Warmup

Evaluate each expression if x = -3 and y = 4.

1. $2x - 5y$ -26

2. $-x^2y$ -36

3. $|x - y|$ 7

4. $(x - 2)(y + 1)$ -25

5. $\dfrac{3x + 1}{y}$ -2

6. $|xy|$ 12

7. $x + 3y$ 9

8. $\dfrac{x - y}{x + y}$ -7

Chapter 2
Quadratic Functions

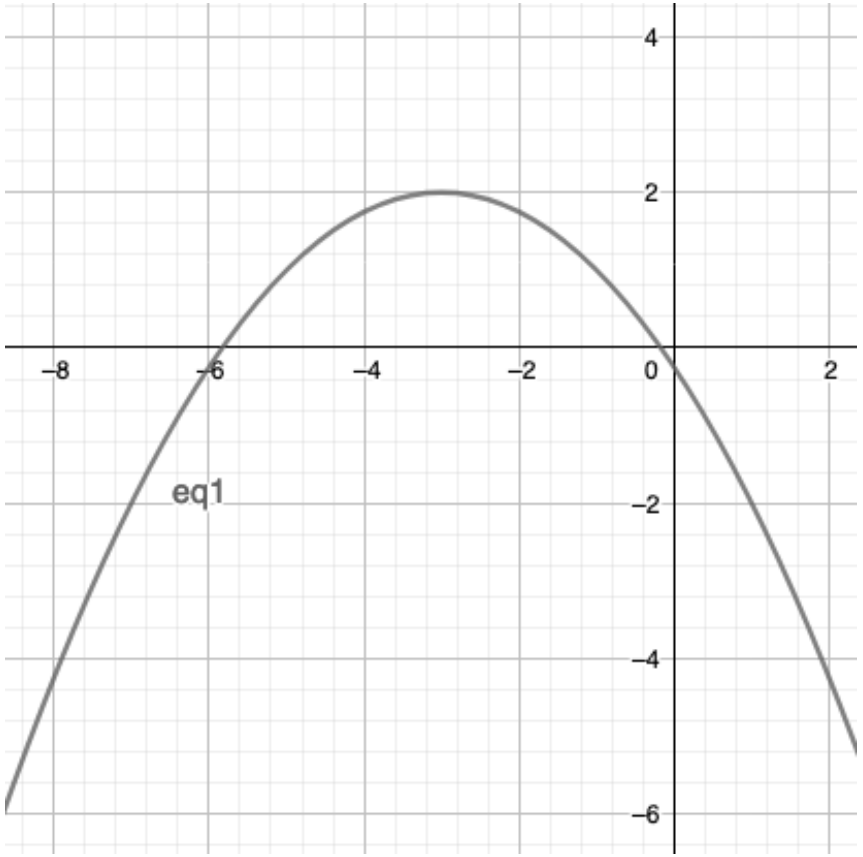
1. **Transformations of Quadratic Functions**
2. Characteristics of Quadratic Functions
3. Focus of a Parabola
4. Modeling with Quadratic Functions

2.1 - Transformations of Quadratic Functions

Determine transformations

$$y - 2 = -\frac{1}{4}(x+3)^2$$

1) Left 3
2) Vertical Shrink 1/4
3) Reflect x-axis
4) Up 2



2.1 - Transformations of Quadratic Functions

Order of transformations

$$y = -2\,(\,-3(x+1)\,)^2 + 4$$

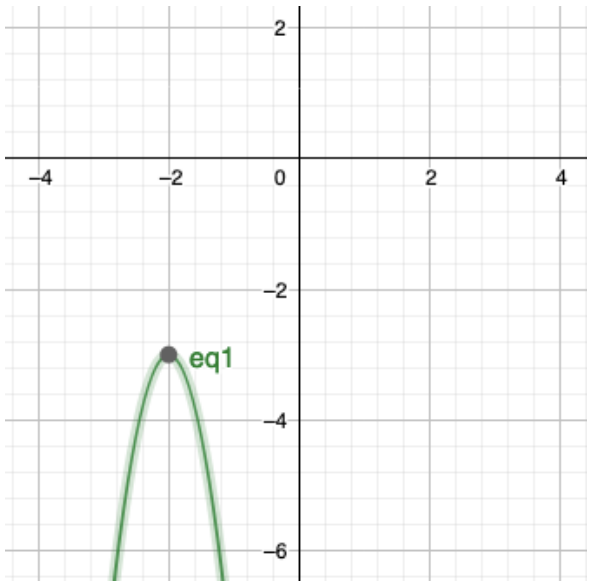
1) Horizontal stretch/shrink $f(Ax)$
2) Horizontal reflection $f(-x)$
3) Horizontal translation $f(x+B)$
4) Vertical stretch/shrink $Af(x)$
5) Vertical reflection $-f(x)$
6) Vertical translation $f(x)+B$

