TOPIC: QUADRATIC FUNCTIONS

Properties of a Parabola

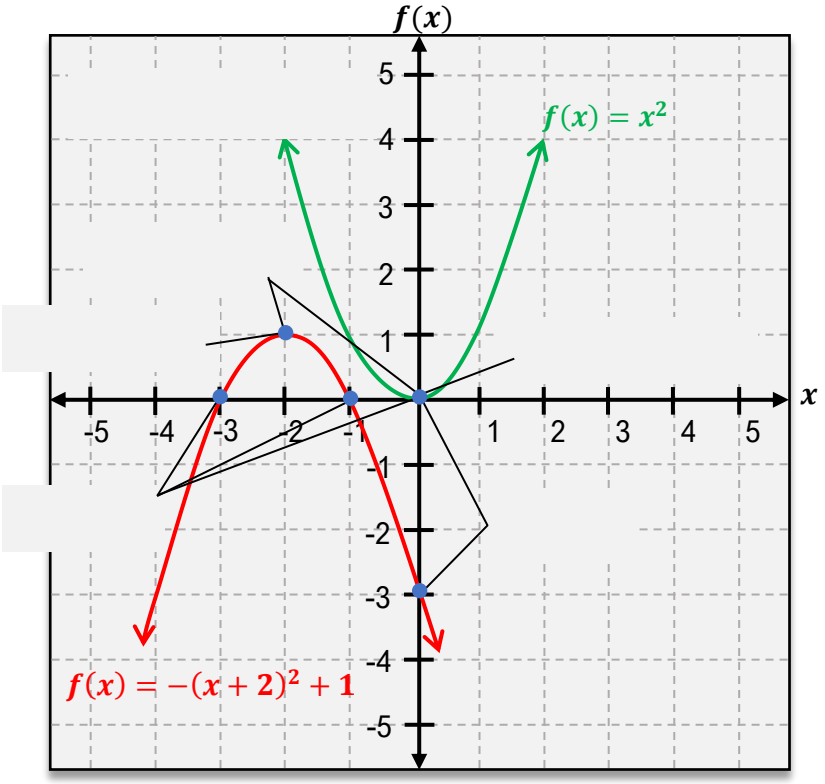
- A **quadratic function** is a polynomial of degree ___ in the **standard form**: $f(x) = ax^2 + bx + c$

$f(x) = x^2$	$f(x) = 2x^2 + 3x - 7$	$f(x) = \frac{2}{3}x^2 + 1$

  - $\boldsymbol{a}, \boldsymbol{b}, \boldsymbol{c}$ can be any real number as long as $a \neq$____.
  - Recall: The square function is a _____, as ***all*** quadratic functions will be.

$f(x) = x^2$
Vertex: _____ [MIN|MAX]
x-intercept(s): _____
y-intercept: _____
Axis of Symmetry: _____
Domain: *always* _____
Range when [MIN], _____: _____

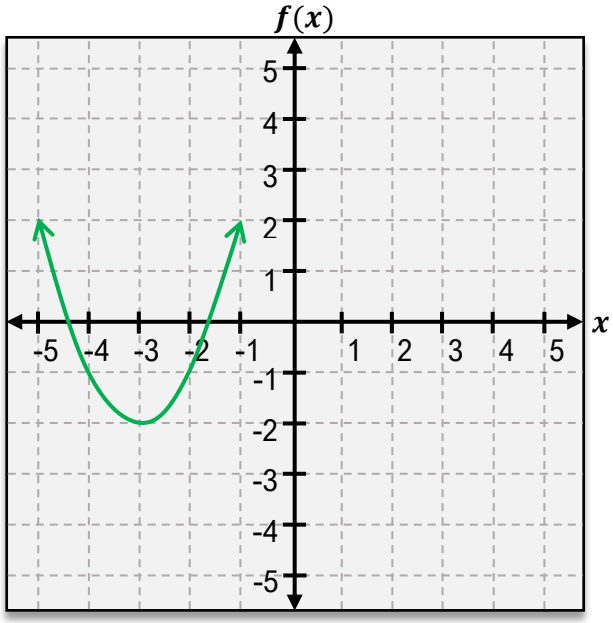
$f(x) = -(x+2)^2 + 1$
Vertex: _____ [MIN|MAX]
x-intercept(s): _____
y-intercept: _____
Axis of Symmetry: _____
Domain: _____
Range when [MAX], _____: _____
Increasing? _____
Decreasing? _____



- Quadratic functions are commonly written in **vertex form**, which will help us graph with ease.

