Warm-Up: Simplify and evaluate the expressions at $x = -2$.

1. $x(x+3)+2x+1$
2. $(x+1)^2 - x + 4$
3. $(x-1)(x+1)+2x$

Quadratic Functions

Today's Plan:

1. Lesson
    a) Standard and vertex form
    b) Properties of quadratic functions
2. Practice exercises in Desmos

Students will know that:

1. A quadratic function can be written in the standard or the vertex form.
2. A parabola has
   a) an axis of symmetry and a vertex
   b) a global extrema (minimum or maximum)

Students will be able to use the graph of a quadratic function to determine:

- global extremes
- Intercepts
- Zeros

Golden Gate Bridge

$y = 0.00037109375x^2 - 0.475x + 227$

Standard Form of the Quadratic Function

$$f(x) = ax^2 + bx + c, a \neq 0$$

Quadratic Term

Linear Term

Constant Term

Why is a different from 0?

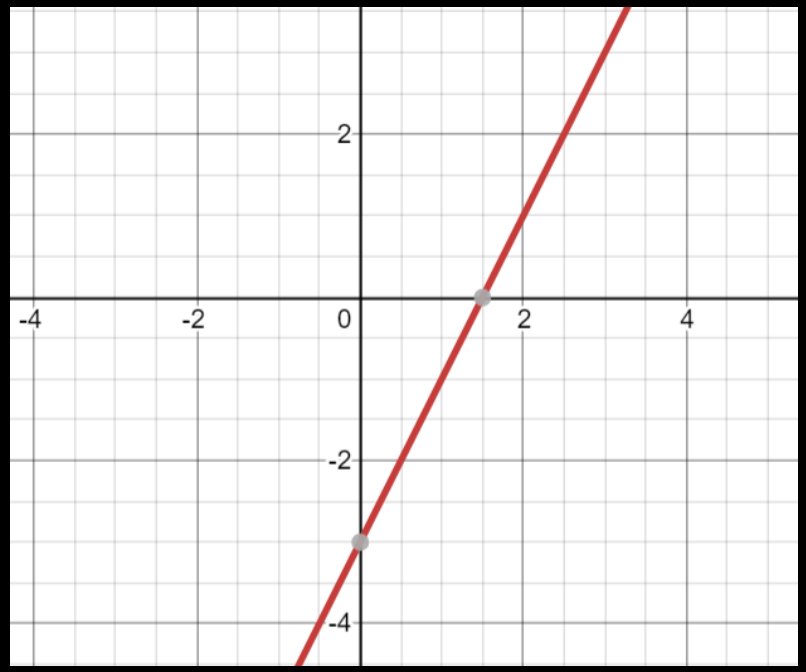
$$f(x) = ax^2 + bx + c, a \neq 0$$

What does f equal to if $a = 0$?

$$f(x) = bx + c$$

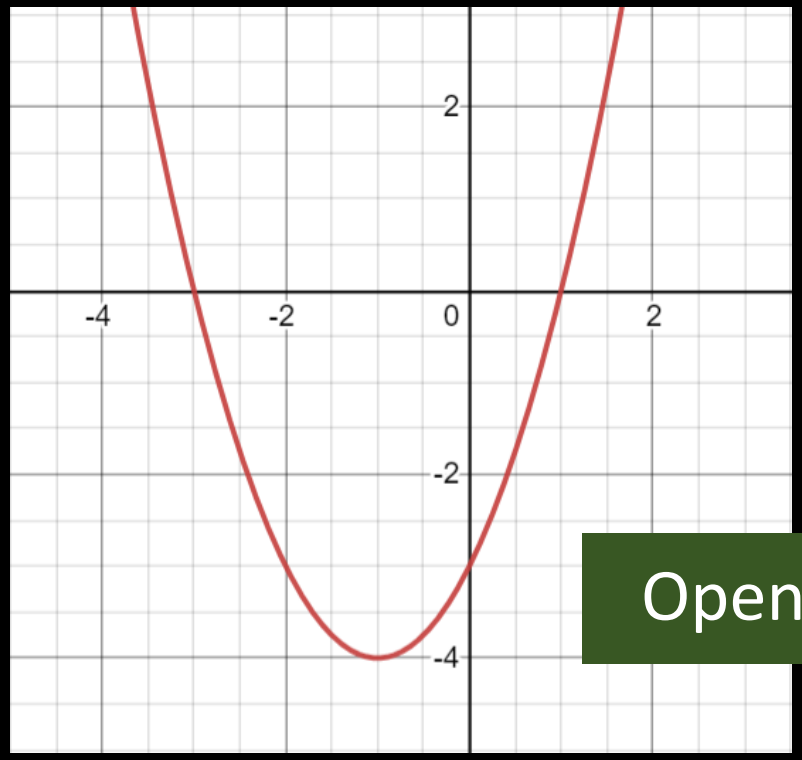
What kind of functions is this?