2.1 - Transformations of Quadratic Functions

Determine transformations

$$y + 3 = -5(x + 2)^2$$

1) Left 2
2) Vertical stretch by 5
3) Reflect x-axis
4) Down 3



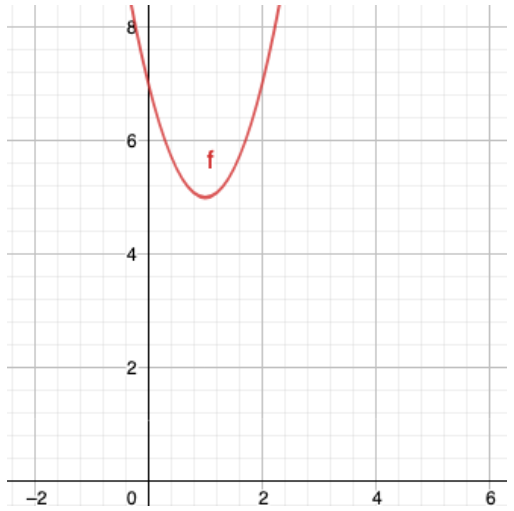
$$y = 2x^2 - 4x + 7$$

$$y - 7 = 2(x^2 - 2x)$$

$$y - 7 + 2 = 2(x^2 - 2x + 1)$$

$$y - 5 = 2(x - 1)^2$$

1) Right 1
2) Vertical stretch by 2
3) Up 5



2.1 - Transformations of Quadratic Functions

Determine transformations (harder!)

$$y-2=-5(-x+3)^2$$

$$y-2=-5(-(x-3))^2$$

$$y-2=-5(x-3)^2$$

1) Right 3
2) Vertical Stretch 5
3) Reflect x-axis
4) Up 2

$$y+3=-5(-2x+2)^2$$

$$y+3=-5(-2(x-1))^2$$

$$y+3=-20(x-1)^2$$

1) Right 1
2) Vertical Stretch 20
3) Reflect x-axis
4) Down 3

2.1 - Transformations of Quadratic Functions

Practice - Identify graphs with functions

a. $g(x) = -(x-2)^2$ D

b. $g(x) = (x-2)^2 + 2$ C

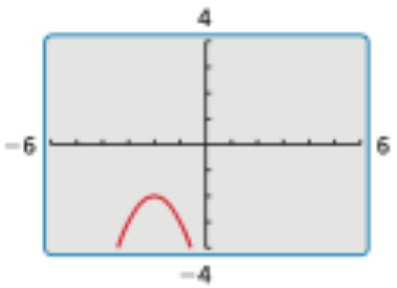
c. $g(x) = -(x+2)^2 - 2$ A

d. $g(x) = 0.5(x-2)^2 - 2$ F

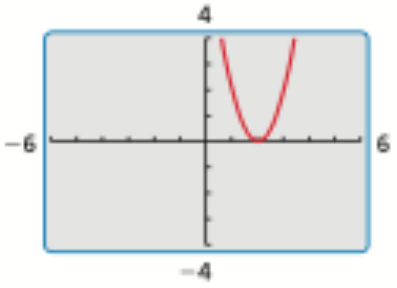
e. $g(x) = 2(x-2)^2$ B

f. $g(x) = -(x+2)^2 + 2$ E

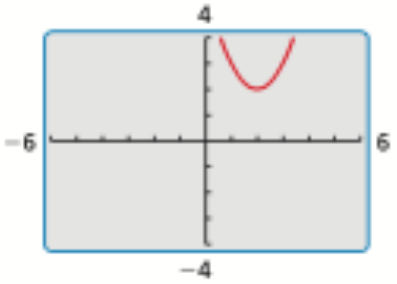
A.



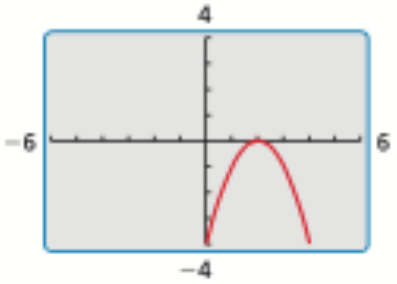
B.