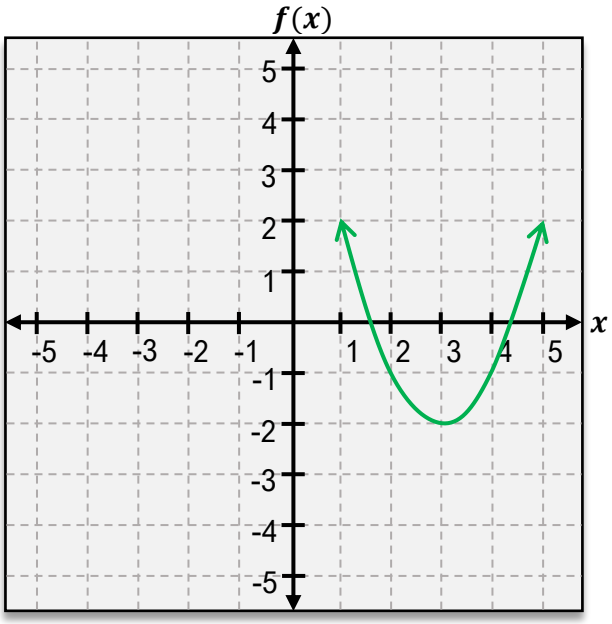
TOPIC: QUADRATIC FUNCTIONS

PRACTICE: Identify the ordered pair of the vertex of the parabola. State whether it is a minimum or maximum.



Vertex: _____ [MIN|MAX]

PRACTICE: Where is the axis of symmetry located on the given parabola?



Axis of Symmetry: _____

TOPIC: QUADRATIC FUNCTIONS

Vertex Form & Transformations

- Vertex form of a quadratic function is based on **transforming** the square function, $f(x) = x^2$.

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

sign — value

$+a$ opens _____

$-a$ opens _____

$|a| > 1$ vertical _____

$|a| < 1$ vertical _____

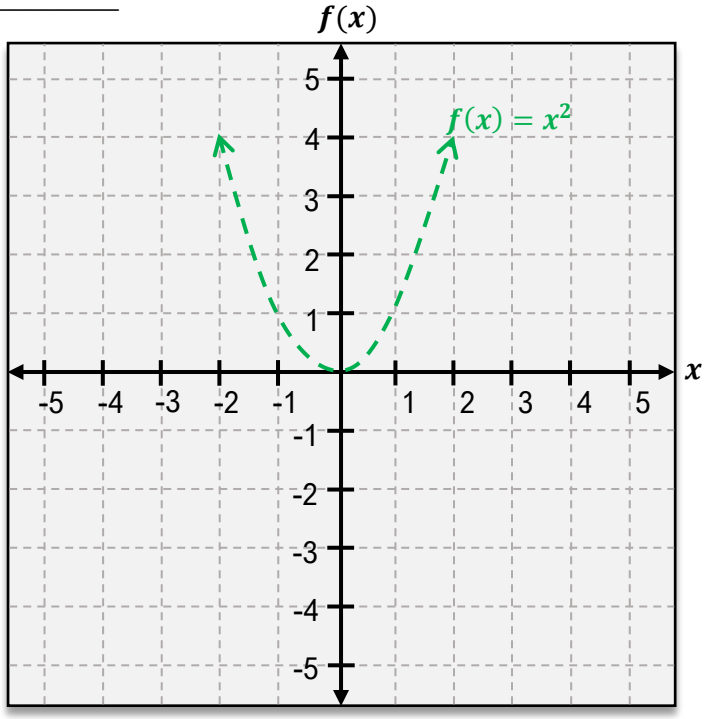
_____ shift by ___ units

_____ shift by ___ units

$f(x) = (x-1)^2 - 4$	
TO GRAPH	**1)** Vertex (_____): _____ [MIN|MAX]
	2) Axis of Symmetry ($x =$ __): _____
	3) x-int(s)→ Solve $f(x) = 0$: _____
	4) y-int→ Compute $f(0)$: _____
	5) _____ & connect with _____

