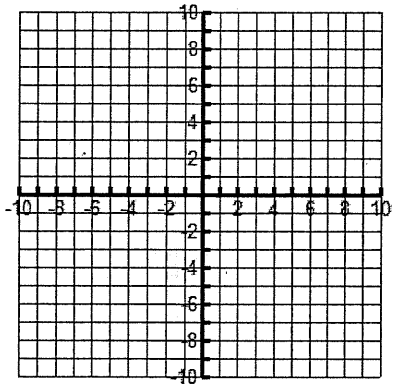
Equations for Parabolas: up/down parabolas: $(x-h)^2 = 4p(y-k)$ right/left parabolas: $(y-k)^2 = 4p(x-h)$

**Example 1: Find the equation of a parabola given the vertex at (3, 3) and a focus at (3, 0). Graph the information given:**



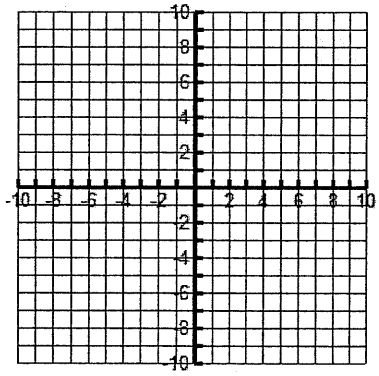
Since the parabola opens _____, the equation we need to use in standard form is:
Since the vertex is given we know *h* and *k* and can substitute *h* and *k* into the equation:
We can also find *p*.
The equation for the parabola is:
Graph the parabola and put in the directrix.

**Example 2: Find the equation for a parabola given a focus at (3 , 5) and a directrix at x = - 1. Graph the parabola.**

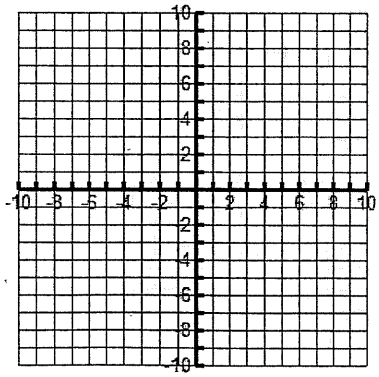


Since the parabola opens _____, the equation we need to use in standard form is:
We can use the information given to find *h* and *k* which is the _____ of the parabola.
Substitute *h* and *k* into the equation:
We can also find *p*. The equation for the parabola is:
Graph the parabola and put in the directrix.

**Example 3: Find the equation and graph the parabola that has a vertex at (- 4, - 2) and the directrix x = - 2.**



**Example 4: Find the equation of a parabola that opens left or right, has the vertex (4, 1) and contains the point (5, - 1).**

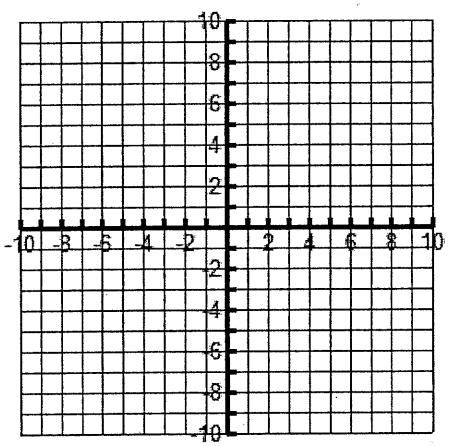


1) Write the standard form of a left/right opening parabola.
2) Substitute in the vertex (h, k).
3) Substitute in the given point for x and y. Now solve for p.
4) Go back to step #2 and write the standard form including the p value.

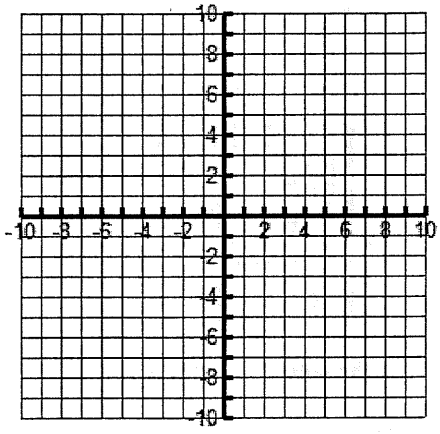
Equations for Parabolas: up/down parabolas: $(x-h)^2 = 4p(y-k)$ right/left parabolas: $(y-k)^2 = 4p(x-h)$

