

NAME \_\_\_\_\_

DATE \_\_\_\_\_

**Module 13** Solving Quadratic Equations  
of One Variable

**Lesson 4** Solving Quadratic Equations  
by Completing the Square



**independent  
practice**

**Complete the square.**

1.  $x^2 + 14x + \underline{\hspace{2cm}}$

2.  $x^2 - 12x + \underline{\hspace{2cm}}$

3.  $y^2 + 3y + \underline{\hspace{2cm}}$

4.  $n^2 - 5n + \underline{\hspace{2cm}}$

5.  $H^2 + \underline{\hspace{2cm}}H + 64$

6.  $x^2 - \underline{\hspace{2cm}}x + 81$

**Factor.**

7.  $x^2 + 6x + 9$   
\_\_\_\_\_

8.  $z^2 + 12z + 36$   
\_\_\_\_\_

9.  $m^2 - 7m + \frac{49}{4}$   
\_\_\_\_\_

10.  $x^2 - 11x + \frac{121}{4}$   
\_\_\_\_\_

**Solve by completing the square.**

11.  $x^2 + 10x = 1$   
\_\_\_\_\_

12.  $x^2 + 14x = -2$   
\_\_\_\_\_

13.  $c^2 - 8c - 5 = 0$   
\_\_\_\_\_

14.  $P^2 - 18P + 28 = 0$   
\_\_\_\_\_

15.  $x^2 + 2 = 11 - 8x$   
\_\_\_\_\_

16.  $x^2 + 14 = 6x + 5$   
\_\_\_\_\_

17.  $3r^2 - 12r + 4 = 10$   
\_\_\_\_\_

18.  $4H^2 + 32H + 20 = 4$   
\_\_\_\_\_

19.  $20x + 5x^2 + 30 = 10$   
\_\_\_\_\_

20.  $9 + 2B^2 - 6B = 5$   
\_\_\_\_\_

21.  $8 + 3w^2 + 6w = 5$   
\_\_\_\_\_

22.  $3x + 9x^2 - 7 = -3$   
\_\_\_\_\_

## Journal

1. Abe and Sarah were given the expression  $x^2 - 16x + \underline{\hspace{2cm}}$  and asked to complete the square. Abe said the answer is  $x^2 - 16x + 256$ , and Sarah said the answer is  $x^2 - 16x + 8$ . Is either student correct? Explain.
2. What are the steps for solving a quadratic equation by completing the square?
3. Explain the process for completing the square in the expression  $x^2 - \underline{\hspace{2cm}}x + 36$ .
4. Richard and Janelle are challenged with solving the equation  $x^2 - 12x + 17 = 13$ . Richard believes the solutions are 13 and  $-1$ . Janelle believes the solutions are  $6 + \sqrt{32}$  and  $6 - \sqrt{32}$ . Is either student correct? Describe any possible errors and explain the process for finding the correct solutions.
5. True or False: The solution set for the equation  $7x^2 + 4x + 3 = 5$  is  $\left\{-\frac{2}{7} + \frac{\sqrt{18}}{7}, -\frac{2}{7} - \frac{\sqrt{18}}{7}\right\}$ . Explain.

## Cumulative Review

Determine if the equation is quadratic, linear or neither.

1.  $2x^2 - 3x = 2x^2 - 4x + 1$

\_\_\_\_\_

2.  $(z + 2)(z - 2) = 0$

\_\_\_\_\_

3.  $d^2(d + 5) = d^3 + 9$

\_\_\_\_\_

4.  $f^2(f^2 + 5f) = f^4 + f^2$

\_\_\_\_\_

Solve by factoring or by evaluating square roots.

5.  $4x^2 - 11 = 53$

\_\_\_\_\_

6.  $3(x + 4)^2 - 16 = 32$

\_\_\_\_\_

7.  $(x - 5)(x + 3) = -7$

\_\_\_\_\_

8.  $(x + 7)(x - 4) = 0$

\_\_\_\_\_

9.  $4x^2 + 12x - 7 = 9$

\_\_\_\_\_

10.  $-5x^2 + 17x = 2x$

\_\_\_\_\_

## Graphing Calculator Problem

Follow the steps below to solve the equation  $x^2 + 8x - 20 = 10$  by graphing the associated quadratic function and finding the x-intercepts. When  $y = 0$  at the x-intercepts, the associated quadratic function becomes the original equation.

