9.5 Completing the Square (Day 1)

* In 9.4 you were able to solve quadratic equations by finding square roots & factoring. Not all equations can be solved this way.

* Another method for solving quadratic equations is by completing the square.

* This method will work for any quadratic equation.

* Goal: Make a perfect square, so you can take the square root of each side & then solve for your variable.

* Review Problem 1 on pg. 577 & then solve

$x^2 - 16x + c$

Steps to find "c"

① Rewrite equation to $x^2 - 16x + \left(\frac{b}{2}\right)^2$

* Think about why $\left(\frac{b}{2}\right)^2 = c$ ... Since it is a perfect trinomial square, the value must be squared & you are dividing the value of b by 2 b/c the outside & inside terms double to make the middle term.

$$x^2 - 16x + \left(\frac{-16}{2}\right)^2$$

(2) Solve for "c" (Write as a square)

$x^2 - 16x + 64$

* Remember "c" cannot be negative. You cannot get a negative from squaring a #.

(3) Solve the equation by factoring

$x^2 - 16x + 64 = 0$ * Perfect Trinomial Square

$(x-8)(x-8)$

or

$(x-8)^2 = 0$

$x = 8$

* Got it #1) Find c & Solve

$x^2 + 20x + c$

$x^2 + 20x + \left(\frac{-20}{2}\right)^2$

$x^2 + 20x + 100$

$(x+10)(x+10) = 0$

$x = -10$

What if it is NOT a perfect trinomial square?

* Review Problem 2 on pg. 577

* (Got it #2) Solve for x

A) $x^2+9x+15=0$

$-15 \quad -15$

$x^2+9x=-15$

* Start to isolate "x" by moving the constant

$x^2+9x+\left(\frac{9}{2}\right)^2=-15+\left(\frac{9}{2}\right)^2$

* Add $\left(\frac{9}{2}\right)^2$ to each side of the equation (Property of Equality)

$x^2+9x+\left(\frac{9}{2}\right)^2=-15+\left(\frac{9}{2}\right)^2$

* Now I have a perfect trinomial square... it is just decimals.

$x^2+9x+20.25=-15+20.25$

$(x+4.5)^2=5.25$

$\sqrt{(x+4.5)^2}=\sqrt{5.25}$

* Round to the nearest hundredth

$x+4.5=\pm 2.29$

$x+4.5=-2.29$ $\qquad$ $x+4.5=2.29$

$x=-6.79$ $\qquad$ $x=-2.21$

$x=-6.79, -2.21$

B) No, there are no factors of 15 with a sum of 9

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9-5 Practice

Form K

Completing the Square

Find the value of c such that each expression is a perfect-square trinomial.

1. $z^2 + 2z + c$

2. $h^2 + 14h + c$

3. $p^2 - 11p + c$

4. $n^2 + 26n + c$

Solve each equation by completing the square. If necessary, round to the nearest hundredth.

5. $t^2 - 17t = -52$

6. $m^2 + 6m = 7$

7. $f^2 + 3f = 88$

8. $z^2 + 9z = 36$

9. $a^2 + 13a = 12$

10. $g^2 + 5g + 4 = 0$

11. $d^2 + 7d + 9 = 0$

12. $b^2 - 5b - 10 = 0$

Solve each equation by completing the square. If necessary, round to the nearest hundredth.

13. $6n^2 + 9n = 12$

14. $2t^2 - 4t = 1$

15. $3v^2 + 9v + 5 = 0$

16. $4c^2 - 8c = 1$

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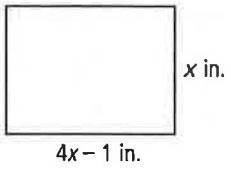
9-5 Practice (continued) *Form K*

Completing the Square

17. The rectangle shown at the right has an area of 663 in^2. What is the value of x?



18. What are all of the values of b that will make $x^2 + bx + 64$ a perfect square?

19. What are all of the values of b that will make $x^2 + bx + 144$ a perfect square?

20. The product of two consecutive positive even integers is 168. What are the integers?

21. **Writing** Discuss how you could use graphing, factoring, and completing the square for solving the quadratic equation $x^2 + 3x - 2 = 0$.

22. The height of a triangle is $6x$ cm and the base is $(3x + 10)$ cm. The area of the triangle is 816 cm^2. What are the dimensions of the base and height of the triangle?

23. **Writing** Does completing the square always give a solution for a quadratic equation that cannot be factored? Explain.

24. **Reasoning** How do the solutions of the equation $x^2 - 6x + 9 = 16$ compare to the solutions of $x^2 - 6x + 9 = 25$? Explain how you can determine the relationship without solving both equations.

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9-5 Practice Key

Completing the Square

Form K

Find the value of c such that each expression is a perfect-square trinomial.

1. $z^2 + 2z + c$ 1

2. $h^2 + 14h + c$ 49

3. $p^2 - 11p + c$ $\frac{121}{4}$

4. $n^2 + 26n + c$ 169

Solve each equation by completing the square. If necessary, round to the nearest hundredth.

5. $t^2 - 17t = -52$ 4, 13

6. $m^2 + 6m = 7$ −7, 1

7. $f^2 + 3f = 88$ −11, 8

8. $z^2 + 9z = 36$ −12, 3

9. $a^2 + 13a = 12$ −13.87, 0.87

10. $g^2 + 5g + 4 = 0$ −4, −1

11. $d^2 + 7d + 9 = 0$ −5.3, −1.7

12. $b^2 - 5b - 10 = 0$ −1.53, 6.53

Solve each equation by completing the square. If necessary, round to the nearest hundredth.

13. $6n^2 + 9n = 12$ −2.35, 0.85

14. $2t^2 - 4t = 1$ −0.22, 2.22

15. $3v^2 + 9v + 5 = 0$ −2.26, −0.74

16. $4c^2 - 8c = 1$ −0.12, 2.12

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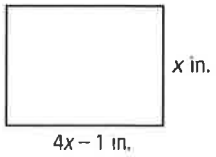
9-5 Practice (continued) Form K

Completing the Square

17. The rectangle shown at the right has an area of 663 in^2. What is the value of x? 13



18. What are all of the values of b that will make $x^2 + bx + 64$ a perfect square? ±16

19. What are all of the values of b that will make $x^2 + bx + 144$ a perfect square? ±24

20. The product of two consecutive positive even integers is 168. What are the integers? 12 and 14

21. **Writing** Discuss how you could use graphing, factoring, and completing the square for solving the quadratic equation $x^2 + 3x - 2 = 0$.

Factoring cannot be used because $x^2 + 3x - 2$ cannot be factored. Graphing will give you an answer that is not precise. Completing the square will give you a precise answer.

22. The height of a triangle is $6x$ cm and the base is $(3x + 10)$ cm. The area of the triangle is 816 cm^2. What are the dimensions of the base and height of the triangle?

height = 48 in.; base = 34 in.

23. **Writing** Does completing the square always give a solution for a quadratic equation that cannot be factored? Explain.

No, some quadratic equations do not have a solution.

24. **Reasoning** How do the solutions of the equation $x^2 - 6x + 9 = 16$ compare to the solutions of $x^2 - 6x + 9 = 25$? Explain how you can determine the relationship without solving both equations.

Solve each equation by factoring the left side as a perfect square trinomial and taking the square roots of both sides. The solutions are 3 ± 4, or -1 and 7. The solutions of the second equation are 3 ± 5, or -2 and 8.