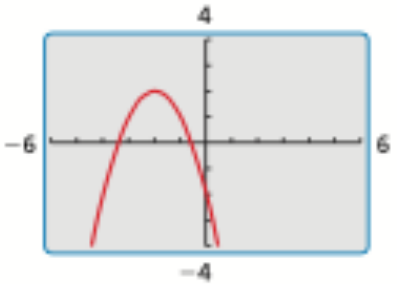
C.



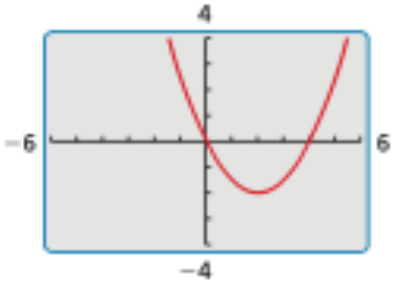
D.



E.



F.

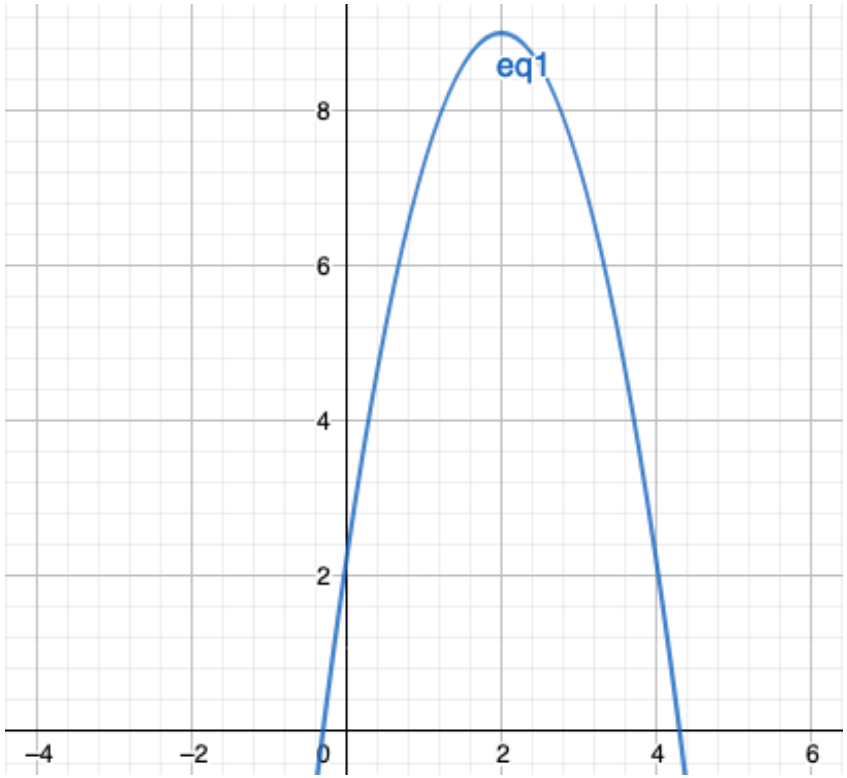


2.1 - Transformations of Quadratic Functions

Determine the quadratic equation

1) Right 2
2) Vertical stretch by 1.7
3) Reflect x-axis
4) Up 9

$$y - 9 = -1.7(x - 2)^2$$



2.1 - Transformations of Quadratic Functions

Practice - Determine equation

1) Right 3
2) Vertical stretch by 3
3) Down 5

$$y + 5 = 3(x - 3)^2$$

1) Horizontal stretch by 2
2) Right 1
3) Reflect x-axis
4) Up 2

$$y - 2 = -\left(\frac{1}{2}(x - 1)\right)^2$$

2.2 - Characteristics of Quadratic Functions

Axis of Symmetry - A line that divides a parabola into mirror images and passes through the vertex. The axis of symmetry is the vertical line $x = h$.

