

# Forms of a Quadratic

There are three main forms for writing a quadratic function.

1. Standard form is  $f(x) = ax^2 + bx + c$  where  $c$  is the  $y$ -intercept.
2. Vertex form is  $f(x) = a(x - h)^2 + k$  where the point  $(h, k)$  is the vertex of the parabola.
3. Factored form is  $f(x) = a(x - r_1)(x - r_2)$  where  $r_1$  and  $r_2$  are the roots (or zeros) of the function.

Any quadratic function can be written in any one of the three above forms. In the case of the factored form it is possible that the roots  $r_1$  and  $r_2$  are imaginary numbers. This occurs when the parabola does not cross or touch the  $x$ -axis.

We can convert any form to either vertex or factored other form graphically by graphing the form we are given and then looking on the graph for the needed values in the form we want. It is difficult to move from vertex or factored to standard. We can get the value of  $a$  from the given form and  $c$  turns out to be the  $y$ -intercept. These are easy, the difficulty is in finding  $b$ . The value of  $b$  is easier to obtain algebraically.

We can convert any form to any other form algebraically using the following techniques.

Standard Form  $\longrightarrow$  Factored Form: Use either factoring or the quadratic formula.

Standard Form  $\longrightarrow$  Vertex Form: Complete the square.

Factored Form  $\longrightarrow$  Standard Form: FOIL.

Factored Form  $\longrightarrow$  Vertex Form: FOIL then complete the square.

Vertex Form  $\longrightarrow$  Standard Form: FOIL.

Vertex Form  $\longrightarrow$  Factored Form: FOIL then factor or use the quadratic formula.

## Activity

Use GSP or WinGeom to dynamically examine the three forms, using  $a$ ,  $b$ ,  $c$ ,  $h$ ,  $k$ ,  $r_1$  and  $r_2$  as parameters.