In this lesson we will graph parabolas in standard form (sometimes called "completed square form") and in general form. We will also find the Maximum and Minimum values of a quadratic function.

General Form $f(x) = ax^2 + bx + c \quad (a \neq 0)$

Standard Form
(completed square form) $f(x) = a(x-h)^2 + k \quad (a \neq 0)$

The Maximum value of a quadratic function is the "y-value" of the vertex of a parabola that "opens down".
The Minimum value of a quadratic function is the "y-value" of the vertex of a parabola that "opens up".

Ex 1

Graph $f(x) = 2(x-3)^2 + 1$

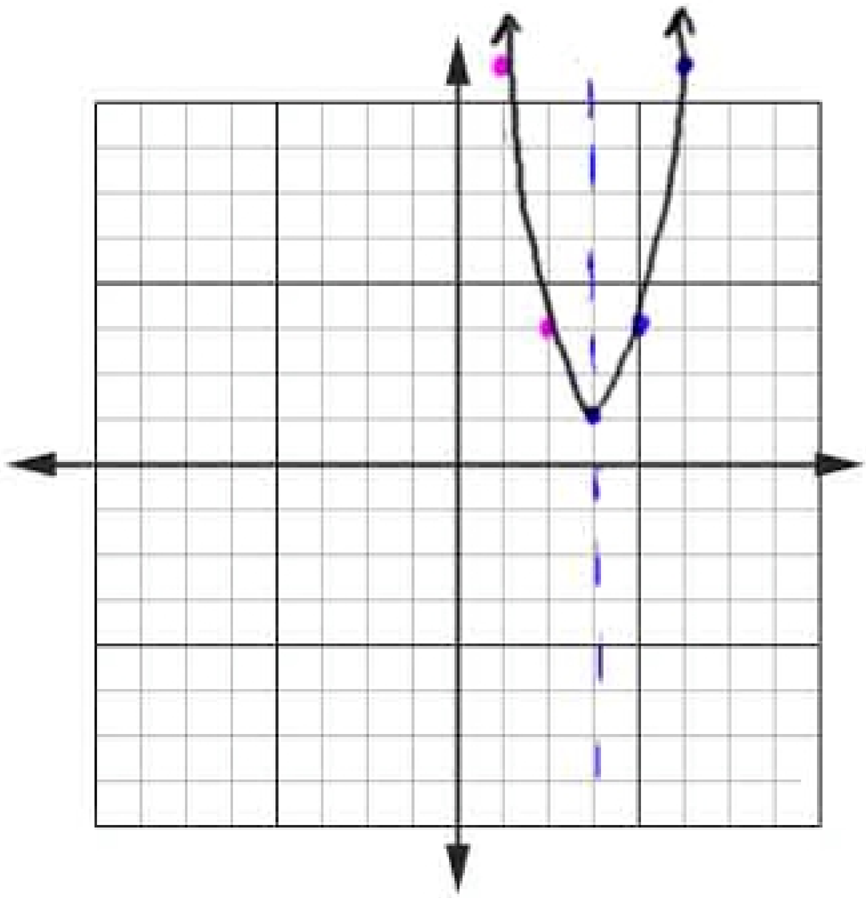
$y = 2(x-3)^2 + 1$

up, narrow

vertex $(3, 1)$

axis: $x = 3$

x	y
(4	3)
(5	9)



Ex2

$f(x) = 3x^2 - 6x + 1$

$y = 3x^2 - 6x + 1$

"Complete The Square"

