Objective: Write Quadratic Functions Using Transformations.

Concept

The parameters of a, h, and k create transformations on $f(x) = x^2$ that can be identified from the vertex form of a quadratic function.

Vertex Form of a Quadratic Function

$$\boldsymbol{f(x) = a(x - h)^2 + k}$$

If $a < 0$	the graph of the function will have an **x-axis reflection**
If $\lvert a\rvert > 1$	the graph of the function will have a **vertical stretch by a factor of $\lvert a\rvert$**
If $\lvert a\rvert < 1$	the graph of the function will have a **vertical compression by a factor of $\lvert a\rvert$**
If $\boldsymbol{h > 0}$	the graph of the function is translated $\lvert h\rvert$ $units$ **right**
If $\boldsymbol{h < 0}$	the graph of the function is translated $\lvert h\rvert$ $units$ **left**
If $\boldsymbol{k > 0}$	the graph of the function is translated $\lvert k\rvert$ $units$ **up**
If $\boldsymbol{k < 0}$	the graph of the function is translated $\lvert k\rvert$ $units$ **down**

Objective: Write Quadratic Functions Using Transformations.

Ex) Given the graph of $f(x) = (x+3)^2 - 5$ how does Mary create the graph of $g(x) = (x-1)^2 + 1$?

parent

opp $= h$ k

transformations = ?

Strategy: graph the vertex of $f(x)$ and the vertex of $g(x)$, then determine the translation(s) from $f(x)$ to $g(x)$. The vertex of a parabola is at (h, k).

① Overtex of f(x)

h = -3 k = -5

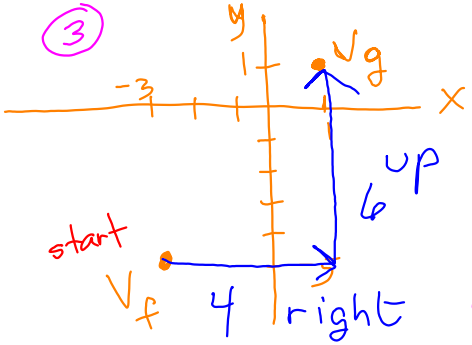
v (-3, -5)

② vertex of g(x)

h = 1 k = 1

v (1, 1)

③



④ Mary creates the graph of g(x) by translating f(x) right 4 units and up 6 units.

Objective: Write Quadratic Functions Using Transformations.

Ex) Given the graph of $f(x) = (x + 2)^2 + 7$ how does Mary create the graph of $g(x) = (x + 8)^2 + 2$?

parent

opp = h k

① vertex of f(x)

h = −2 k = 7

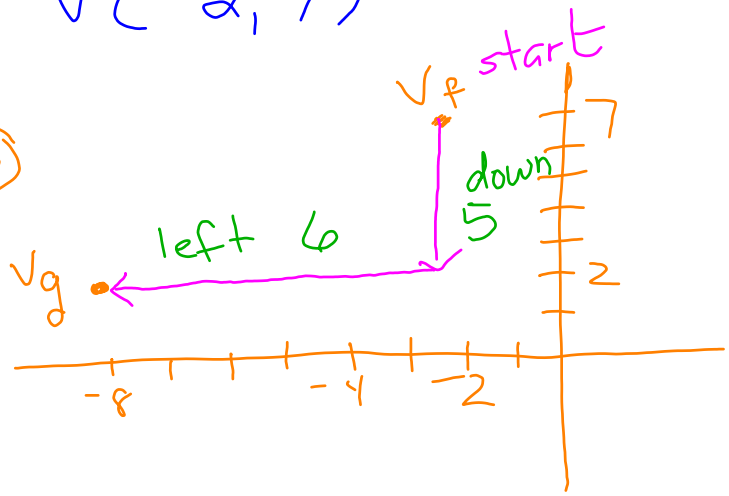
V(−2, 7)

② vertex of g(x)

h = −8 k = 2

V(−8, 2)

③



④ Mary can create the graph of g(x) by translating f(x) left 6 units and down 5 units

Objective: Write Quadratic Functions Using Transformations.

Ex) Write a quadratic function in the form $f(x) = a(x-h)^2 + k$ that has the given transformations.

- a reflection over the x-axis → $a = -3$
- a vertical stretch by a factor of 3
- a translation left 4 units and down 7 units
  $h = -4$ $k = -7$

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

$f(x) = -3(x-(-4))^2 + (-7)$

$f(x) = -3(x+4)^2 - 7$

Objective: Write Quadratic Functions Using Transformations.

Ex) Write a quadratic function in the form $f(x) = a(x-h)^2 + k$ that has the given transformations.

- a vertical compression by a factor of $\frac{3}{7}$ → $a = \frac{3}{7}$
- a translation right 12 units

$h = 12$ $k = 0$

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

$f(x) = \frac{3}{7}(x-12)^2 + 0$

$$f(x) = \frac{3}{7}(x-12)^2$$