3) $(x-1)^2 - 4 = 0$

4) $f(0) = (0-1)^2 - 4$



Recall:

	FACTORING	SQ. ROOT PROPERTY	COMPLETE THE SQUARE	QUADRATIC FORMULA
USE IF	• Has obvious factors **OR** • $c = 0$	• $(x + \#)^2 = [\text{constant}]$ **OR** • $b = 0$	• Leading coeff. is 1 **AND** • b is even	• Can't easily factor • Unsure what method to use

TOPIC: QUADRATIC FUNCTIONS

EXAMPLE: Graph the given quadratic function. Identify the vertex, axis of symmetry, intercepts, domain, range, and intervals for which the function is increasing or decreasing.

$$f(x) = -\frac{1}{2}(x+1)^2 + 2$$

TO GRAPH

1) Vertex (h, k): _____ [MIN|MAX]

2) Axis of Symmetry $(x = h)$: _____

3) x-int(s)→ Solve $f(x) = 0$: _____

4) y-int→ Compute $f(0)$: _____

5) Plot & connect with smooth curve

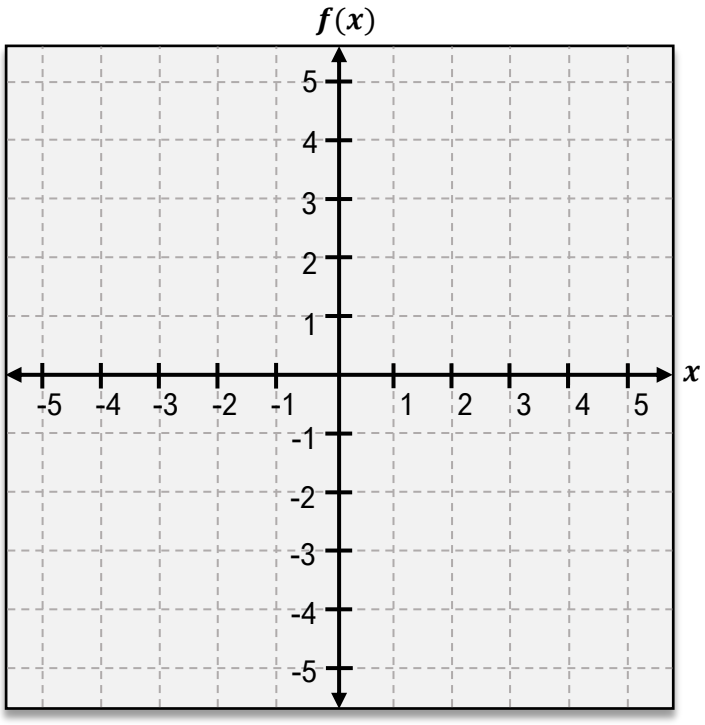
FROM GRAPH

Domain: _____

Range: _____

Increasing? _____

Decreasing? _____



3) $f(x) = 0$

4) $f(0) =$

TOPIC: QUADRATIC FUNCTIONS

PRACTICE**:** Graph the given quadratic function. Identify the vertex, axis of symmetry, intercepts, domain, range, and intervals for which the function is increasing or decreasing.

$f(x) = -(x-5)^2 + 1$

TO GRAPH

1) Vertex (h, k): _____ [MIN|MAX]