**Practice: Find the equation of the parabola with the given characteristics:**

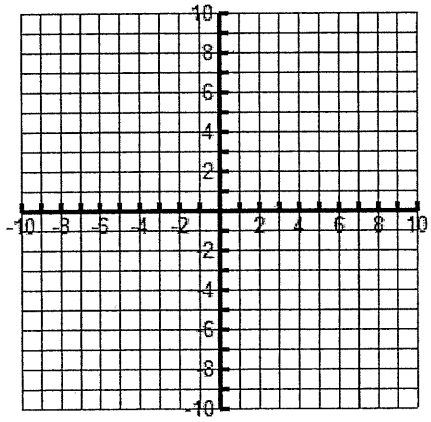
1. Vertex: (0, 6)
   Focus: ( - 3, 6)



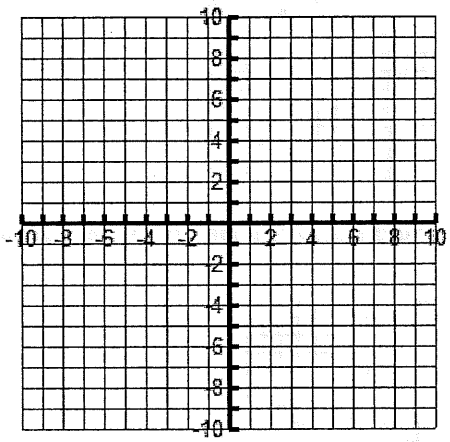
2. Directrix: y = - 4
   Focus: (0, 4)



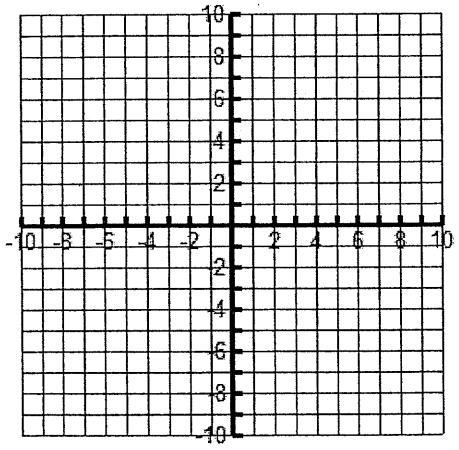
3. Opens left or right
   Vertex: (7, 6)
   Passes through: ( - 11, 9)



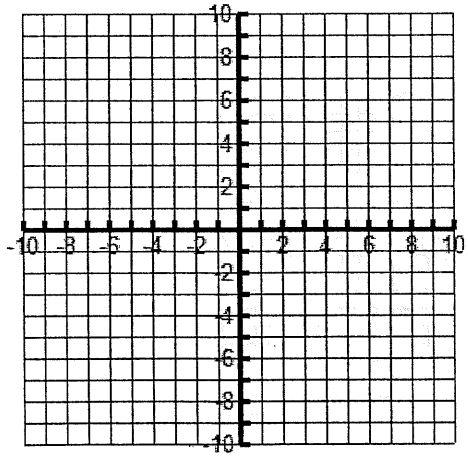
4. Vertex (8, - 1)
   y-intercept: - 17



5. Focus: (3, 0)
   Directrix: x = - 3



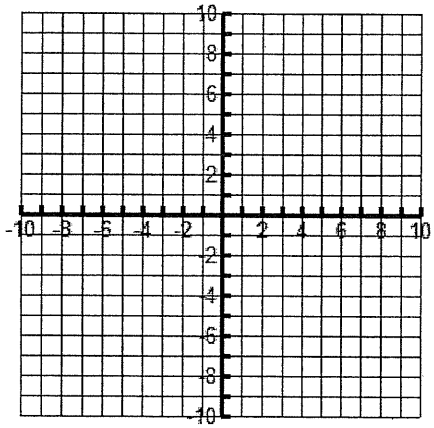
6. Vertex: (5, - 2)
   Directrix: y = - 5



