

Lesson 3.2 ~ Investigating Quadratic Functions in Standard Form

Different Forms of a Quadratic Function

- Vertex Form: $y = a(x - p)^2 + q$
- Standard Form: $y = ax^2 + bx + c$

Example #1: Vertex Form \rightarrow Standard Form

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

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

$$y = 2(x^2 - 3x - 3x + 9) + 5$$

$$y = 2(x^2 - 6x + 9) + 5$$

$$y = 2x^2 - 12x + 18 + 5$$

$$y = 2x^2 - 12x + 23$$

$$y = -\frac{1}{2}(x + 10)^2 + 2$$

$$y = -\frac{1}{2}(x + 10)(x + 10) + 2$$

$$y = -\frac{1}{2}(x^2 + 10x + 10x + 100) + 2$$

$$y = -\frac{1}{2}(x^2 + 20x + 100) + 2$$

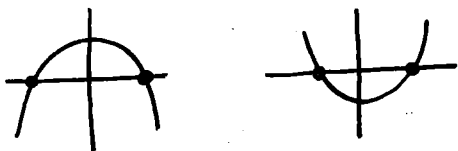
$$y = -\frac{1}{2}x^2 - 10x - 50 + 2$$

$$y = -\frac{1}{2}x^2 - 10x - 48$$

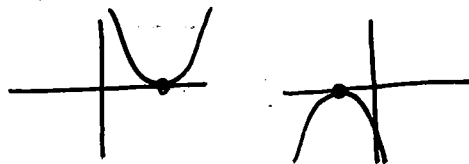
Number of x -Intercepts

A quadratic function can have two, one, or zero x -intercepts. The number of intercepts can be determined by looking at the vertex and the direction of opening.

- Two x -intercepts: vertex above the x -axis and opening down, or vertex below the x -axis and opening up.



- One x -intercept: vertex on the x -axis, opening up or down.

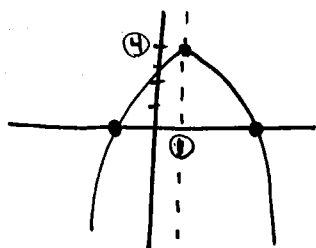


- No x -intercepts: vertex above the x -axis and opening up, or vertex below the x -axis and opening down.



Example #2:

How many x -intercepts does a quadratic function with a range of $y \leq 4$ and an axis of symmetry $x = 1$ have? Explain how you know.



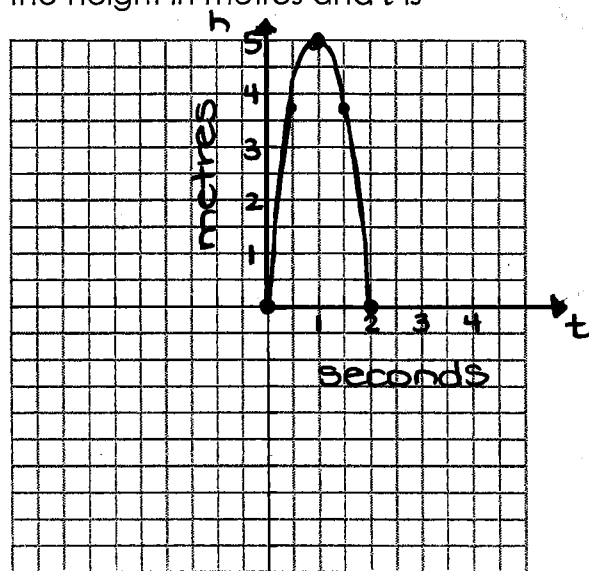
This graph has 2 x -intercepts since the vertex is above the x -axis (@ 4) and opens down (≤ 4).

Example #3: Analyzing a Quadratic Function

The height of a soccer ball after being kicked by the goalkeeper can be modelled by the equation $h = -5t^2 + 10t$, where h is the height in metres and t is the time in seconds.

a) Graph the equation using a table of values.

t	h
0	0
1	5
2	0
0.5	3.75
1.5	3.75



b) What does the y-intercept represent?

→ height from which ball was kicked (0 m @ 0 s)

c) Determine the coordinates of the vertex. What information does this give you?

→ (1, 5)

→ ball was at a max. height of 5 m after 1 s in the air

d) How long is the ball in the air? Explain how you know.

→ 2 s

→ height is 0 m again at time 2 s

e) Estimate the height of the ball 1.5 s after being kicked.

→ 3.75 m

Example #4:

At a children's music festival, the organizers are roping off a rectangular area for stroller parking. There is 160 m of rope available to create the perimeter. Write a quadratic function in standard form to represent the area for the stroller parking.



$$2x + 2y = 160$$

$$2y = -2x + 160$$

$$y = -x + 80$$

$$A = xy \leftarrow \text{too many variables}$$

$$A = x(-x + 80) \leftarrow \text{substitute in } y \text{ from perimeter equation}$$

$$A = -x^2 + 80x$$