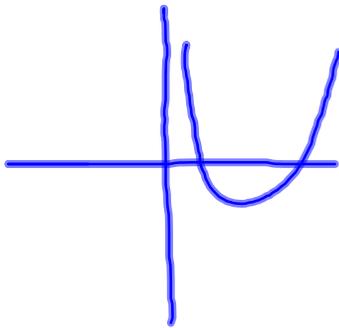


2.1 Quadratic Functions and Models

- Analyze graphs of quadratic functions
- Write quadratic functions in standard form and use the result to sketch a graph
- Use quadratic functions to model real life problems



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

January 17, 2012

What is a Polynomial Function?

$$a_0x^n + a_1x^{n-1} + a_2x^{n-2} \dots a_{n-1}x^1 + \underline{a_n}$$

Constant term

Examples:

	terms	Lead forti	Degree	constant
$f(x) = 3 \cdot x^0$	1	—	0	3
$f(x) = 2x^1 - 1$	2	2	1	-1
$f(x) = 3x^2 - 2x + 5$	3	3	2	5
$f(x) = 5x^3 - x^2 + 3x - 2$	4	5	3	-2

Vocabulary

Terms (separated by + or -)

Leading term (first term when terms are in order of decreasing exponents)

Coefficient (Number preceding the variable)

Degree (exponent on the leading term when in decreasing order)

Constant term (term without a variable)

Examples of

Linear function: $f(x) = \frac{2}{3}x - 3$

Constant function: $g(x) = 5$

Squaring function: $g(x) = -3x^2 - 4x + 3$

A quadratic function is a function of degree 2.

$$f(x) = ax^2 + bx + c \text{ with } a \neq 0$$

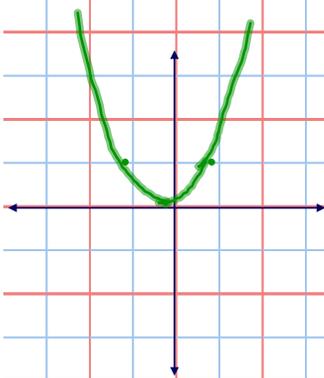
Standard form of a quadratic function

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

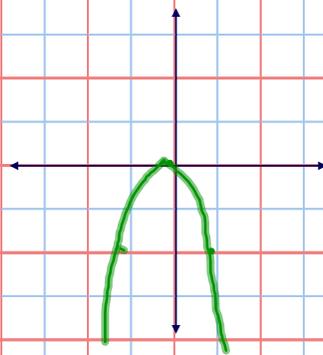
Review of transformations of the quadratic function.

Sketch each of these:

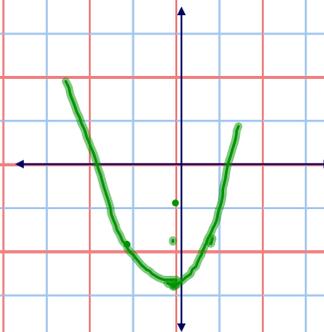
$$y = x^2$$



$$y = -2x^2$$

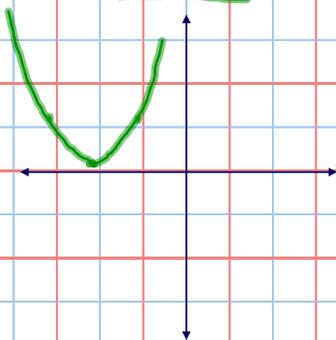


$$y = x^2 - 3$$



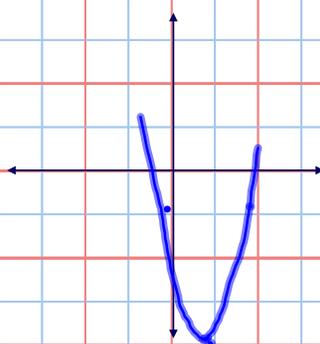
$$(x-2)$$

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



$$y = 3(x-1)^2 - 4$$

right 1
down 4
stretch 3

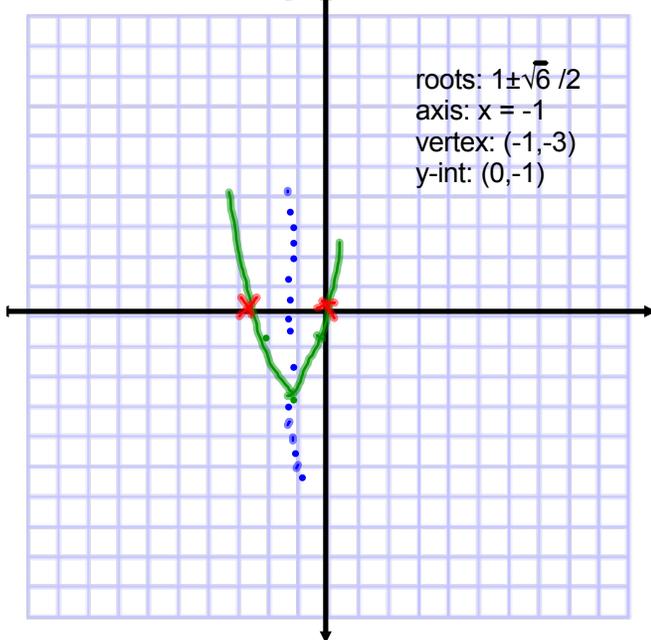


Example 1: Graph each of these and determine the roots.
 Show roots, axis of symmetry, vertex and y-intercept.