Vertex form $f(x) = a(x - h)^2 + k$

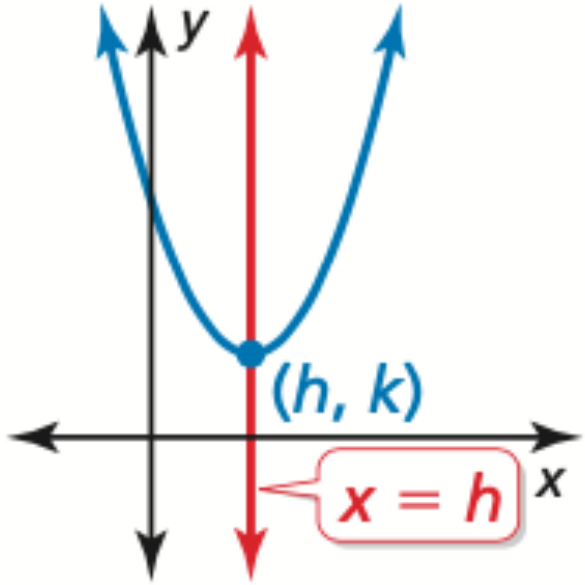
AOS: $x = h$

or

Standard form $f(x) = ax^2 + bx + c$

AOS:

$$x = -\frac{b}{2a}$$



2.2 - Characteristics of Quadratic Functions

Find Vertex and Axis of Symmetry (AOS)

$y = 2x^2 - 3x + 1$

$V : \left(\frac{3}{4}, -\frac{1}{8}\right)$

$AOS : x = \frac{3}{4}$

$y - 9 = -1.7(x - 2)^2$

$V : (2,9)$

$AOS : x = 2$

2.2 - Characteristics of Quadratic Functions

Practice - Find Vertex and Axis of Symmetry (AOS)

$y = x^2 - 2x + 3$

$V : (1,2)$

$AOS : x = 1$

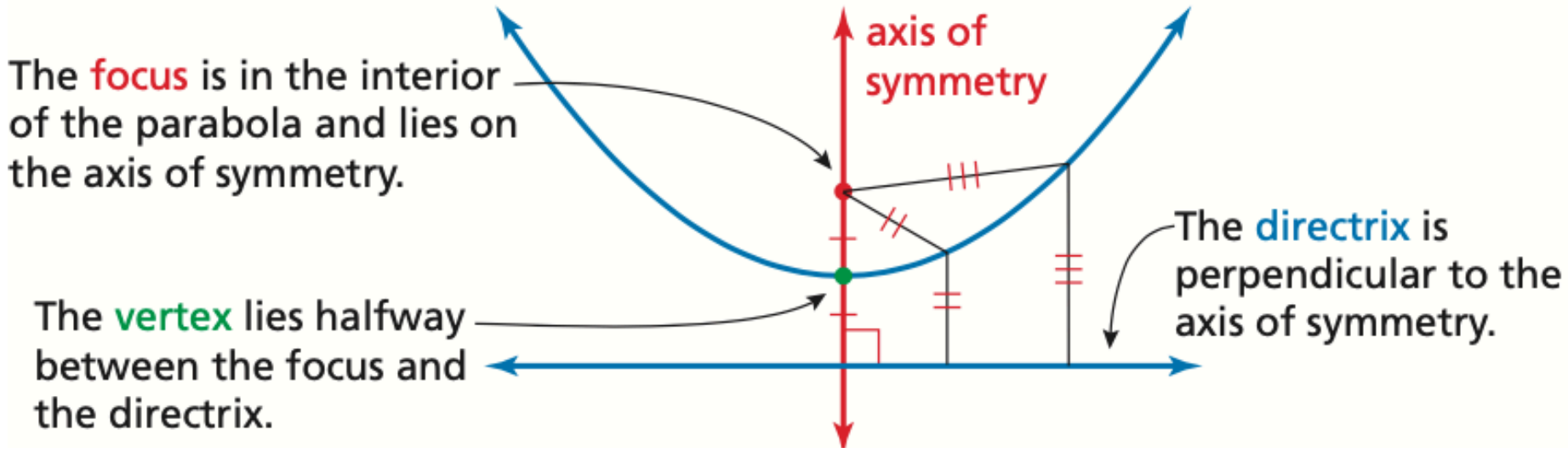
$y = -2x^2 - 4x + 7$

$V : (-1,9)$

$AOS : x = -1$

2.3 - Focus of a Parabola

A parabola can be defined as the set of all points in a plane equidistant from a fixed point called the **focus** and a fixed line called the **directrix**.



2.3 - Focus of a Parabola

Deriving the equation for the parabola.

