Objectives

- Graph $f(x) = ax^2$
- Graph $f(x) = a(x-h)^2$
- Graph $f(x) = a(x-h)^2 + k$
- Given a quadratic function stated in standard form, $f(x) = ax^2 + bx + c$, learn how to complete the square in order to put the function definition into vertex form, $f(x) = a(x-h)^2 + k$
- Graph Identify domains and ranges for quadratic functions.
- Graph Find minimum and maximum values of quadratic functions

Exercises

1. **Graph each of the following quadratic functions.**

a) $f(x) = 2x^2$

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

c) $f(x) = -2x^2$

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

e) $f(x) = (x-3)^2$

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

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

h) $f(x) = (x+1)^2 + 3$

i) $f(x) = (x-3)^2$

j) $f(x) = 2(x+3)^2$

k) $f(x) = (x+1)^2 + 3$

l) $f(x) = 3(x+1)^2 - 2$

GRAPHING $f(x) = ax^2$

The graph of $f(x) = ax^2$ is a parabola with $x = 0$ as its axis of symmetry. Its vertex is the origin.

For $a > 0$, the parabola opens upward. For $a < 0$, the parabola opens downward.

If $|a|$ is greater than 1, the parabola is narrower than $y = x^2$.

If $|a|$ is between 0 and 1, the parabola is wider than $y = x^2$.

GRAPHING $f(x) = a(x - h)^2$

The graph of $f(x) = a(x - h)^2$ has the same shape as the graph of $y = ax^2$.

- If h is positive, the graph of $y = ax^2$ is shifted h units to the right.
- If h is negative, the graph of $y = ax^2$ is shifted $|h|$ units to the left.
- The vertex is $(h, 0)$, and the axis of symmetry is $x = h$.

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

The graph of $f(x) = a(x - h)^2 + k$ has the same shape as the graph of $y = a(x - h)^2$.

- If k is positive, the graph of $y = a(x - h)^2$ is shifted k units up.
- If k is negative, the graph of $y = a(x - h)^2$ is shifted $|k|$ units down.
- The vertex is (h, k), and the axis of symmetry is $x = h$.
- For $a > 0$, the minimum function value is k. For $a < 0$, the maximum function value is k.