

# Graphs of Quadratic Functions

**Parabolas**

**Vertex Form**

**Intercept Form**

**Standard Form**

# Parabolas

A parabola is the U-shaped curve made by a quadratic equation such as  $y = x^2$ .

| Aspect                    | Definition                                                                            | In Example             | Example |
|---------------------------|---------------------------------------------------------------------------------------|------------------------|---------|
| <b>Vertex</b>             | point $(h, k)$ at the tip of the parabola                                             | $(-2, 28)$             |         |
| <b>Maximum or Minimum</b> | value of $k$ at the vertex                                                            | 28                     |         |
| <b>Axis of Symmetry</b>   | mirror line $x = h$ that divides the parabola in half                                 | $x = -2$               |         |
| <b>y-intercept</b>        | point at which the parabola intersects the y-axis (and $x$ is 0)                      | $(0, 26)$              |         |
| <b>x-intercepts</b>       | points (if any) at which the parabola intersects the x-axis (and $y$ is 0)            | $(-9, 0)$ and $(5, 0)$ |         |
| <b>Domain</b>             | set of all possible values of $x$ , which is all real numbers                         | all real numbers       |         |
| <b>Range</b>              | set of all possible values of $y$ , which is all real numbers not past the min or max | $y \leq 28$            |         |

# Forms of Quadratic Equations

---

There are three main ways to write a quadratic equation. All three use the same value of  $a$ .

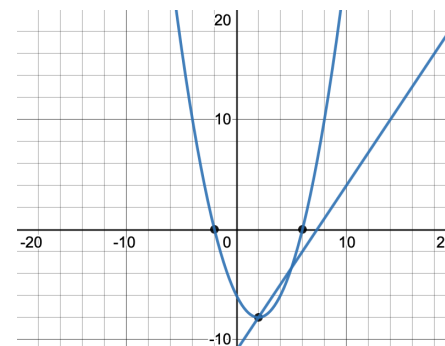
To convert from vertex form or intercept form to standard form, multiply and simplify.

To convert from standard form to vertex form or intercept form, find the vertex or  $x$ -intercepts.

| Form      | Equation                 | Vertex                              | $x$ -intercepts                                                                                                              |
|-----------|--------------------------|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------|
| Vertex    | $f(x) = a(x - h)^2 + k$  | $(h, k)$                            | Set $f(x) = 0$ , and solve for $x$ by doing the following on each side: Subtract $k$ , divide by $a$ , take the square root. |
| Intercept | $f(x) = a(x - p)(x - q)$ | $(\frac{p+q}{2}, f(\frac{p+q}{2}))$ | $(p, 0)$ and $(q, 0)$                                                                                                        |
| Standard  | $f(x) = ax^2 + bx + c$   | $(\frac{-b}{2a}, f(\frac{-b}{2a}))$ | Set $f(x) = 0$ , and solve for $x$ by factoring (see chapter 5) or the quadratic formula (see chapter 7).                    |

# Finding a Quadratic Equation from its Graph

Finding the equation of a parabola is like finding the equation of a line: Fill in the known parameters in the equation, plug in the  $(x, y)$  coordinates of another known point, and solve for the unknown value. For a line, the known parameter is the slope  $m$ . For a parabola, the known parameters can either be  $h$  and  $k$  from the vertex or the  $x$ -coordinates of the  $x$ -intercepts.



| Graph    | Known Parameters                          | Solve for | Above Example                                                                     |
|----------|-------------------------------------------|-----------|-----------------------------------------------------------------------------------|
| Line     | slope:<br>$y = mx + b$                    | $b$       | $m = 1.5$<br>$-8 = 1.5(2) + b$<br>$b = -11$<br>$y = 1.5x - 11$                    |
| Parabola | vertex:<br>$y = a(x - h)^2 + k$           | $a$       | $(h, k) = (2, -8)$<br>$0 = a(6 - 2)^2 - 8$<br>$a = 0.5$<br>$y = 0.5(x - 2)^2 - 8$ |
| Parabola | $x$ -intercepts:<br>$y = a(x - p)(x - q)$ | $a$       | $p = -2, q = 6$<br>$-8 = a(2 + 2)(2 - 6)$<br>$a = 0.5$<br>$y = 0.5(x + 2)(x - 6)$ |