Linear!



Graph of parabola

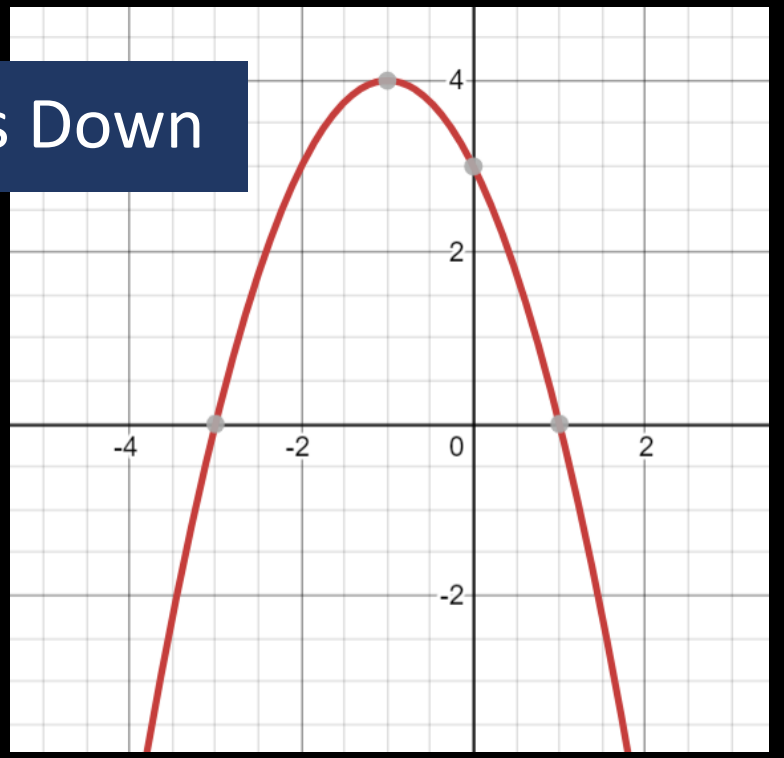
$a > 0$



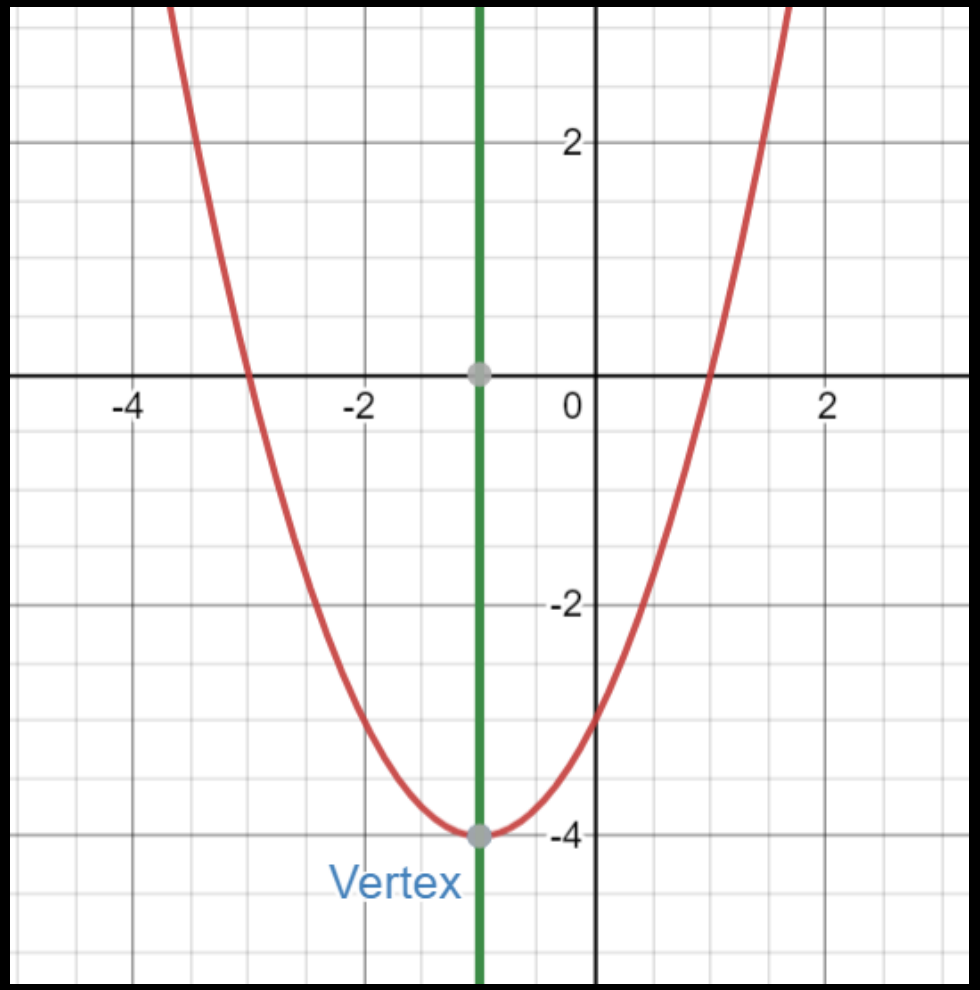
Opens Up

$a < 0$

Opens Down



Vertex and Axis of Symmetry



$$f(x) = ax^2 + bx + c, a \neq 0$$

The vertex of f is the point

$$\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$$

The axis of symmetry of f is

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

Determine the vertex and axis of symmetry

