

Functions and Applications

Chapter 4: Working with Quadratic Models - Standard and Vertex Forms

4.1 The Vertex Form of a Quadratic Equation

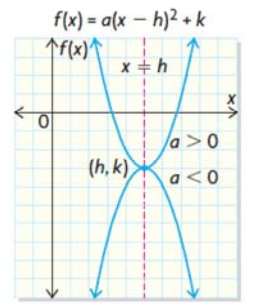
Functions and Applications

Chapter 4: Working with Quadratic Models - Standard and Vertex Forms

4.1 The Vertex Form of a Quadratic Equation

Learning Goals:

- A quadratic function in vertex form, $f(x) = a(x - h)^2 + k$, can be expressed in standard form, $f(x) = ax^2 + bx + c$, by expanding and simplifying. The two forms are equivalent.
- If a quadratic function is expressed in vertex form, $f(x) = a(x - h)^2 + k$, then
 - the vertex is located at (h, k)
 - the equation of the axis of symmetry is $x = h$
 - the function has a maximum value of k when $a < 0$
 - the function has a minimum value of k when $a > 0$

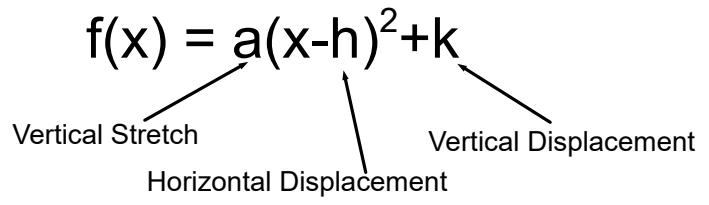


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4.1 The Vertex Form of a Quadratic Equation

Vertex Form:

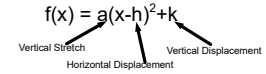


Vertex = V(h,k)

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4.1 The Vertex Form of a Quadratic Equation



The most useful form of writing quadratics

1. Gives axis, and max / min easily
2. Can still be used to easily find zeros (substitute $y = 0$)
3. Can still be used to easily find y-intercept (substitute $x = 0$)

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4.1 The Vertex Form of a Quadratic Equation

Example:

Given: $f(x) = -3(x-4)^2+5$

Determine:

- a. Direction of opening
- b. Vertical Stretch
- c. Axis of Symmetry
- d. Max / Min
- e. zeros ($y = 0$)
- f. Vertex
- g. y - intercept ($x = 0$)
- h. Domain and Range

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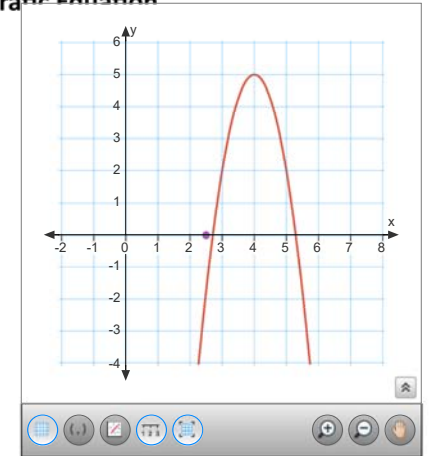
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4.1 The Vertex Form of a Quadratic Equation

Example: $f(x) = -3(x-4)^2+5$

Direction of opening:

$$y = -3(x-4)^2 + 5$$



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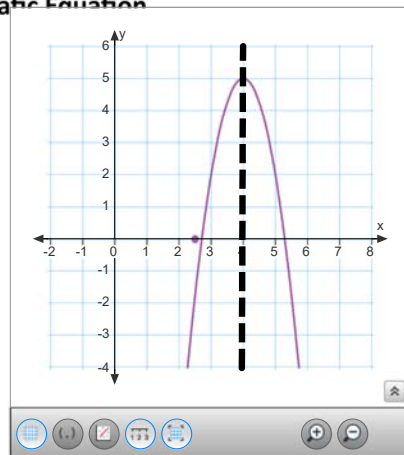
4.1 The Vertex Form of a Quadratic Equation

Example: $f(x) = -3(x-4)^2+5$

Axis of Symmetry:

Axis = -4

$$y = -3(x-4)^2 + 5$$



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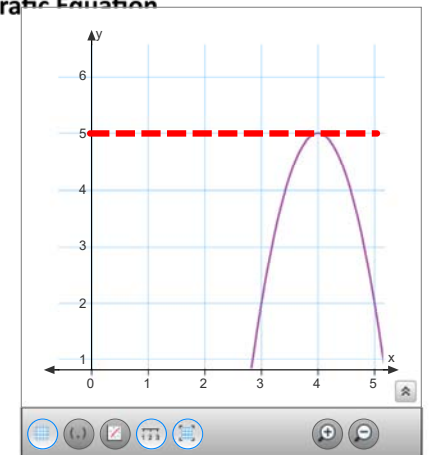
Example: $f(x) = -3(x-4)^2+5$