$y - 1 = 3x^2 - 6x$

$\underset{+3}{y - 1} = 3(1x^2 - 2x + 1)$

$y + 2 = 3(x - 1)^2$

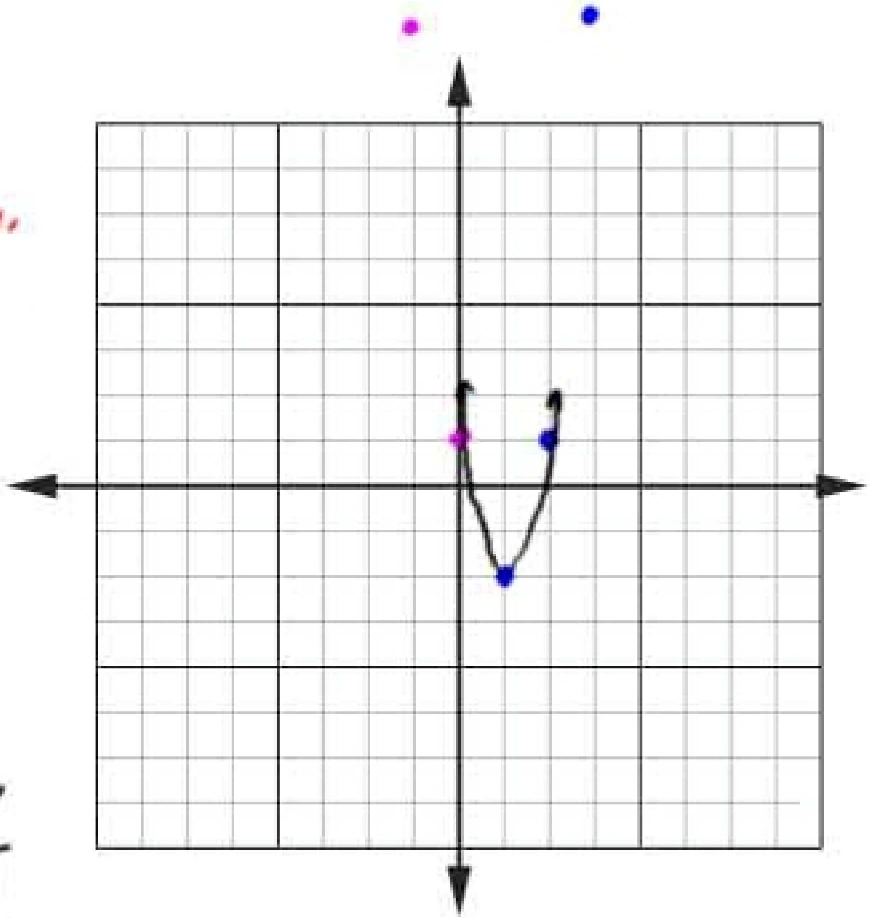
$y = 3(x - 1)^2 - 2$

up, narrow

vertex $(1, -2)$

axis: $x = 1$

x	y
2	1
3	10



Ex3

$g(x) = 6 + 6x - 3x^2$ Find Domain, Range, zeros and vertex

$y = -3x^2 + 6x + 6$

$-6 \qquad -6$

$y - 6 = -3x^2 + 6x$

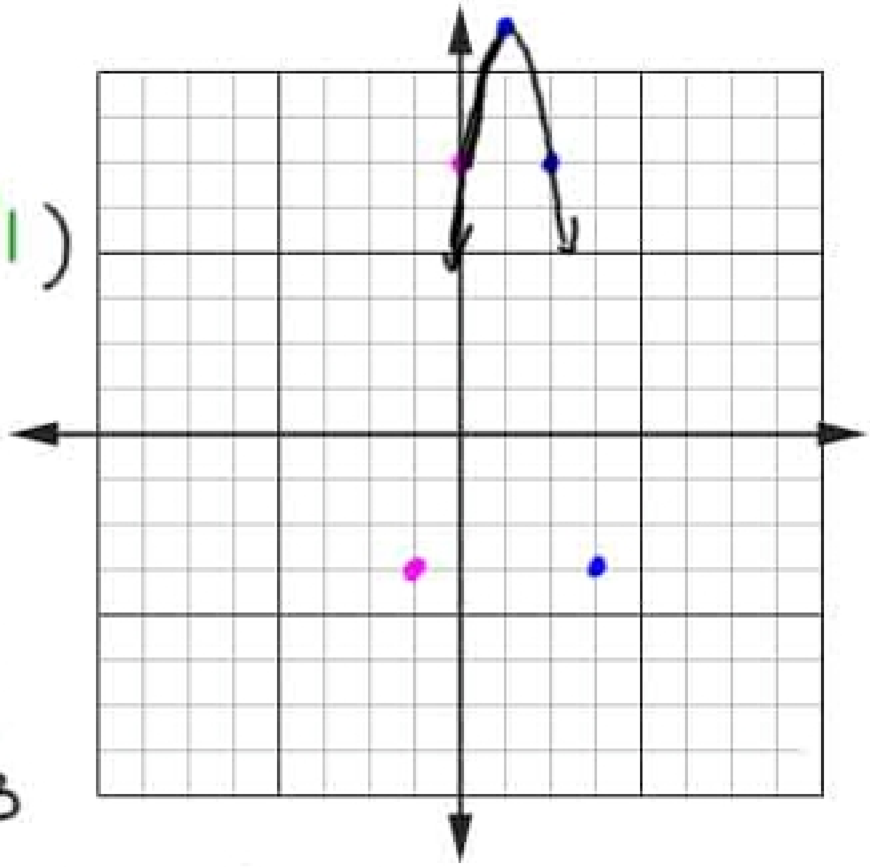
$y - 6 = -3(1x^2 - 2x + 1)$

-3

$y - 9 = -3(x - 1)^2$

$+9 \qquad +9$

$y = -3(x-1)^2 + 9$



down, narrow

vertex $(1, 9)$

axis: $x = 1$

x	y
2	6
3	-3

Domain (x-values) D = real numbers

Range (y-values) $R = \{y \mid y \leq 9\}$

Zeros:

$g(x) = -3x^2 + 6x + 6$

$0 = -3x^2 + 6x + 6$

$a = -3 \quad b = 6 \quad c = 6$

$$x = \frac{-6 \pm \sqrt{6^2 - 4(-3)(6)}}{2(-3)}$$

$$x = \frac{-6 \pm \sqrt{36 + 72}}{-6}$$

$$x = \frac{-6 \pm \sqrt{108}}{-6}$$

$$x = \frac{-6 \pm \sqrt{36}\sqrt{3}}{-6}$$

$$x = \frac{-6 \pm 6\sqrt{3}}{-6}$$

$$x = 1 \pm \sqrt{3}$$

Ex 4 $f(x) = \frac{1}{2}x^2 + 3x - \frac{7}{4}$

$+\frac{7}{4}$ $+\frac{7}{4}$

$y + \frac{7}{4} = \frac{1}{2}x^2 + 3x$

$y + \frac{7}{4} = \frac{1}{2}(1x^2 + 6x + 9)$

$+\frac{9}{2}$

$y + \frac{25}{4} = \frac{1}{2}(x+3)^2$

$-\frac{25}{4}$ $-\frac{25}{4}$

$y = \frac{1}{2}(x+3)^2 - 6\frac{1}{4}$

vertex $(-3, -6\frac{1}{4})$

Min: $-6\frac{1}{4}$