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

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

Time to create some parabolas!

Vertex Form

If the vertex of the parabola is (h, k), then the vertex form equation is written

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

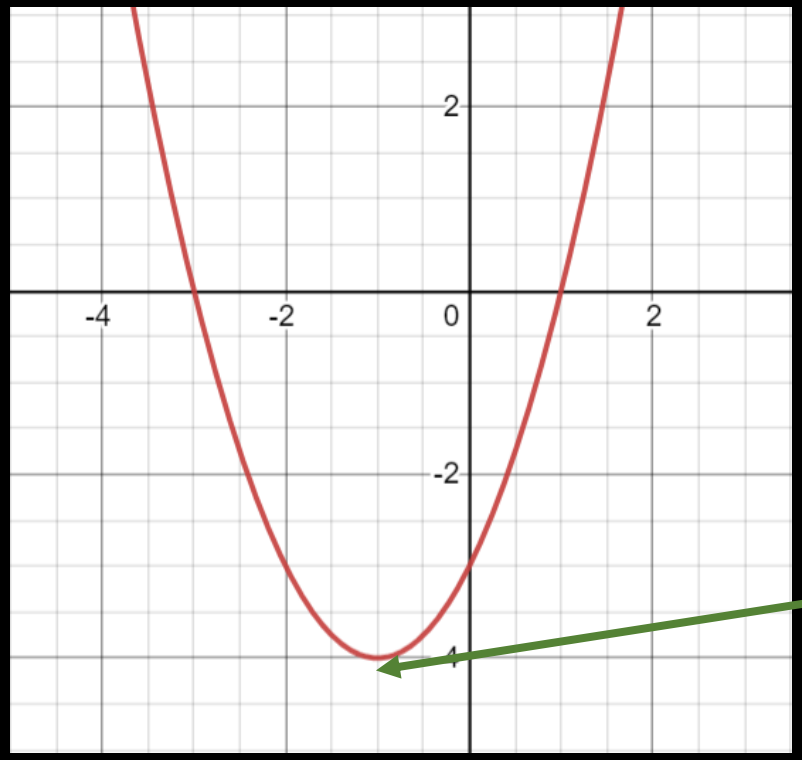
Write the vertex form equation of a parabola with $a = -2$ and vertex $(1,4)$.