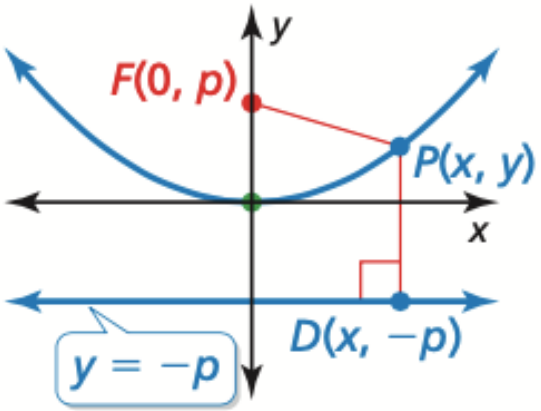
$$\sqrt{(x-x)^2+(y-(-p))^2}=\sqrt{(x-0)^2+(y-p)^2}$$

$$(y+p)^2=x^2+(y-p)^2$$

$$y^2+2py+p^2=x^2+y^2-2py+p^2$$

$$4py=x^2$$

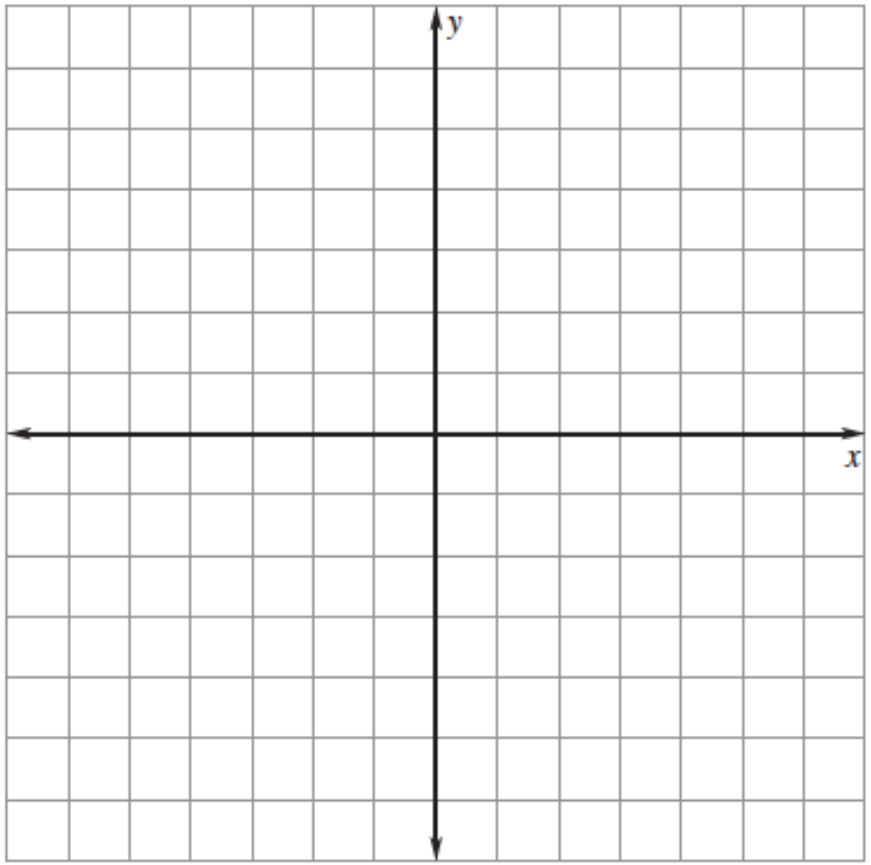
$$y=\frac{1}{4p}x^2$$



