Essential Questions: In how many ways can we write a quadratic function? What information do the different forms of quadratic functions tell us?

Do Now:

Consider the quadratic equation $y = x^2 + 4x - 12$ *written in standard form.*

a) *Rewrite the equation in vertex form.*

$$y = x^2 + 4x - 12$$
$$y + 12 = x^2 + 4x$$
$$y + 12 + 4 = x^2 + 4x + 4$$
$$y + 16 = (x+2)^2$$
$$y = (x+2)^2 - 16$$

b) *Determine the vertex of the function.* $(-2, -16)$

Think About This...

Is there another way to write the quadratic function from the Do Now?

Terry says the function $y = x^2 + 4x - 12$ can be written in ***factored form***.

What do you think the function looks like in factored form?

Factored Form $y = (x+6)(x-2)$

What does this equation tell us about the graph of the function?

we can quickly see the roots (zeroes) of the function $\{-6, 2\}$

Standard Form $y = x^2 + 4x - 12$	**Vertex Form** $y = (x+2)^2 - 16$	**Factored Form** $y = (x+6)(x-2)$
• Opens up	• Opens up	• Opens up
• y-intercept -12	• Vertex $(-2, -16)$	• Roots $-6, 2$

Let's Review – There are three ways we can represent a quadratic function.

STANDARD FORM

$$f(x) = ax^2 + bx + c$$

where a, b, & c are real numbers

When a quadratic function is written in **standard** form, we find the

- **vertex** by using $x = \frac{-b}{2a}$ to find the x-coordinate. By substituting the x value into the function, we find the y-coordinate of the vertex.
- **roots** by solving the quadratic equation algebraically when f(x) = 0 or by graphing and finding the zeros of the function (locate x-intercepts).
- **y-intercept** by identifying the c value.

VERTEX FORM

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

where a, h and k are real numbers, (h, k) is the vertex

When a quadratic function is written in **vertex** form, we can determine the

- **vertex** by identifying (h, k) from the equation.

FACTORED FORM

$$f(x) = a(x - r_1)(x - r_2)$$

where a is a real number and r_1 and r_2 are real roots

When a quadratic function is written in **factored** form, we can determine the

- **roots** by identifying r_1 and r_2 from the equation.

1. The roots for two quadratic functions are given. Write the equation of each function in **factored form** if the a value equals -5.

(a) $r_1 = -2$, $r_2 = 3$

$x = -2 \quad x = 3$

$x + 2 = 0 \quad x - 3 = 0$

$y = -5(x+2)(x-3)$

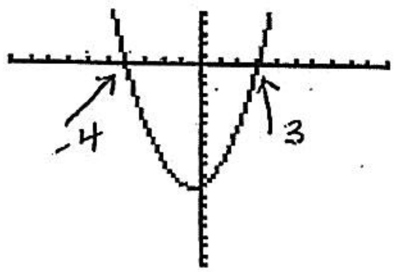
(b) $r_1 = -6$, $r_2 = -1$

$x = -6 \quad x = -1$

$x + 6 = 0 \quad x + 1 = 0$

$y = -5(x+6)(x+1)$

2. Write the equation for the function of the graph given below in **factored form** (a = 1).



$y = (x+4)(x-3)$

3. Write the equation for each function in **vertex form** given a and the vertex.

(a) $a = 1$, vertex: (-2, -7)

$y = (x+2)^2 - 7$

(b) $a = -2$, vertex: (4, 0)

$y = -2(x-4)^2$

4. Find the vertex of the following parabolas.

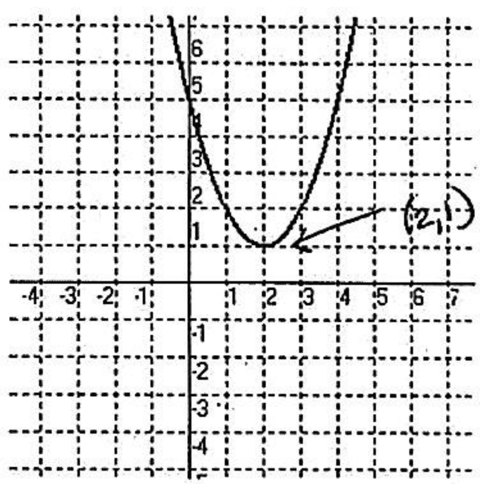
(a) $f(x) = (x - 7)^2 - 4$

$(7, -4)$

(b) $f(x) = 3(x + 4)^2 + 6$

$(-4, 6)$

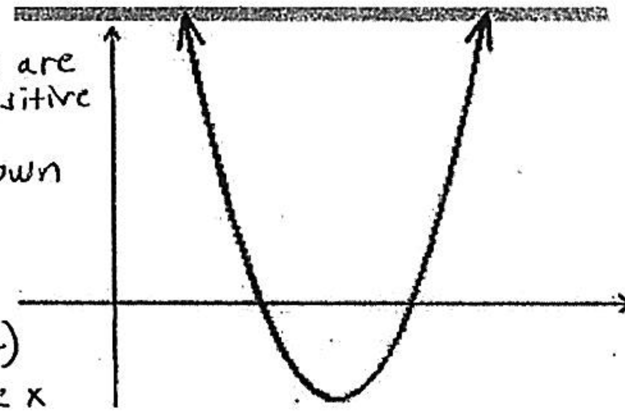
5. Write the equation, in **vertex form**, of the function shown in the graph below if a = 1.



vertex $(2, 1)$

$y = (x-2)^2 + 1$

6. Which of the following equations could describe the function seen in the graph at the right? Select all that apply.



X A. $y = (x + 2)(x - 5)$ roots $-2, 5$

No, the roots on the graph are both positive

X B. $y = -2x^2 + 4x - 1$

No, this function opens down

✓ C. $y = (x - 6)(x - 10)$ roots $6, 10$

X D. $y = (x + 5)^2 + 4$ vertex $(-5, 4)$

No, the graph has a positive x and negative y for its vertex

✓ E. $y = (x - 8)^2 - 6$

vertex $(8, -6)$

Think about this...

Any equation written in the form $y = a(x^2 + x - 12)$, where a is a constant, has the same solution set as the equation $y = x^2 + x - 12$.

For example, graph the equations $y = x^2 + x - 12$ and $y = 3x^2 + 3x - 36$ on your calculator. What do you notice?

They both cross the x-axis (roots, solutions) in the same places.

The second graph is narrower.

There are three forms in which to write the equation of a quadratic function:

- standard form: $y = ax^2 + bx + c$
- factored form: $y = a(x - r_1)(x - r_2)$
- vertex form: $y = a(x - h)^2 + k$

Take Away