**CCGPS Analytic Geometry** **Parabolas Day 3 - Homework**

**Write the standard form of the equation of each parabola. Sketch the graph and show the items in the list.**

1. The vertex is at (-5, 1), and the focus is at (-1, 1).



Equation: _____

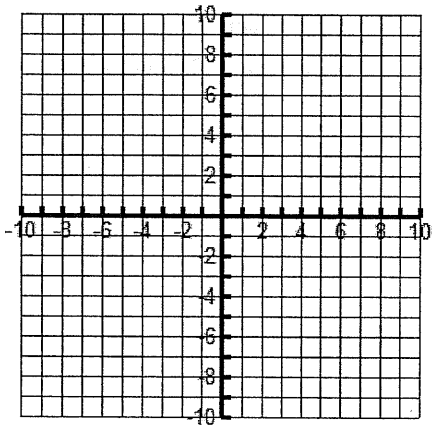
Axis of Symmetry: _____

Directrix: _____

Vertex: _____ Focus: _____

Focal width: _____ p = _____

2. The equation of the axis of symmetry is y = 2, the focus is at (0, 2), and p = -3.



Equation: _____

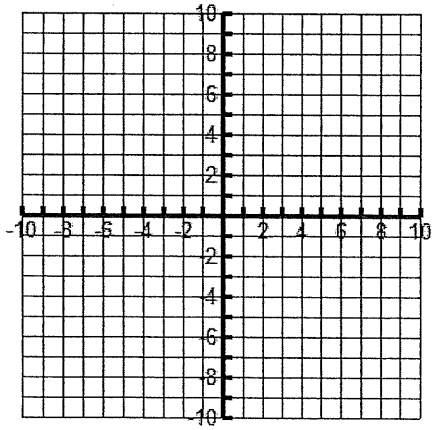
Axis of Symmetry: _____

Directrix: _____

Vertex: _____ Focus: _____

Focal width: _____ p = _____

3. The parabola passes through the point at (-3, 1), has its vertex at (-2, -3), and opens to the left.



Equation: _____

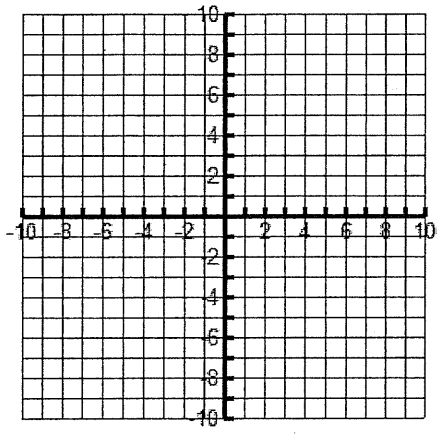
Axis of Symmetry: _____

Directrix: _____

Vertex: _____ Focus: _____

Focal width: _____ p = _____

4. The focus is at (3, 2), the distance from the focus to the vertex is 2 units, and the function has a minimum.



Equation: _____

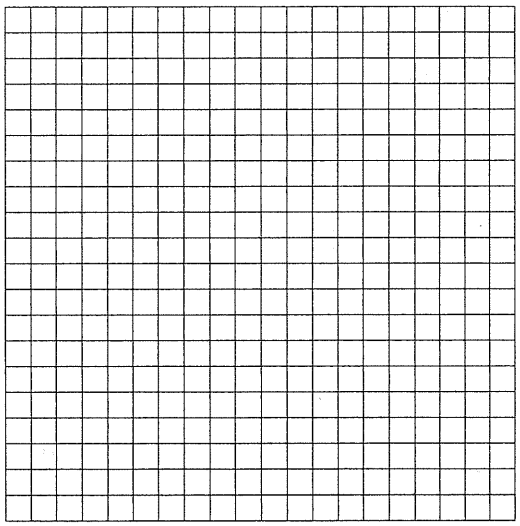
Axis of Symmetry: _____

Directrix: _____

Vertex: _____ Focus: _____

Focal width: _____ p = _____

5. The arch in Freedom Park has a parabolic shape. Its height is 25 feet and its base is 30 feet wide. Find an equation, which models this shape, using the *x*-axis to represent the ground. Hint: Use 1 square = 2 feet and put origin on lower left corner of graph.



Equation: _____

Axis of Symmetry: _____

Directrix: _____

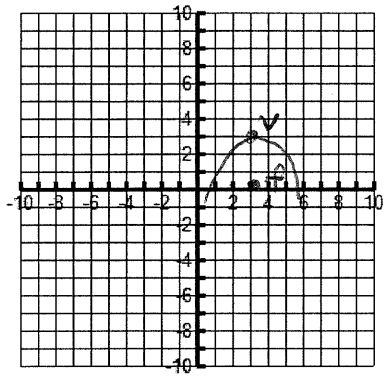
Vertex: _____ Focus: _____

Focal width: _____ p = _____

Key

CCGPS Analytic Geometry – Parabola Notes Day 3

**Example 1: Find the equation of a parabola given the vertex at (3, 3) and a focus at (3, 0). Graph the information given:**



