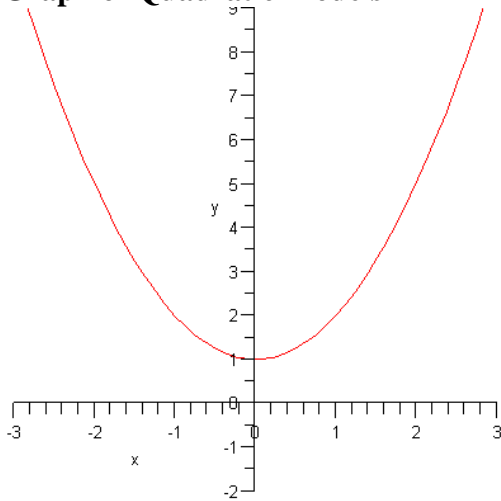


Quadratic Models

Graph of Quadratic Models



The parabola

A **quadratic function** is a function where the graph is a parabola and an equation of the

Form: $y = ax^2 + bx + c$ where $a \neq 0$

The x coordinate vertex is given by the equation: $x = -\frac{b}{2a}$

Example 1

Find the vertex of the graph of the equation.

$$y = x^2 - 6x + 5$$

$$a = 1$$

$$b = -6$$

$$c = 5$$

$$x = -\frac{b}{2a} = -\frac{-6}{2(1)} = 3$$

$$y = 3^2 - 6(3) + 5 = 9 - 18 + 5 = -4$$

$$(3, -4)$$

Example 2

Find the intercepts of the following equation.

$$y = x^2 - 6x + 5$$

Find the x-intercept by letting $y = 0$

$$x^2 - 6x + 5 = 0$$

$$(x - 5)(x - 1) = 0$$

$$x - 5 = 0 \text{ or } x - 1 = 0$$

$$x = 5 \qquad x = 1$$

Find the y-intercepts by letting $x = 0$

$$y = 0^2 - 6(0) + 5 = 5$$

Example 3

Find the intercepts of the following equation.

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

Find the x-intercept by letting $y=0$

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

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

$$(x - 2)(x - 1) = 0$$

$$x - 2 = 0 \text{ or } x - 1 = 0$$

$$x = 2 \qquad x = 1$$

Find the y-intercept by letting $x = 0$

$$y = -0^2 - 0 - 2 = 0 - 0 - 2 = -2$$

Example 4

Find the vertex and x-intercepts, and then make a sketch of the parabola.

$$y = x^2 - 2x$$

$$a = 1, b = -2$$

$$x = -\frac{-2}{2(1)} = \frac{2}{2} = 1$$

x-intercepts

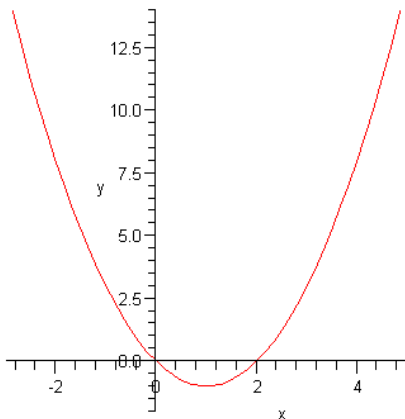
$$x^2 - 2x = 0$$

$$x(x-2) = 0$$

$$x = 0 \text{ or } x - 2 = 0$$

$$x = 0 \text{ or } x = 2$$

(0,0) and (2,0)

Graph

Example 5

Find the vertex and x-intercepts, and then make a sketch of the parabola.

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

Vertex

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

x-intercepts

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

$$x(x-3) = 0$$

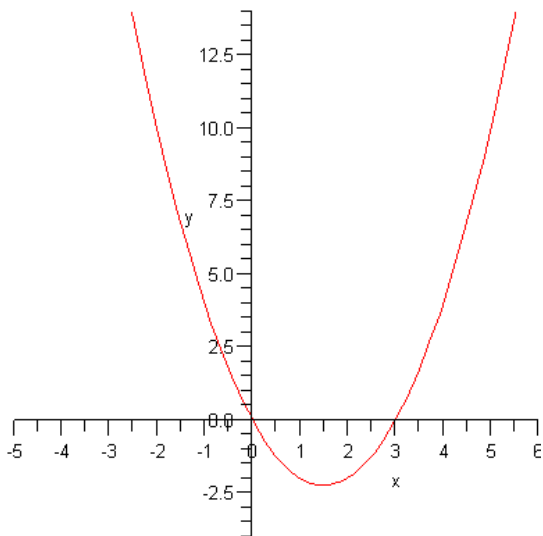
$$x = 0 \text{ or } x - 3 = 0$$

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

$$x = 3$$

(0,0) and (3,0)