Standard form.

→ $y = 2(x+1)^2 - 3$

axis of sym $x = -1$



roots: $1 \pm \sqrt{6} / 2$
 axis: $x = -1$
 vertex: $(-1, -3)$
 y-int: $(0, -1)$

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

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

$$= 2x^2 - 4x + 2 - 3$$

$$= 2x^2 - 4x - 1$$

y-int. → $x=0, y=-1$

$$0 = 2x^2 - 4x - 1$$

$$x = \frac{4 \pm \sqrt{16 - 4(2)(-1)}}{2 \cdot 2}$$

$$= \frac{4 \pm \sqrt{24}}{4}$$

$$= \frac{4 \pm 2\sqrt{6}}{4} = \frac{2 \pm \sqrt{6}}{2}$$

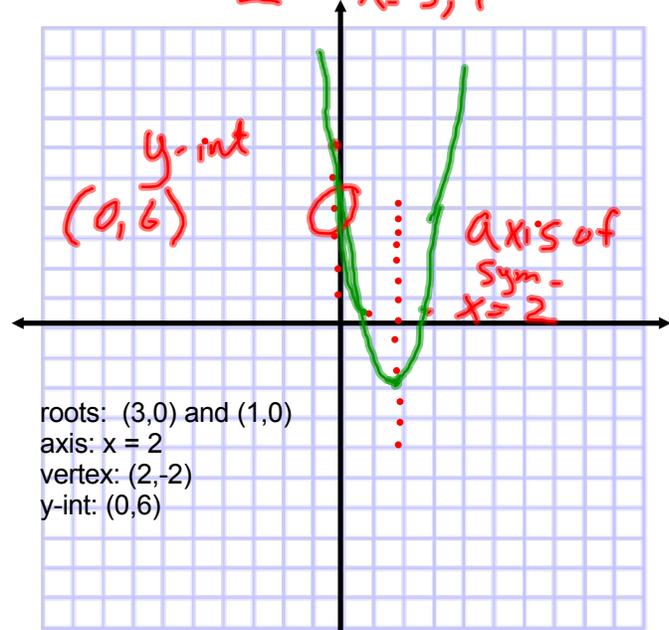
$$= 1 \pm \frac{\sqrt{6}}{2}$$

$$0 = 2(x^2 - 4x + 3)$$

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

$$= x = 3, 1$$

$y = 2x^2 - 8x + 6$



roots: $(3,0)$ and $(1,0)$
 axis: $x = 2$
 vertex: $(2, -2)$
 y-int: $(0,6)$

$$y = 2(x^2 - 4x + 4) + 6 - 8$$

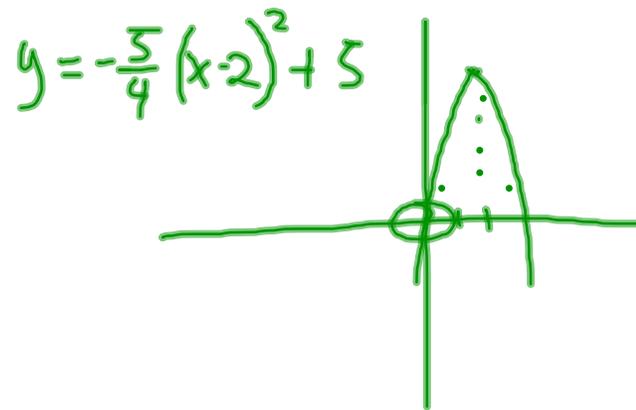
$$y = 2(x-2)^2 - 2$$

rt 2 vertex
 down 2 $(2, -2)$
 v.s. 2

Finding an equation:

Determine the equation of a parabola with a vertex at (2,5) which passes through the origin.

$$\begin{aligned} & \underline{(0,0)} \\ & y = a(x-2)^2 + 5 \\ & 0 = a(0-2)^2 + 5 \\ & 0 = 4a + 5 \\ & a = -\frac{5}{4} \end{aligned}$$



Application:

An object thrown straight up in the air from a height of 128 ft. with an initial velocity of 32 ft per second will travel according to this equation:

$$h(t) = -16t^2 + 32t + 128$$

How high will it go? \rightarrow Vertex (t, h)

When will it hit the ground?

How high?

$$h = -16(t^2 - 2t + 1) + 128 + 16$$

$$-16(t-1)^2 + 144 \quad \text{Vertex}(1, 144) \text{ at } 1 \text{ sec } 144 \text{ ft.}$$

When it lands

roots

$$\begin{aligned} 0 &= -16t^2 + 32t + \\ &= -16(t^2 - 2t - 8) \\ &= -16(t-4)(t+2) \\ t &= 4, \cancel{-2} \end{aligned}$$

$$\begin{aligned} h &= 0 \\ t &= 4 \end{aligned}$$

hits ground at
4 sec.