# Multiple Transformations for Absolute Value and Quadratic Functions

*When finding the equation of absolute value or quadratic functions from a graph in the form $f(x) = a(x-h)^2 + k$ or $f(x) = a|x-h| + k$, follow these steps:*

1.) Figure out what kind of parent function it is:
   - V-shaped → Absolute value function so $f(x) = a|x-h| + k$
   - U-shaped/parabola → $f(x) = a(x-h)^2 + k$

2.) Find the vertex. This will give you *h* and *k*.

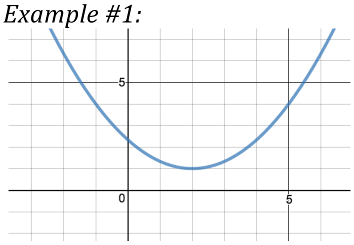
3.) Plug the vertex into the above equation for the correct parent function. Remember, if *h* is negative, it will become + inside the absolute value/parentheses since two negatives equals a positive.

4.) If the function is opening downward, you know it's a reflection and there will be a negative sign in front of the absolute value/parentheses.

5.) Lastly, find $a$. To do this, find another point that's on your graph besides the vertex. If you use the vertex, this will not work! Plug the point in for *x* and *y* $(f(x))$ in your equation. You should have the *h* and *k* already filled in from the vertex and you now will have *x* and *y* filled in as well. The only variable left should be *a*! Solve your equation for *a*.

6.) In your final equation, you should have *h* and *k* from the vertex and *a* from the previous step filled in. You should not have anything filled in for *x* and *y* as this point is dependent on the actual graph. Voila! You're done!

*Example #1:*



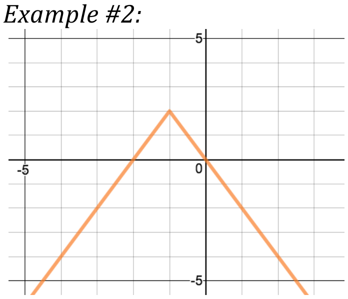

Step 1: Since this is u-shaped/parabola, use the general form of the function: $f(x) = a(x-h)^2 + k$
Step 2: Find the vertex → (2,1). Thus, *h*=2 and *k*=1.
Step 3: Plug *h* and *k* into the equation: $f(x) = a(x-2)^2 + 1$
Step 4: Since the parabola is opening up, it is not a reflection and thus, there will be no negative sign.
Step 5: We need to pick another point on the parabola that's not the vertex. For this, I'll use (5,4). Now, plug this into your equation for step 3. *x=5* and *y* or $f(x) = 4$. So our new equation is $4 = a(5-2)^2 + 1$. Solve your new equation.

$$4 = a(5-2)^2 + 1$$
$$4 = a(3)^2 + 1$$
$$4 = 9a + 1$$
$$3 = 9a$$
$$a = \frac{1}{3}$$

Step 6: Plug the values for *h*, *k*, and *a* back into your general form of the equation and you're done!

$$f(x) = \frac{1}{3}(x-2)^2 + 1$$

*Example #2:*




Step 1: Since this is v-shaped, use the general form of the function: $f(x) = a|x-h| + k$
Step 2: Find the vertex → (-1,2). Thus, *h*=-1 and *k*=2.
Step 3: Plug *h* and *k* into the equation: $f(x) = a|x+1| + 2$ ***Note – Since h is negative, it becomes + inside the absolute value.*
Step 4: Since the parabola is opening down, it is a reflection and thus, there will be a negative sign in front of the absolute value.
Step 5: We need to pick another point on the parabola that's not the vertex. For this, I'll use (0,0). Now, plug this into your equation for step 3. *x=0* and *y* or $f(x) = 0$. So our new equation is $0 = a|0+1| + 2$ . Solve your new equation.

$$0 = a|0+1| + 2$$
$$0 = a|1| + 2$$
$$0 = 1a + 2$$
$$-2 = 1a$$
$$a = -2$$

Step 6: Plug the values for *h*, *k*, and *a* back into your general form of the equation and you're done!

$$f(x) = -2|x+1| + 2$$