Since the parabola opens down, the equation we need to use in standard form is: $y = -x^2$

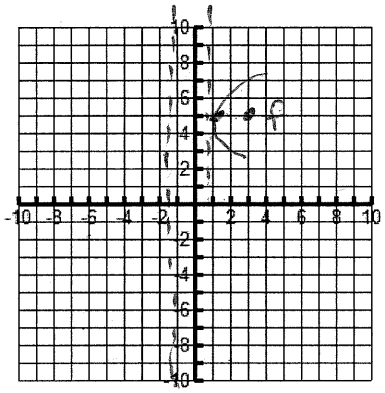
Since the vertex is given we know $h$ and $k$ and can substitute $h$ and $k$ into the equation: $(x-h)^2 = 4p(y-k)$

We can also find $p$. $p = -3$

The equation for the parabola is: $(x-h)^2 = -12(y-k)$

Graph the parabola and put in the directrix.

**Example 2: Find the equation for a parabola given a focus at (3 , 5) and a directrix at x = - 1. Graph the parabola.**



Since the parabola opens _____, the equation we need to use in standard form is: $p = 2$ $(y-k)^2 = 4p(x-h)$

We can use the information given to find $h$ and $k$ which is the (1, 5) of the parabola. $(y-5)^2 = 8(x-1)$

Substitute $h$ and $k$ into the equation:

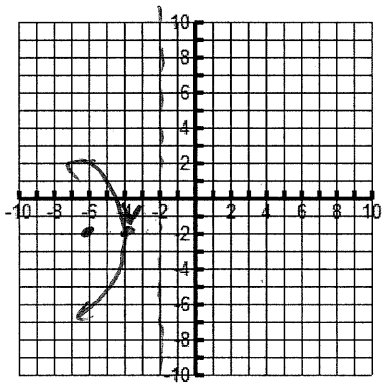
We can also find $p$.

The equation for the parabola is:

Graph the parabola and put in the directrix.

$x = y^2$

**Example 3: Find the equation and graph the parabola that has a vertex at (- 4, - 2) and the directrix x = - 2.**

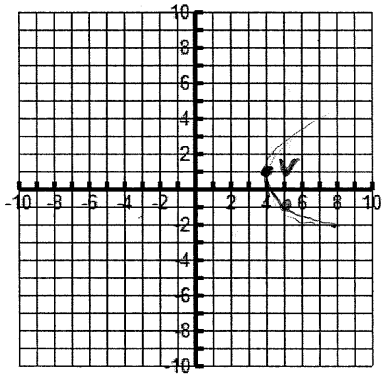


$p = -2$ $(y-k)^2 = 4p(x-h)$

$(y+2)^2 = -8(x+4)$

h k x y

**Example 4: Find the equation of a parabola that opens left or right, has the vertex (4, 1) and contains the point (5, - 1).**



1) Write the standard form of a left/right opening parabola. $(y-k)^2 = 4p(x-h)$ $(-1-1)^2 = 4p(5-4)$

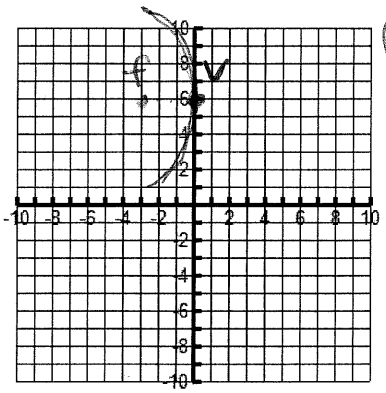
2) Substitute in the vertex (h, k). $4 = 4p$ $p = 1$

3) Substitute in the given point for x and y. Now solve for p. $(y-1)^2 = 4(x-4)$

4) Go back to step #2 and write the standard form including the p value.