2) Axis of Symmetry $(x = h)$: _____

3) x-int(s)→ Solve $f(x) = 0$: _____

4) y-int→ Compute $f(0)$: _____

5) Plot & connect with smooth curve

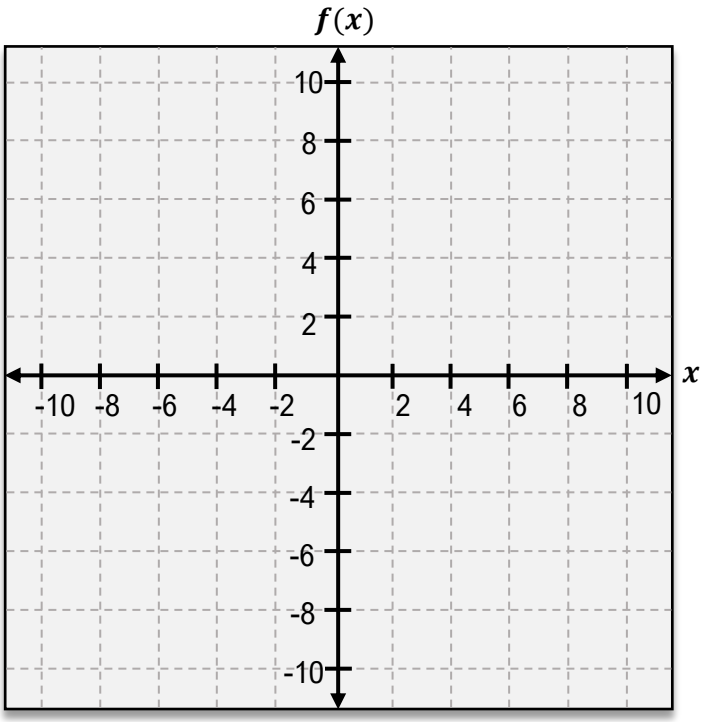
FROM GRAPH

Domain: _____

Range: _____

Increasing? _____

Decreasing? _____



3) $f(x) = 0$

4) $f(0) =$

TOPIC: QUADRATIC FUNCTIONS

Standard Form → Vertex Form

- When given a quadratic function in **standard form**, put it in **vertex form** by *completing the square*, then graph.

$f(x) = x^2 + 6x + 7$ Standard Form

↓ Rewrite

$f(x) = (x^2 + 6x + \_\_\_\_) + 7 - \_\_\_\_$

↓ Complete the Square

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

$f(x) = (x + 3)^2 - 2$ Vertex Form

- Since we are working with a *function*, not an *equation*, our steps change slightly.

EXAMPLE: Put the standard form quadratic function in vertex form by completing the square.

$f(x) = \quad x^2 + 6x \qquad\qquad + 7$

$f(x) = (x + \_\_\_)^2$

COMPLETE THE SQUARE

1) Factor a out of 1st 2 terms→ $a(x^2 + \frac{b}{a}x) + c$

2) Add & _____ $\left(\frac{b}{2\_\_}\right)^2$ _____

Move **(**subtraction × a**)** _____

3) Factor to $\left(x + \frac{b}{2\_\_}\right)^2$ & simplify

4) Graph from _____ form

TOPIC: QUADRATIC FUNCTIONS

EXAMPLE: Graph the given quadratic function. Identify the vertex, axis of symmetry, intercepts, domain, range, and intervals for which the function is increasing or decreasing.

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

COMPLETE THE SQUARE

1) Factor a out of 1st 2 terms→ $a(x^2 + \frac{b}{a}x) + c$

2) Add & subtract $\left(\frac{b}{2a}\right)^2$ *inside*

Move **(**subtraction × $\boldsymbol{a}$**)** *outside*

3) Factor to $\left(x + \frac{b}{2a}\right)^2$ & simplify

4) Graph from vertex form

TO GRAPH

_____

1) Vertex (h, k): _____ [MIN|MAX]