1. First, replace the equation with an equivalent equation of the form  $ax^2 + bx + c = 0$ . In this case, subtract 10 from both sides of the equation. The equation becomes  $x^2 + 8x - 30 = 0$ .
2. Enter the associated quadratic function  $y = x^2 + 8x - 30$  into the calculator: Press  $\boxed{Y=}$  then  $\boxed{\text{CLEAR}}$  (if needed). With the cursor on the line  $Y_1=$  (use the arrow keys to move it there, if necessary), press  $\boxed{\text{x.T.}\theta/n}$   $\boxed{x^2}$   $\boxed{+}$   $\boxed{8}$   $\boxed{\text{x.T.}\theta/n}$   $\boxed{-}$  (do NOT use the  $\boxed{(-)}$  key)  $\boxed{3}$   $\boxed{0}$ . See Figure 1.
3. Graph the function; press  $\boxed{\text{ZOOM}}$   $\boxed{6}$  to use the standard window. See Figure 2. This window does not show enough of the graph; press  $\boxed{\text{ZOOM}}$   $\boxed{3}$   $\boxed{\text{ENTER}}$  to zoom out.
4. The x-intercepts (the x-values of the points where the graph crosses the x-axis) are the x values that make  $y = 0$ . This means that the x-intercepts make  $x^2 + 8x - 30 = 0$  true and are, therefore, the solutions to the original equation.
5. Find the (approximate) first x-intercept; press  $\boxed{2nd}$   $\boxed{\text{CALC}}$   $\boxed{2}$ . **Left Bound?** will appear in the lower left hand corner of the screen. Use the left and right arrow keys to move the cursor just above the x-axis, to the left of what appears to be the first x-intercept. Press  $\boxed{\text{ENTER}}$ . **Right Bound?** will appear in the lower left hand corner of the screen. Use the right arrow key to move the cursor just below the x-axis to the right of this x-intercept. Press  $\boxed{\text{ENTER}}$ . **Guess?** will appear in the lower left hand corner of the screen; press  $\boxed{\text{ENTER}}$ . **x = -10.78233 y = 0** appear in the lower left hand corner of the screen. See Figure 3. These values represent the point  $(-10.78233, 0)$  on the graph, where  $-10.78233$  is the calculator's decimal approximation for the true solution, which is irrational. Write this approximate solution on your paper.
6. Repeat Step 5 to identify the approximate value of the other x-intercept. Remember to use the left and right arrow keys to move the cursor just to the left of the second x-intercept and then just to the right of the second x-intercept. See Figure 4. You should get 2.78233 as the calculator's decimal approximation.
7. Finally, write the set of approximate solutions for the equation  $x^2 + 8x - 20 = 10$ :  $\{-10.78233, 2.78233\}$



Figure 1

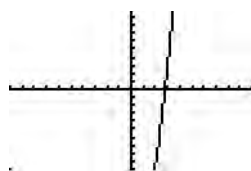


Figure 2

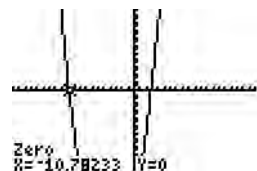


Figure 3

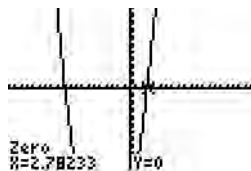


Figure 4

Use the graphing calculator to solve (find the approximate roots of) these equations.

1.  $4x^2 - 9x + 4 = 6$

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2.  $-3n^2 + 9n - 1 = 2$

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3.  $-17D^2 - 31D + 7 = -12$

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4.  $\frac{1}{6}x^2 - 8x + 7 = 27$

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