

Section 2.1 – Quadratic Functions

Definition of a Quadratic Function

- Let a , b , and c be real numbers with $a \neq 0$,
The function $f(x) = ax^2 + bx + c$ is called a QUADRATIC function in standard form.
- “ a ” is called the leading coefficient
 - If the leading coefficient is positive, the parabola opens upward (like a smile)
 - If the leading coefficient is negative, the parabola opens downward (like a frown)
- All parabolas are symmetric with respect to a line called the axis of symmetry
(Or simply the *axis* of the parabola)
- The point where the axis intersects the parabola is the vertex of the parabola.

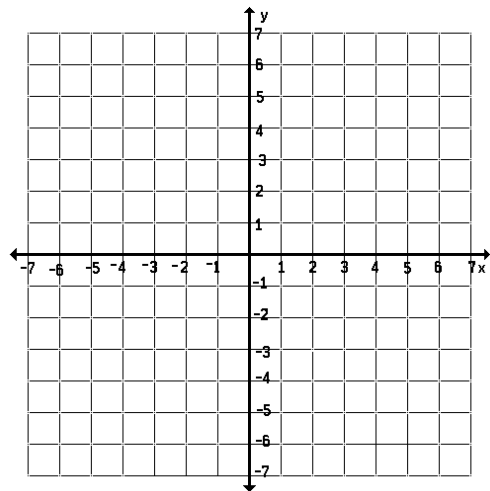
Vertex Form of a Quadratic Function

- The quadratic function $f(x) = a(x-h)^2 + k$, $a \neq 0$ is in vertex form.
- The graph of f is a parabola whose axis is the vertical line $x = h$ and whose vertex is (h,k) .

Examples

- 1) Sketch a graph of the parabola and identify the vertex and axis of symmetry of the parabola.

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



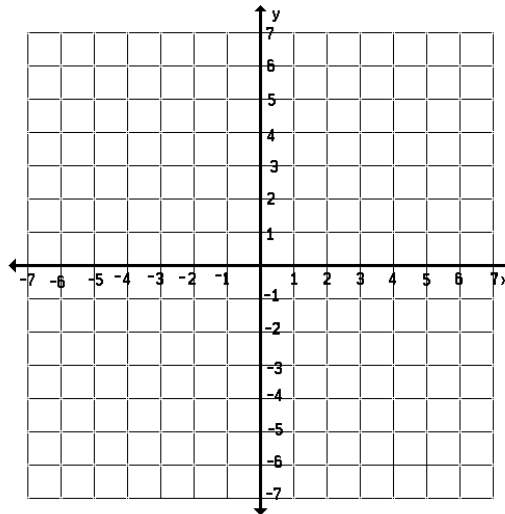
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If a quadratic function is in standard form, it is easier to find the vertex of the graph like this:

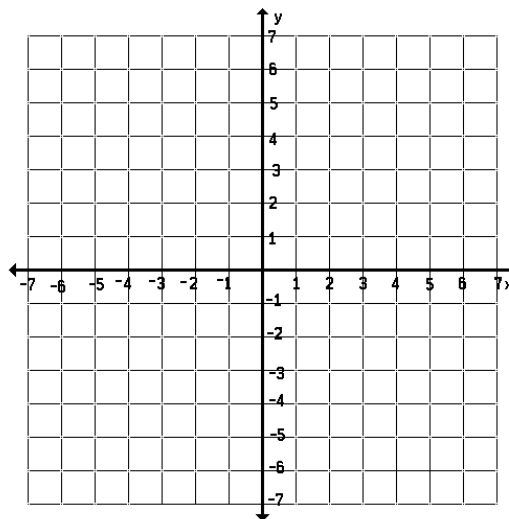
The vertex of $f(x) = ax^2 + bx + c$ is (h, k) , where $h = \frac{-b}{2a}$ and $k = f(h)$

2) Sketch a graph of the parabola and identify the vertex and x-intercepts of the parabola.

a) $g(x) = x^2 + 2x + 1$



b) $f(x) = x^2 + 2x - 30$



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3) The Maximum Height of a Baseball

A baseball is hit at a point 3 feet above the ground at a velocity of 100 feet per second and at an angle of 45 degrees with respect to the ground. The path of the baseball is given by the function

$$f(x) = -0.0032x^2 + x + 3$$

where $f(x)$ is the height of the baseball in feet, and x is the horizontal distance from home plate in feet.