2.3 - Focus of a Parabola

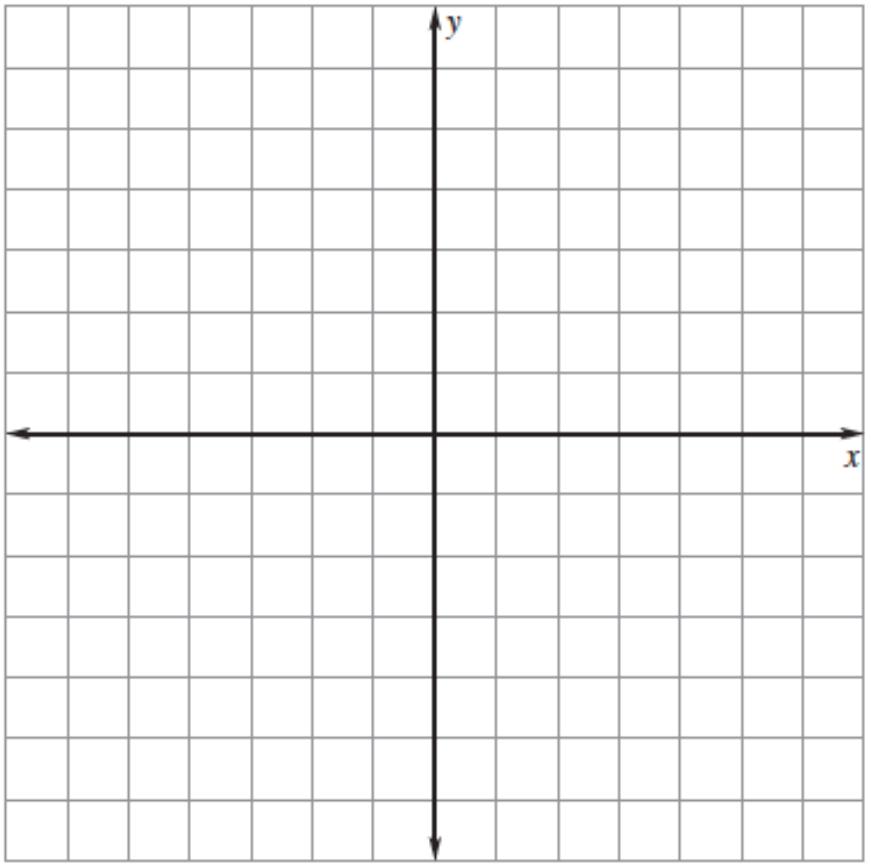
$V : (2,0)$ $F : (2,4)$

What is the directrix? D: y = -4



$V : (2,0)$ $D : x = -1$

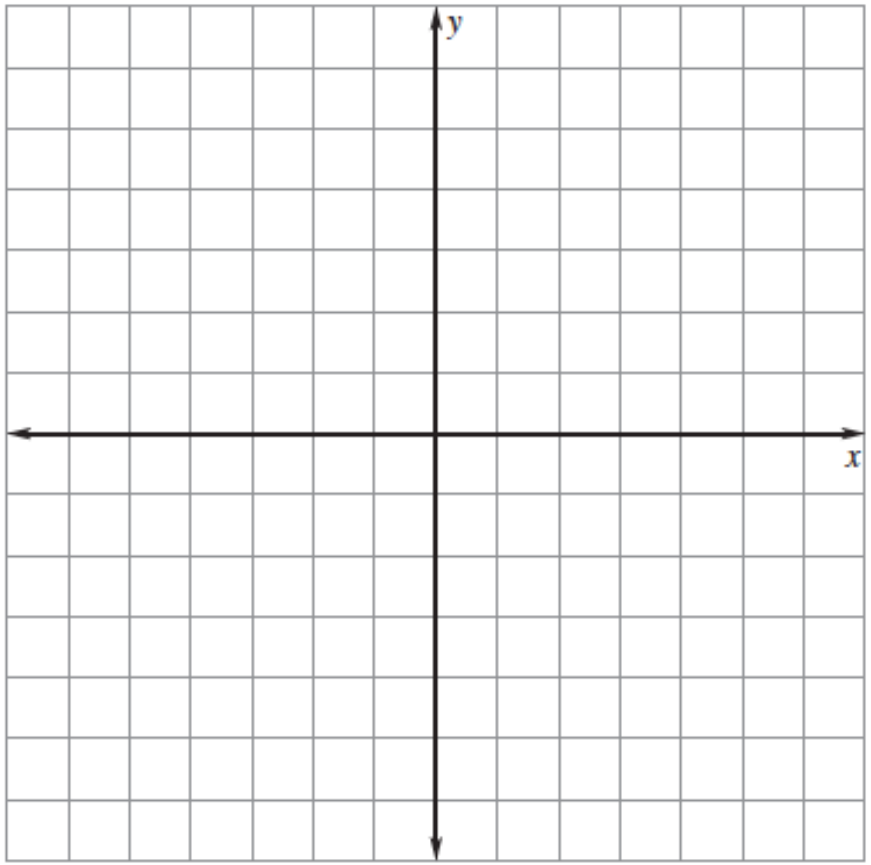
What is the focus? F: (5, 0)