Max / Min:

Maximum: $y = 5$

(because $f(x)$ opens down)

$$y = -3(x-4)^2 + 5$$



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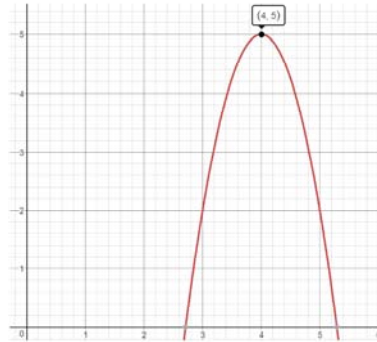
4.1 The Vertex Form of a Quadratic Equation

Example: $f(x) = -3(x-4)^2+5$

Vertex:

Vertex = (h, k)

Vertex = V(4, 5)



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4.1 The Vertex Form of a Quadratic Equation

Example: $f(x) = -3(x-4)^2+5$

y - intercept (x = 0)

$$y = -3(0-4)^2 + 5$$

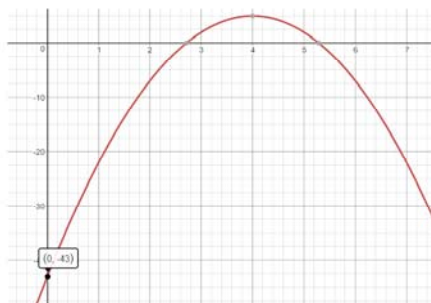
$$y = -3(-4)^2 + 5$$

$$y = -3(16) + 5$$

$$y = -48 + 5$$

$$y = -43$$

y-intercept = (0, -43)



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4.1 The Vertex Form of a Quadratic Equation

Example: $f(x) = -3(x-4)^2+5$

Zeroes: (y = 0)

$$0 = -3(x-4)^2 + 5$$

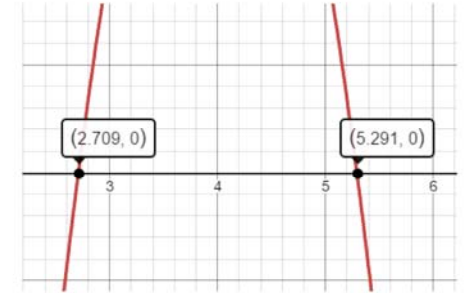
$$-5 = -3(x-4)^2$$

$$\frac{-5}{-3} = (x-4)^2$$

$$\frac{5}{3} = (x-4)^2$$

$$\pm\sqrt{\frac{5}{3}} = x-4$$

$$4 \pm \sqrt{\frac{5}{3}} = x$$



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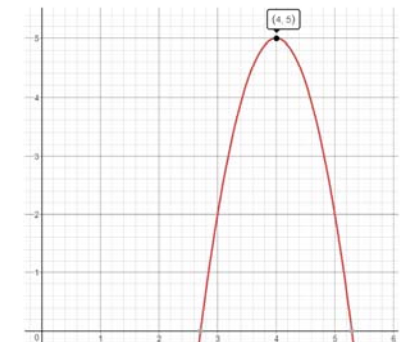
Domain and Range:

Domain:

$$D: \{x \in R\}$$

Range:

$$R: \{y \in R \mid y \leq 5\}$$





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4.1 The Vertex Form of a Quadratic Equation

Example:

Given: $f(x) = 2(x+4)^2 - 6$

Determine:

- | | |
|-------------------------|------------------------------|
| a. Direction of opening | e. zeros ($y = 0$) |
| b. Vertical Stretch | f. Vertex |
| c. Axis of Symmetry | g. y - intercept ($x = 0$) |
| d. Max / Min | h. Domain and Range |



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4.1 The Vertex Form of a Quadratic Equation

Example:

Given: $f(x) = 2(x+4)^2 - 6$

Determine:

- | | |
|-------------------------|----------------|
| a. Direction of opening | UP |
| b. Vertical Stretch | V.S. = 2 |
| c. Axis of Symmetry | Axis: $x = -4$ |
| d. Max / Min | Min: $y = -6$ |



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4.1 The Vertex Form of a Quadratic Equation

Example:

Given: $f(x) = 2(x+4)^2 - 6$

Determine:

- | | |
|------------------------------|---|
| e. zeros ($y = 0$) | $x = -4 \pm \sqrt{3}$ |
| f. Vertex | Vertex: $V(-4, -6)$ |
| g. y - intercept ($x = 0$) | $x = 0, y = 26$ $(0, 26)$ |
| h. Domain and Range | $D: \{x \in R\}$
$R: \{y \in R \mid y \geq -6\}$ |



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4.1 The Vertex Form of a Quadratic Equation

Homework:

Page 203 - Questions 4, 5a,c,e,8,9,10,12