**Practice: Find the equation of the parabola with the given characteristics:**

1. Vertex: (0, 6)
   Focus: ( - 3, 6)



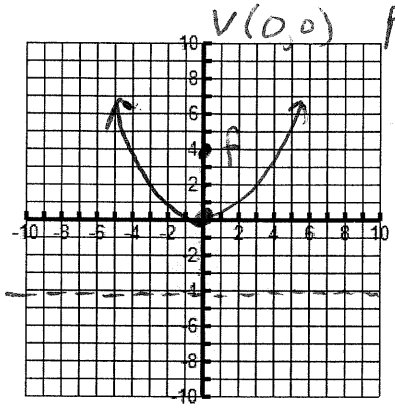

$p = -3$

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

$(y-6)^2 = -12(x-0)$

2. Directrix: y = - 4
   Focus: (0, 4)

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

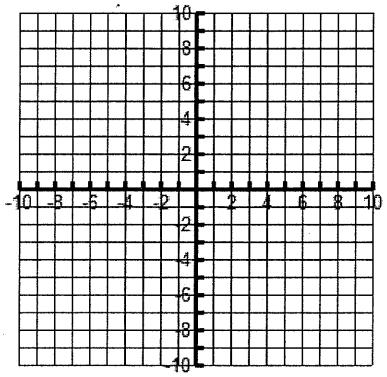



$p = 4$

$(x-0)^2 = 16(y-0)$

3. Opens left or right
   Vertex: (7, 6)
   Passes through: ( - 11, 9)

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



4. Vertex (8, - 1)
   y-intercept: - 17

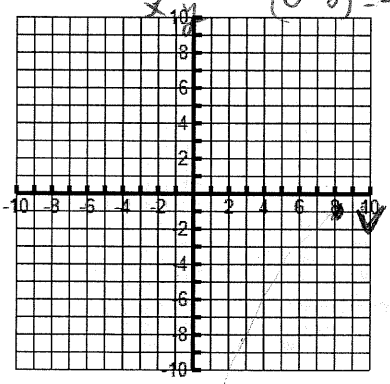
opens down

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

$(0-8)^2 = 4p(-17+1)$

$64 = 4p(-16)$

$-1 = p$



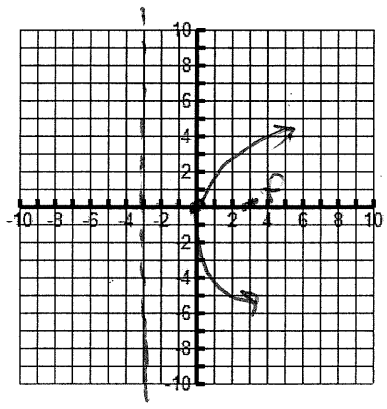

5. Focus: (3, 0)
   Directrix: x = - 3

vertex (0, 0)