What is the maximum height reached by the baseball?

4) Finding the Vertex of a Parabola by completing the square! (instead of using $h = \frac{-b}{2a}$)

(note: this method is easiest to use when $a = 1$)

a) $f(x) = x^2 + 8x + 11$

Vertex: _____

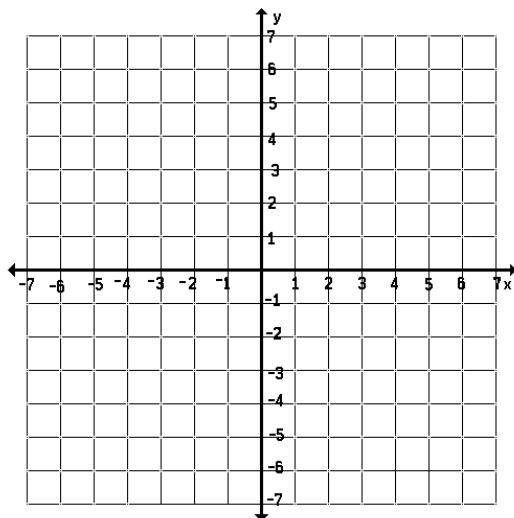
b) $f(x) = x^2 - 14x + 9$

Vertex: _____

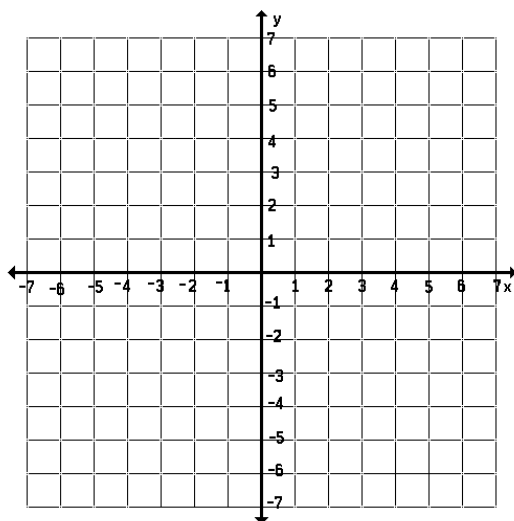
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5) Writing the Equation of a Parabola

- a) Write the vertex form of the equation of the parabola whose vertex is $(1,2)$ and that passes through the point $(0,0)$.
Sketch a graph too!



- b) Write the vertex form of the equation of the parabola whose vertex is $(4,-1)$ and that passes through the point $(2,5)$.
Sketch a graph too!



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- 6) A study was done to compare the speed x (in miles per hour) with the mileage y (in miles per gallon) of an automobile. The results are shown in the table.

Speed, x	Mileage, y
15	22.3
20	25.5
25	27.5
30	29.0
35	28.8
40	30.0
45	29.9
50	30.2
55	30.4
60	28.8
65	27.4
70	25.3
75	23.3

- Use your graphing calculator to create a scatter plot of the data (STAT- EDIT—enter the data)
- Use the regression feature of the calculator to find a quadratic model for the data (STAT- CALC- QuadReg (VARS – Y-VARS – Y_1) – ENTER)
- Enter the equation you just found into the “ $y =$ ” so that it graphs the regression on top of the scatter plot.
- Estimate the speed for which the mileage is the **greatest**.

Homework Day 1: p.134 #1-8, 9, 13, 18, 24, 25, 37, 40, 44, 45, 53, 56, 65 (where it says “standard form” use “vertex form”)

Homework Day 1 ½: p.136, #77,78,79