NAME ____________________

independent practice

Module 13 Solving Quadratic Equations of One Variable

Lesson 5 Solving Quadratic Equations by the Quadratic Formula

Solve each quadratic equation using the quadratic formula.

1. $n^2 + 4n + 4 = 0$

$\{-2\}$

2. $w^2 - 3w - 28 = 0$

$\{-4, 7\}$

3. $x^2 - 24 = -2x$

$\{-6, 4\}$

4. $y^2 - 15 = 2y$

$\{-3, 5\}$

5. $10y^2 + 29y = -10$

$\left\{-\frac{5}{2}, -\frac{2}{5}\right\}$

6. $3t^2 - 2t = -15$

$\varnothing$

7. $9x = 2x^2 - 4$

$\left\{\frac{9 + \sqrt{113}}{4}, \frac{9 - \sqrt{113}}{4}\right\}$

8. $3g + 5 = 4g^2$

$\left\{\frac{3 + \sqrt{89}}{8}, \frac{3 - \sqrt{89}}{8}\right\}$

9. $8m^2 - m - 1 = 0$

$\left\{\frac{1 + \sqrt{33}}{16}, \frac{1 - \sqrt{33}}{16}\right\}$

10. $-11b + 4 = 9b^2$

$\left\{\frac{-11 + \sqrt{265}}{18}, \frac{-11 - \sqrt{265}}{18}\right\}$

Use the discriminant to determine the number of solutions for each equation. Then, solve the equation using the value of the discriminant.

11. $-7 = m^2 - m$

$b^2 - 4ac = -27$; no real solution

$\varnothing$

12. $5x^2 = 3x - 10$

$b^2 - 4ac = -191$; no real solution

$\varnothing$

13. $-x = 5x^2 - 19$

$b^2 - 4ac = 381$; two real solutions

$\left\{\frac{-1 + \sqrt{381}}{10}, \frac{-1 - \sqrt{381}}{10}\right\}$

14. $9y^2 - 7y = 7$

$b^2 - 4ac = 301$; two real solutions

$\left\{\frac{7 + \sqrt{301}}{18}, \frac{7 - \sqrt{301}}{18}\right\}$

Journal

1. Explain why it is important to write quadratic equations in standard form before applying the quadratic formula.
2. What is meant by the symbol ± in the quadratic formula?
3. Annie solved the following quadratic equation using $a = 3$, $b = -1$, and $c = 2$. Will Annie get the correct solution? Explain.

$$3x^2 - x + 2 = 5$$

4. The quantity $b^2 - 4ac$ is called the *discriminant*. How does the discriminant determine whether a quadratic equation has zero, one, or two real number solutions? Explain.

Cumulative Review

Factor completely.

1. $20 - 5r$

   $5(4 - r)$

2. $t^2 + 5t + 6$

   $(t + 2)(t + 3)$

3. $3t^2 - 300$

   $3(t + 10)(t - 10)$

4. $30x^2 - 5x - 10$

   $5(2x + 1)(3x - 2)$

5. $-2x^3 - 2x^2 + 5x + 5$

   $(-2x^2 + 5)(x + 1)$

6. $x^4 - 625$

   $(x^2 + 25)(x + 5)(x - 5)$

Solve by evaluating square roots, factoring, or completing the square.

7. $x^2 = 121$

   $\{-11, 11\}$

8. $(x + 4)^2 = -100$

   $\varnothing$

9. $x^2 + 6x - 20 = 0$

   $\{-3 + \sqrt{29}, -3 - \sqrt{29}\}$

10. $5(x - 1)^2 - 2 = 18$

    $\{-1, 3\}$

Possible Journal Answers

1. It is easiest to identify the values of the constants a, b, and c when the quadratic equation is in standard form, $ax^2 + bx + c = 0$.

2. The symbol ± means "plus or minus" and can be used to express two answers of a quadratic equation in one simplified form.