Properties of Quadratic Functions

1. One global extremum
2. May have 0, 1, or 2 zeros.
3. May have 0, 1, or 2 x-intercepts.

Extremum

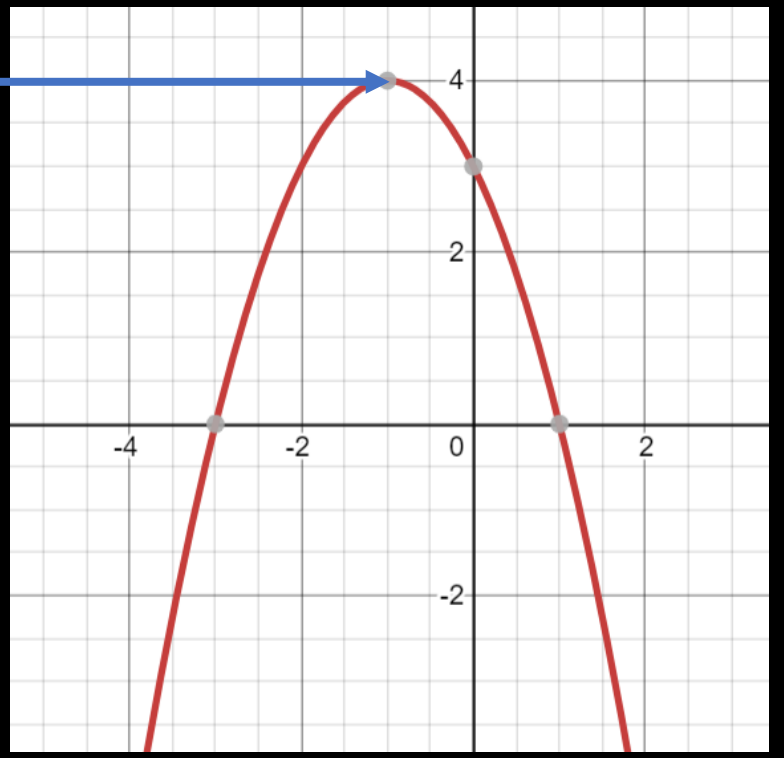
$a > 0$



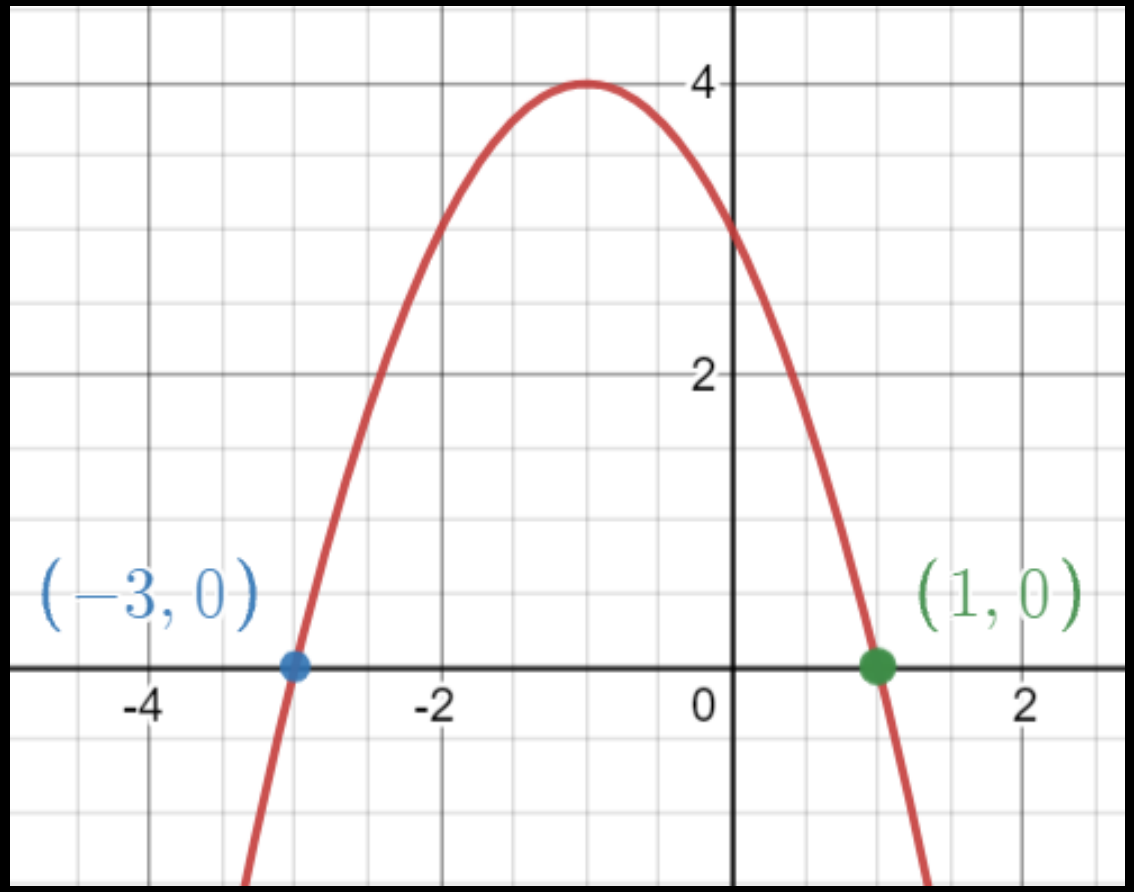