2) Axis of Symmetry $(x = h)$: _____

3) x-int(s)→ Solve $f(x) = 0$: _____

4) y-int→ Compute $f(0)$: _____

5) Plot & connect with smooth curve

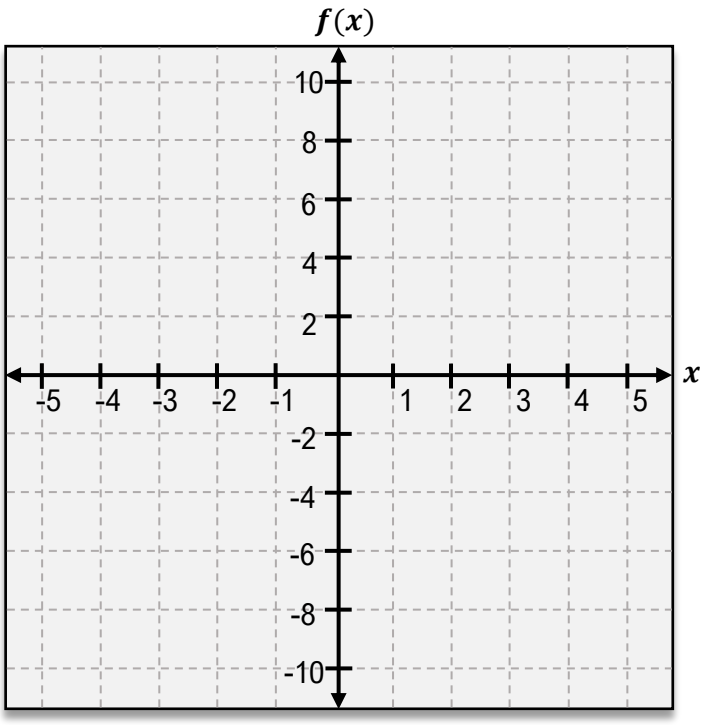
FROM GRAPH

Domain: _____

Range: _____

Increasing? _____

Decreasing? _____



3) $f(x) = 0$

4) $f(0) =$

TOPIC: QUADRATIC FUNCTIONS

PRACTICE: Graph the given quadratic function. Identify the vertex, axis of symmetry, intercepts, domain, range, and intervals for which the function is increasing or decreasing.

$$f(x) = \ 3x^2 + 12x$$

COMPLETE THE SQUARE

1) Factor a out of 1st 2 terms→ $a(x^2 + \frac{b}{a}x) + c$

2) Add & subtract $\left(\frac{b}{2a}\right)^2$ *inside*

Move **(**subtraction × $\boldsymbol{a}$**)** *outside*

3) Factor to $\left(x + \frac{b}{2a}\right)^2$ & simplify

4) Graph from vertex form

_____

TO GRAPH

1) Vertex (h, k): _____ [MIN|MAX]

2) Axis of Symmetry $(x = h)$: _____

3) x-int(s)→ Solve $f(x) = 0$: _____

4) y-int→ Compute $f(0)$: _____

5) Plot & connect with smooth curve

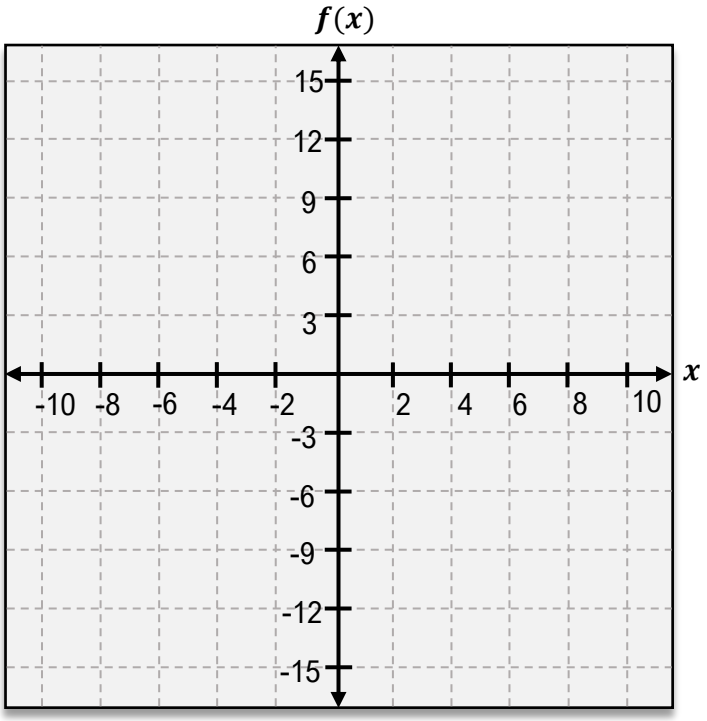
FROM GRAPH

Domain: _____

Range: _____

Increasing? _____

Decreasing? _____



3) $f(x) = 0$

4) $f(0) =$