Section 4.1 Quadratic Functions

Objective 1: Understanding the Definition of a Quadratic Function and its Graph

**Definition:** A quadratic function is a function of the form \( f(x) = ax^2 + bx + c \) where \( a, b, \) and \( c \) are real numbers with \( a \neq 0 \). Every quadratic function has a “u-shaped” graph called a parabola.

The five basic characteristics of a parabola are its
1. vertex
2. axis of symmetry
3. \( y \)-intercept
4. \( x \)-intercept(s) or real zeros, and
5. domain and range.

Objective 2: Graphing Quadratic Functions Written in Vertex Form

**Vertex Form of a Quadratic Function**
A quadratic function is in **vertex form** if it is written as \( f(x) = a(x - h)^2 + k \).

The graph is a parabola with vertex \((h, k)\).
The parabola “opens up” if \( a > 0 \), and the parabola “opens down” if \( a < 0 \).
The domain of the function is \((-\infty, \infty)\).
The line \( x = h \) is the axis of symmetry.
The range is \([k, \infty)\) if \( a > 0 \), and the range is \((-\infty, k)\) if \( a < 0 \).
Objective 4: Graphing Quadratic Functions Using the Vertex Formula

Formula for the Vertex of a Parabola
Given a quadratic function of the form $f(x) = ax^2 + bx + c$, $a \neq 0$, the vertex of the parabola is $\left(-\frac{b}{2a}, f\left(-\frac{b}{2a}\right)\right)$.
Objective 5: Determining the Equation of a Quadratic Function Given its Graph