2.3 - Focus of a Parabola

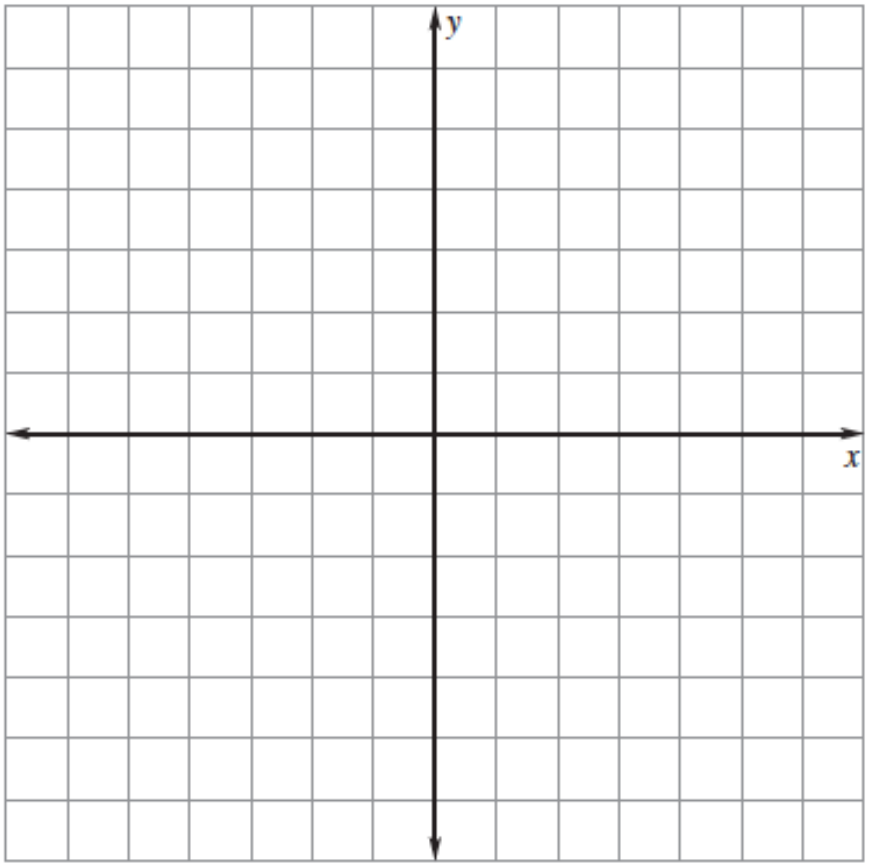
$V : (0,0)\ \ F : (-3,0)$

Directrix? D: x = 3



$V : (0,0) \quad D : x = -2$

What is focus? F: (2, 0)