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

$p = 3$

$(y-0)^2 = 12(x-0)$

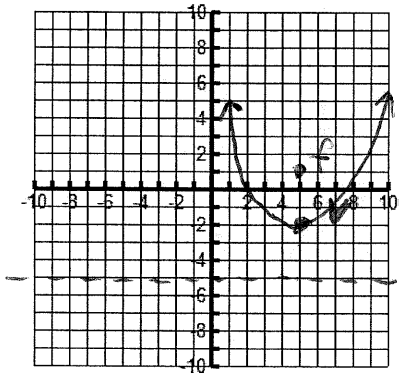



6. Vertex: (5, - 2)
   Directrix: y = - 5

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

$(x-5)^2 = 12(y+2)$

$p = 3$

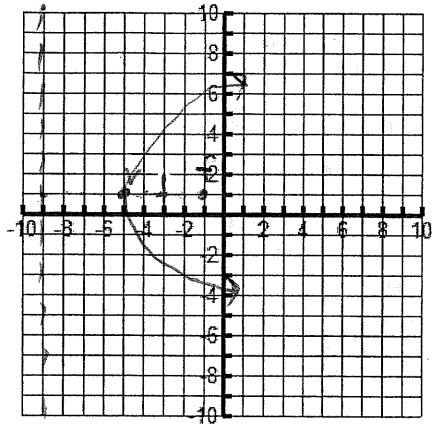


CGPS Analytic Geometry  Parabolas Day 3 - Homework

**Write the standard form of the equation of each parabola. Sketch the graph and show the items in the list.**

1. The vertex is at (-5, 1), and the focus is at (-1, 1).

h k  p = 4



Equation: $(y-1)^2 = 16(x+5)$

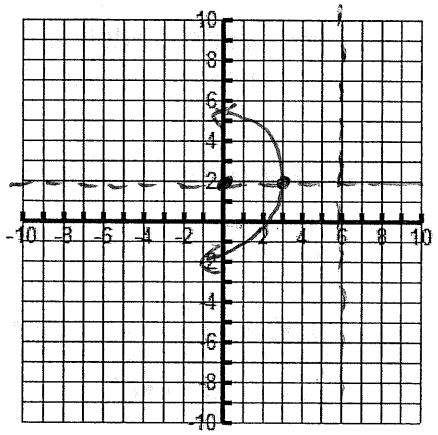
Axis of Symmetry: $y = 1$

Directrix: $x = -9$

Vertex: $(-5, 1)$  Focus: $(-1, 1)$

Focal width: 16  p = 4

2. The equation of the axis of symmetry is y = 2, the focus is at (0, 2), and p = -3.



Equation: $(y-2)^2 = 12(x-3)$

Axis of Symmetry: $y = 2$

Directrix: $x = 6$

Vertex: $(3, 2)$  Focus: $(0, 2)$

Focal width: 12  p = -3

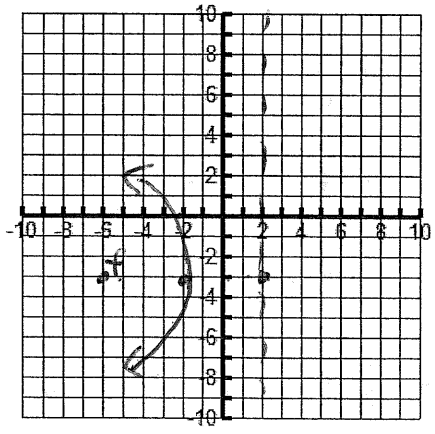
$4p = 12$

x y  h k

3. The parabola passes through the point at (-3, 1), has its vertex at (-2, -3), and opens to the left.

$(y-k)^2 = 4p(x-h)$  $4^2 = 4p(-1)$

$(1+3)^2 = 4p(-3+2)$  $16 = -4p$  $p = -4$



Equation: $(y+3)^2 = -16(x+2)$

Axis of Symmetry: $y = -3$

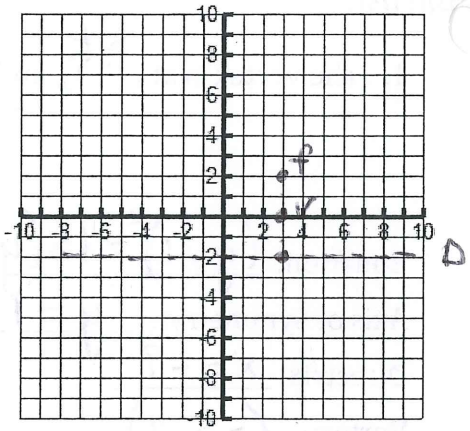
Directrix: $x = 2$

Vertex: $(-2, -3)$  Focus: $(-6, -3)$

Focal width: 16  p = -4

$4p$

4. The focus is at (3, 2), the distance from the focus to the vertex is 2 units, and the function has a minimum. opens up


Equation: $(x-3)^2 = 8(y-0)$

Axis of Symmetry: $x=3$

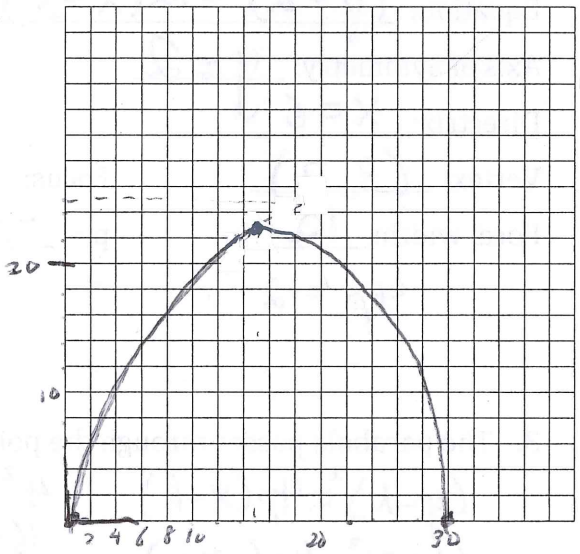
Directrix: $y=-2$

Vertex: $(3,0)$ Focus: $(3,2)$

Focal width: $8$ $p = 2$

$4p = 8$

5. The arch in Freedom Park has a parabolic shape. Its height is 25 feet and its base is 30 feet wide. Find an equation, which models this shape, using the *x*-axis to represent the ground. Hint: Use 1 square = 2 feet and put origin on lower left corner of graph.




Equation: $(x-15)^2 = -\frac{15}{2}(y-30)$

Axis of Symmetry: $x=+15$

Directrix: $y = 25 + 15/8$

Vertex: $(15, 30)$ Focus: $(15, 25-15/8)$

Focal width: _____ $p = -15/8$

point $(0,0)$ $x, y$

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

$(0-15)^2 = 4p(0-30)$

$-\frac{15}{2} = 4p$

$-\frac{15}{8} = p$