Global minimum at $x = -\frac{b}{2a}$

Global maximum at $x = -\frac{b}{2a}$

$a < 0$



Two Zeros/x-intercepts



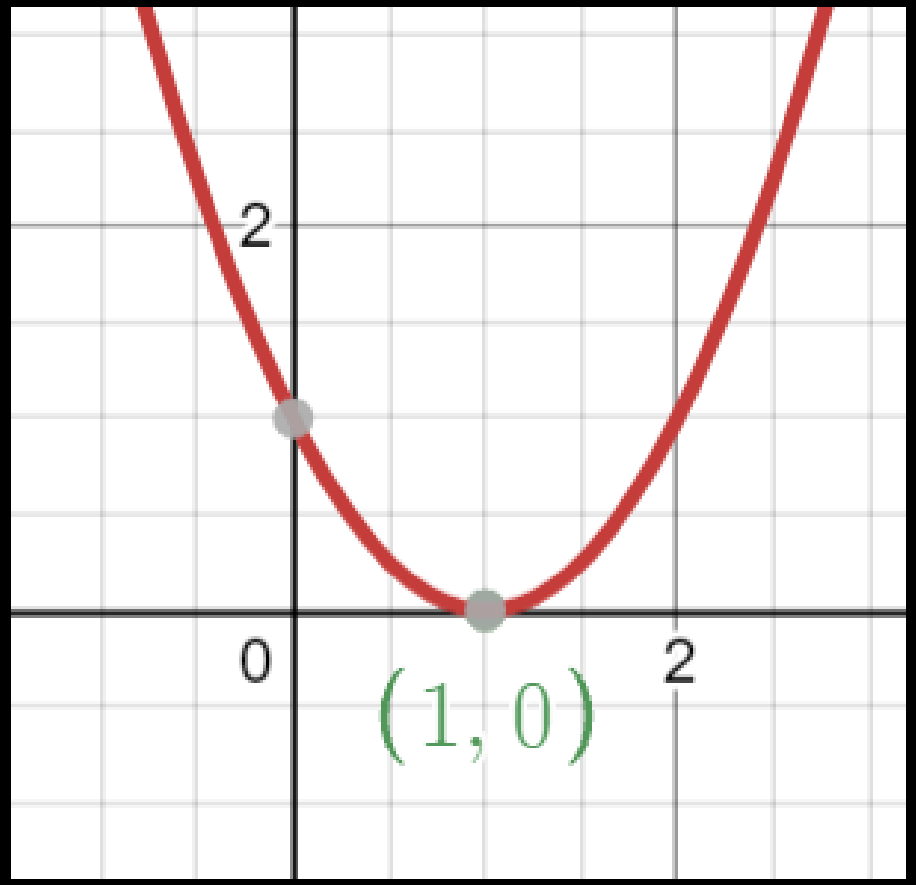
Two zeros at

$x = -3$ and $x = 1$

Two x-intercepts at

$(-3,0)$ and $(1,0)$.