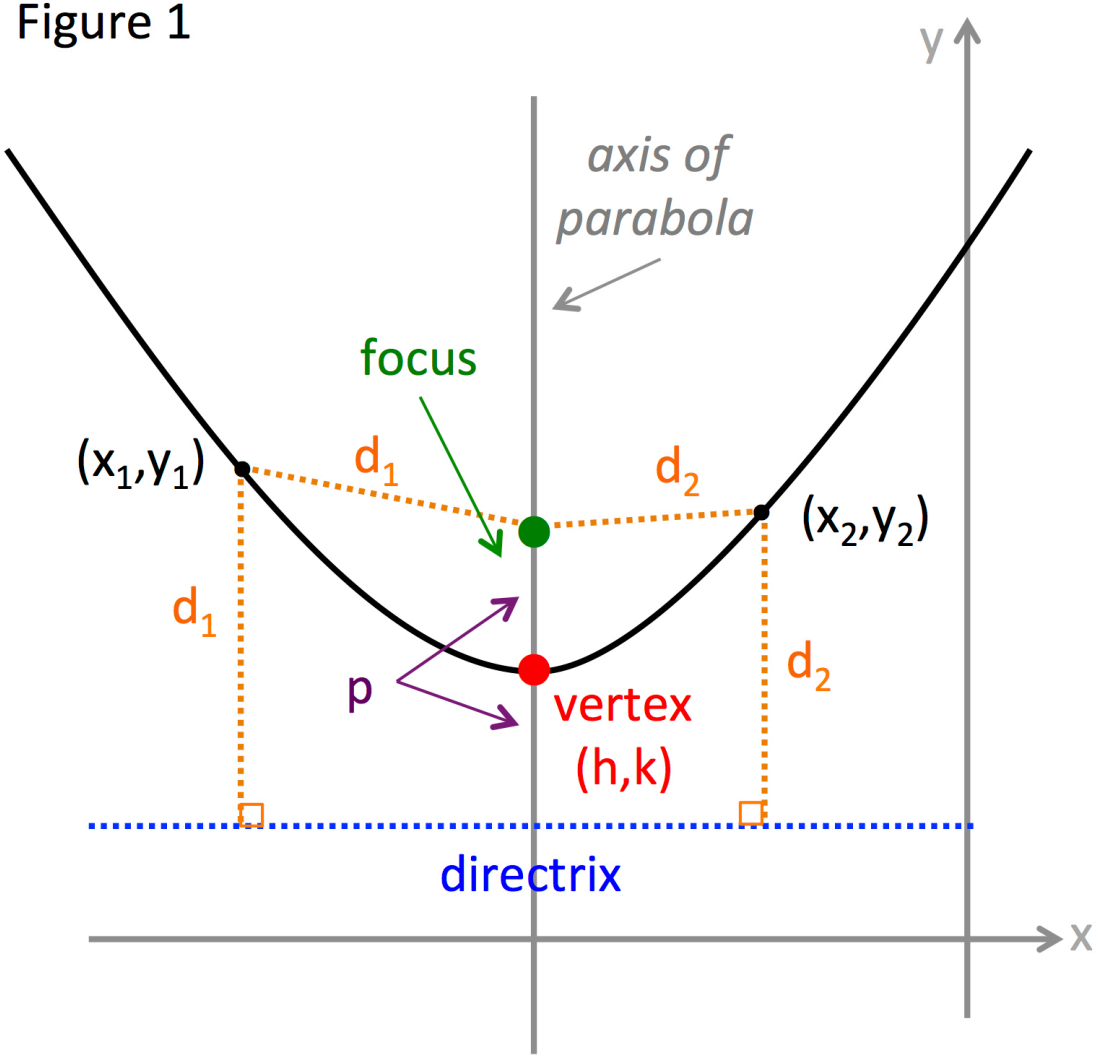


2.3 - Focus of a Parabola

General equation of a parabola

$$y - k = \frac{1}{4p}(x - h)^2$$

Figure 1

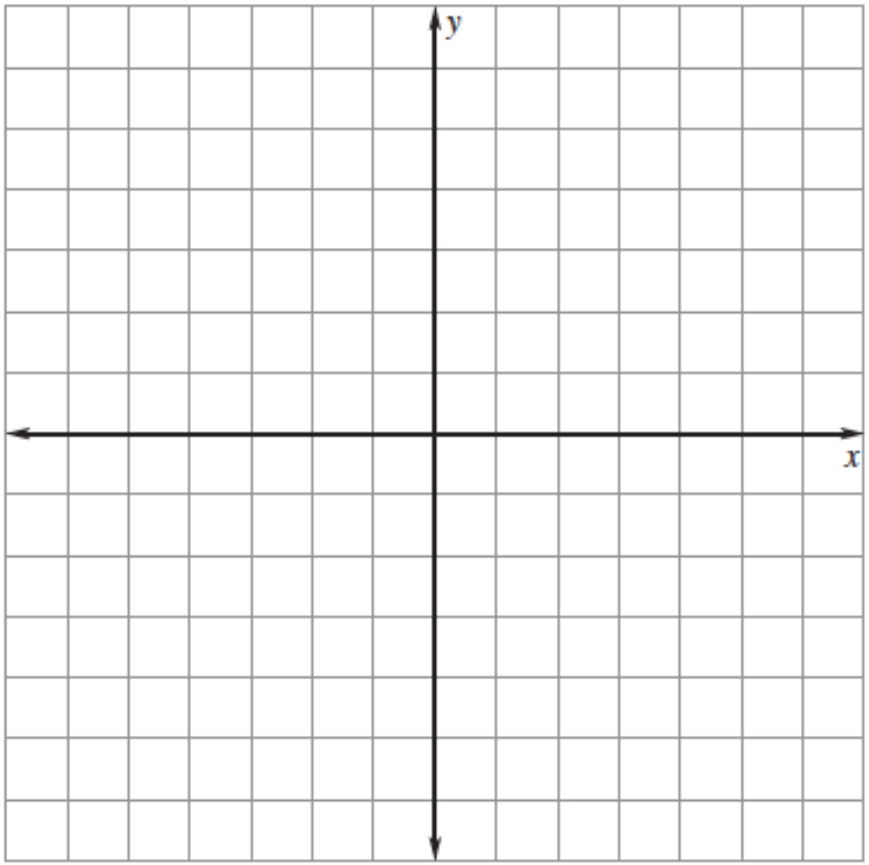


2.3 - Focus of a Parabola

Find equation of the parabola

$$y-k=\frac{1}{4p}(x-h)^2$$

$F:(0,2)\quad D:y=6$

$$y-4=-\frac{1}{4(2)}(x-0)^2$$

$$y-4=-\frac{1}{8}x^2$$