NAME _____ DATE _____

8–8 *Linear and Quadratic Functions*

Objective: To graph linear and quadratic functions.

Vocabulary

Graph of a function The graph of an equation that defines a function.

Linear function A function defined by $f(x) = mx + b$. For example, $f(x) = 2x + 3$.

Quadratic function A function defined by $f(x) = ax^2 + bx + c\ (a \neq 0)$. For example, $f(x) = 2x^2 - x - 1$.

Parabola The graph of $f(x) = ax^2 + bx + c$, where the domain of f is the set of real numbers and $a \neq 0$. If $a > 0$, the parabola opens upward; if $a < 0$, the parabola opens downward.

Maximum point of a parabola The highest point on a parabola that opens downward; the point whose y-coordinate is the *greatest value* of the corresponding function.

Minimum point of a parabola The lowest point on a parabola that opens upward; the point whose y-coordinate is the *least value* of the corresponding function.

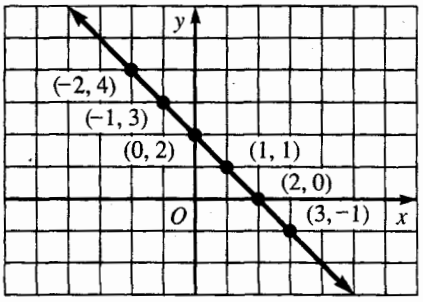
Axis of symmetry of a parabola The vertical line containing the maximum or minimum point of the parabola. The axis of symmetry of $y = ax^2 + bx + c\ (a \neq 0)$ is $x = -\frac{b}{2a}$.

Vertex of a parabola The maximum or minimum point of the parabola. The x-coordinate of the vertex of $y = ax^2 + bx + c\ (a \neq 0)$ is $x = -\frac{b}{2a}$.

Example 1 Graph the function h defined by the equation $y = h(x) = -x + 2$.

Solution Find the coordinates of selected points as shown in the table below. Plot the points and connect them with a line.

x	$-x + 2 = y$
-2	$-(-2) + 2 = 4$
-1	$-(-1) + 2 = 3$
0	$-(0) + 2 = 2$
1	$-(1) + 2 = 1$
2	$-(2) + 2 = 0$
3	$-(3) + 2 = -1$



Draw the graph of each linear function. You may wish to verify your graphs on a computer or a graphing calculator.

1. $g: x \to x - 2$

2. $f: x \to -x + 3$

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

4. $d(x) = -\frac{2}{3}x$

5. $h(x) = -4$

6. $n(x) = 5$

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8–8 *Linear and Quadratic Functions* *(continued)*

Example 2 Find the coordinates of the vertex of the function $g(x) = x^2 - 2x - 3$. Then give the equation of the axis of symmetry. Use the vertex and four other points to graph the equation.

Solution

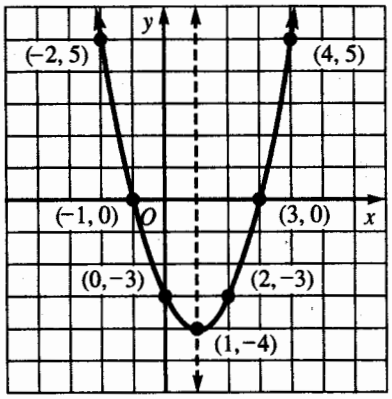
1. x-coordinate of vertex $= -\frac{b}{2a} = -\frac{-2}{2} = 1$

2. To find the y-coordinate of the vertex, substitute 1 for x.
   $y = x^2 - 2x - 3 = (1)^2 - 2(1) - 3 = 1 - 2 - 3 = -4$
   The vertex is $(1, -4)$.

3. The axis of symmetry is the line $x = 1$.

4. For values of x, select three numbers greater than 1 and three numbers less than 1 to obtain paired points with the same y-coordinate.

x	$x^2 - 2x - 3 = y$
-2	$(-2)^2 - 2(-2) - 3 = 5$
-1	$(-1)^2 - 2(-1) - 3 = 0$
0	$(0)^2 - 2(0) - 3 = -3$
1	$(1)^2 - 2(1) - 3 = -4$
2	$(2)^2 - 2(2) - 3 = -3$
3	$(3)^2 - 2(3) - 3 = 0$
4	$(4)^2 - 2(4) - 3 = 5$



5. Plot the points. Connect them with a smooth curve.

Find the vertex and the axis of symmetry of the graph of each equation. Use the vertex and at least four other points to graph the equation.

7. $y = 2 - x^2$ **8.** $y = -2x^2$ **9.** $y = x^2 - 3x$

10. $y = -x^2 + x$ **11.** $y = -x^2 - x + 2$ **12.** $y = x^2 + 2x - 3$

Mixed Review Exercises

Find the range of each function.

1. $f(x) = 2x^2 + 3, D = \{0, 1, 2\}$ **2.** $m(b) = b^3 + 4, D = \{-1, 1, 2\}$

Translate each phrase into a variable expression.

3. 3 times the sum of a number and 2

4. The difference between a number and 6

5. The product of a number and 7

6. 4 less than one half of a number