3. No, Annie will not get the correct solution because she did not put the equation in standard form and, therefore, listed an incorrect value for c. The equation should be written as $3x^2 - x - 3 = 0$, and the value of c is -3.

4. When the discriminant is negative, there is a negative number under the radical sign in the quadratic formula, so there is no real number solution. When the discriminant is zero, there is one real number solution because the expression $\frac{-b \pm \sqrt{0}}{2a}$ is the same, $\frac{-b}{2a}$, in both cases. When the discriminant is positive, there are two real number solutions, one when there is a sum in the numerator of $\frac{-b + \sqrt{b^2 - 4ac}}{2a}$ and one when there is a difference: $\frac{-b - \sqrt{b^2 - 4ac}}{2a}$.

Graphing Calculator Problem

A quadratic function is of the form $y = ax^2 + bx + c$, where $a \neq 0$. The graph of every quadratic function is a parabola that opens either upward or downward. Such a parabola can intersect the *x*-axis at zero, one, or two points. The *x*–coordinates of these points are called the *x*–intercepts of the graph.

A linear function is of the form $y = ax + b$ (more commonly, $y = mx + b$). The graph of every linear function is a line. Unless the line is the *x*–axis, a line can intersect the *x*–axis in at most one place. So, the graph of all linear functions except $y = 0$ has exactly one *x*–intercept.

The solution(s) to the quadratic equation $ax^2 + bx + c = 0$, where $a \neq 0$, is/are the *x*–intercepts of the graph of the quadratic function $y = ax^2 + bx + c$. The solution to the linear equation $ax + b = 0$, where $a \neq 0$, is the *x*-intercept of the graph of the linear function $y = ax + b$.

You can use your graphing calculator to determine whether an equation is a *linear equation* or a *quadratic equation*.

Follow the steps below to determine whether the equation $x - 4x^2 = 5$ is linear, quadratic, or neither.

1. Write the equation in standard form (one side in decreasing degree of *x*; the other side equal to zero): $0 = 4x^2 - x + 5$
2. Substitute *y* for zero to write the associated function: $y = 4x^2 - x + 5$.
3. Enter the function $y = 4x^2 - x + 5$ into the calculator; press [Y=] then [CLEAR] (if needed). With the cursor on the line Y_1= (user the arrow keys to move it there, if necessary), press [4] [X,T,θ,n] [x^2] [−] (do NOT use the [(−)] key) [X,T,θ,n] [+] [5]. See Figure 1.
4. Graph the function; press [GRAPH]. Press [ZOOM] [6] to use the standard window. See Figure 2
5. Look at the shape of the graph. If it is a line, the equation is *linear*. If it is a parabola, it is *quadratic*. If it is neither a line nor a parabola, the function is neither linear nor quadratic. Because the graph of this function is U–shaped, the equation $x - 4x^2 = 5$ is quadratic. Because the parabola does not intersect the *x*–axis, the equation $x - 4x^2 = 5$ has no real number solutions.

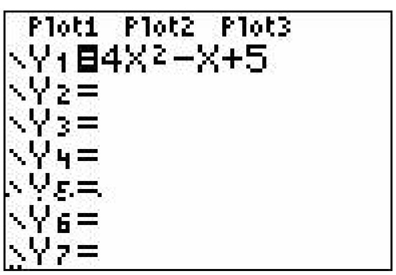

Figure 1

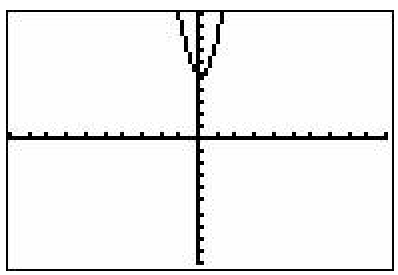

Figure 2

Use your calculator to determine whether each equation is *linear, quadratic,* or *neither*.

1. $4s^2 - 5 = 0$

   Quadratic

2. $3x + 4x^2 = 5$

   Quadratic

3. $d^2(d + 4) = 0$

   Neither

4. $(x - 3)^2 = x^2$

   Linear