Graph of the function



Example 6

vertex :

$$x = -\frac{-(-4)}{2(1)} = 2$$

$$y - \text{coordinate} : y = 2^2 - 4(2) + 3 = -1$$

x-intercepts

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

$$(x-3)(x-1) = 0$$

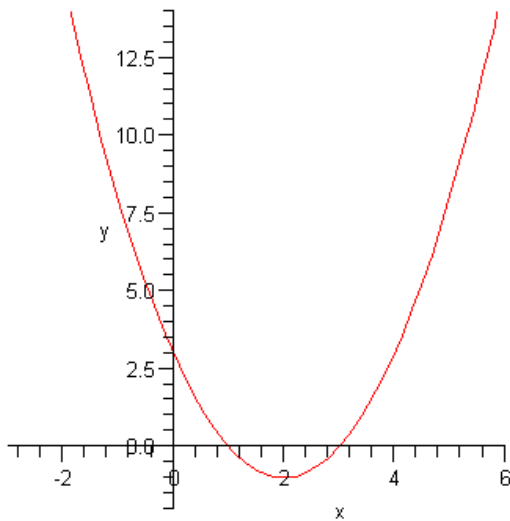
$$x-3=0 \quad \text{or} \quad x-1=0$$

$$x-3+3=0+3 \quad x-1+1=0+1$$

$$x=3 \quad \quad \quad x=1$$

(1,0) and (3,0)

Graph



Example 7

Find the vertex and x-intercepts, and then make a sketch of the parabola.

$$y = x^2 - 3$$

$$a = 1, c = -3$$

$$x = -\frac{0}{2(1)} = -\frac{0}{2} = 0$$

x-intercepts

$$x^2 - 3 = 0$$

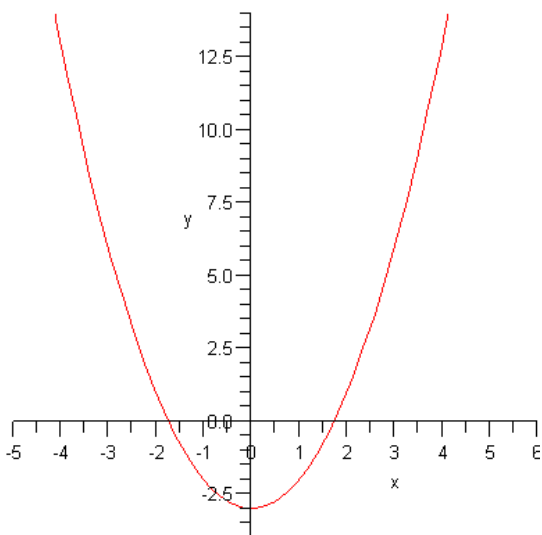
$$x^2 = 3$$

$$\sqrt{x^2} = \sqrt{3}$$

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

$$(\sqrt{3}, 0) \text{ and } (-\sqrt{3}, 0)$$

Graph



Example 8

The path of a ball thrown by a boy is given in yards by the equation $y = -.04x^2 + 1.5x$ where x is the horizontal distance the ball travels and y is the height of the ball. Find the maximum height of the ball in yards.

Find the vertex of the ball

$$x = -\frac{1.5}{2(-.04)} = \frac{1.5}{.08} = 18.75$$

$$y = -.04(18.75)^2 + 1.5(18.75) = -14.1 + 28.1 = 14 \text{ yards}$$

Example 9

The path of a cannon ball is given in feet by the equation $y = -.1x^2 + 6.0x$ where x is the horizontal distance the ball travels and y is the height of the cannon ball. Find the maximum height of the cannon ball in feet.

Find the vertex of the cannon ball.

$$x = -\frac{6.0}{2(-.1)} = -\frac{6.0}{-.2} = 30$$

$$y = -.1(30)^2 + 6(30) = -90 + 180 = 90 \text{ feet}$$

Example 10

A pool is treated with a chemical to reduce the number algae in the pool t days after the treatment can be approximate by the function

$$A(t) = 30t^2 - 300t + 450$$

How many days after treatment will the pool have the least number algae?

$$x = -\frac{b}{2a} = -\frac{-300}{2(30)} = \frac{300}{60} = 5$$