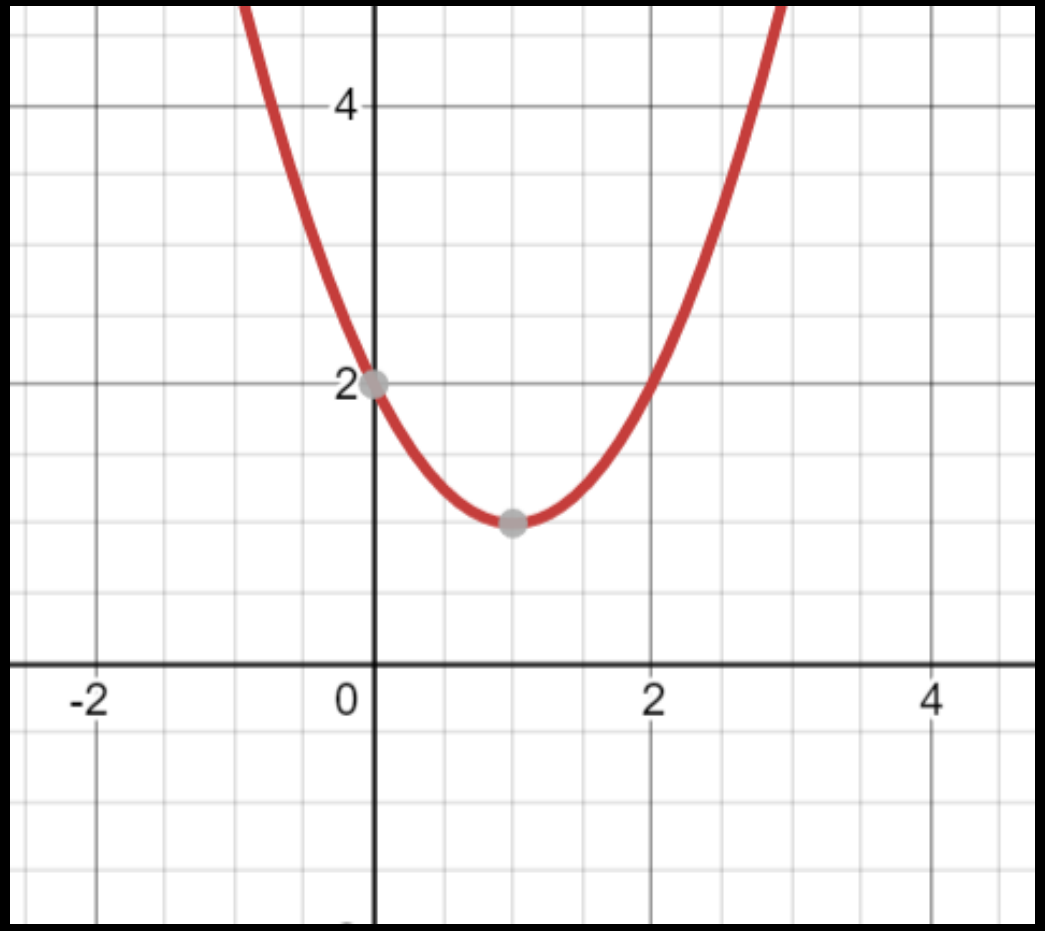
One zero/x-intercept

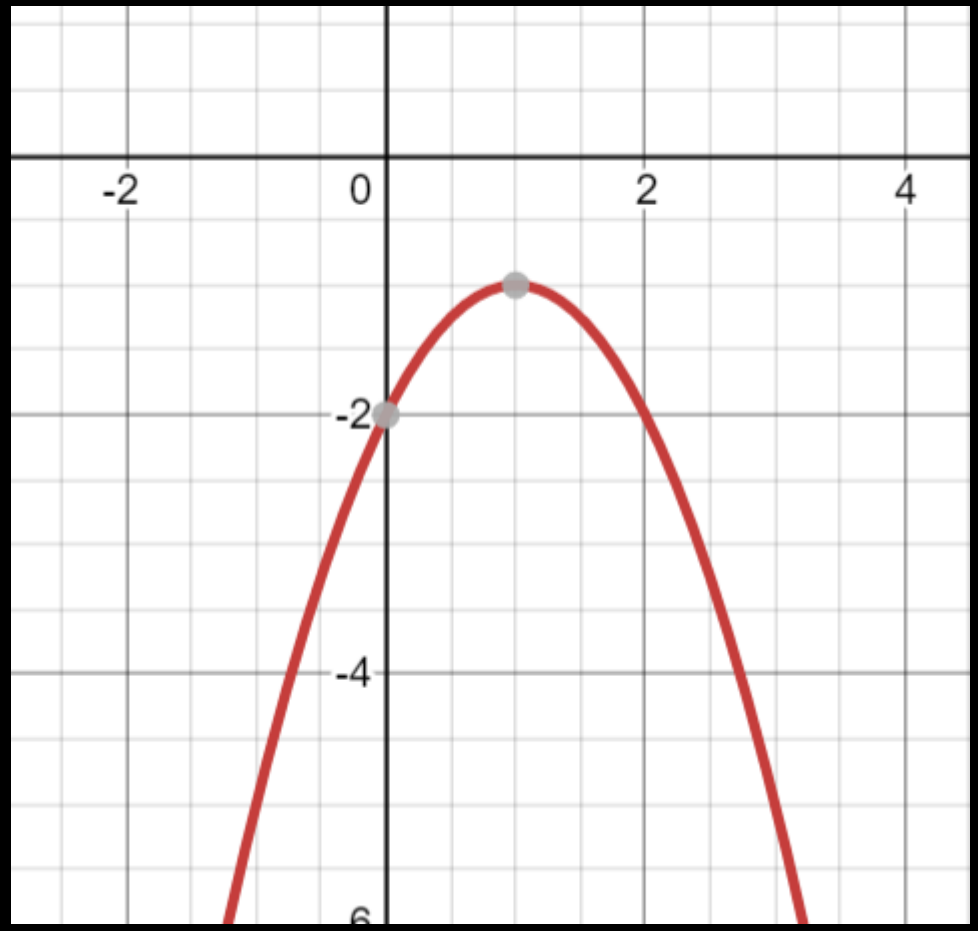


1. What is the zero of the function?
2. What is the x-intercept?

Is it a coincidence that the x-intercept is the same as the vertex?

NO zeros/x-intercepts





Charge

In-class:

Work on the practice problems in Desmos.

At-home:

Complete the Desmos activity today.

Keep working on the Delta Math assignments