

Name: Key Date: \_\_\_\_\_

## Solving Quadratic Equations by Completing the Square

Today's Question: When is it useful to solve quadratics by completing the square?

MCC9-12.A.REI.4b

### Solving Quadratic Equations by Completing the Square

1. Rewrite so all terms containing  $x$  are on one side.
2. Find the number that completes the square on the left side of the equation. Add that number to both sides. **(Half it, Square it, Add it!)**
3. Factor the perfect square trinomial on the left side of the equation. Simplify the right side of the equation.
4. Take the square root of each side.
5. Solve for  $x$ .
6. Check your answers!!!

Solve each equation.

1.  $x^2 - 10x - 54 = 0$

$$x^2 - 10x = 54$$

$$x^2 - 10x + 25 = 54 + 25$$

$$(x - 5)^2 = 79$$

$$x - 5 = \pm\sqrt{79}$$

$$\boxed{x = 5 \pm \sqrt{79}}$$

2.  $x^2 - 18x + 77 = 0$

$$x^2 - 18x = -77$$

$$x^2 - 18x + 81 = -77 + 81$$

$$(x - 9)^2 = 4$$

$$x - 9 = \pm 2$$

$$x = 9 \pm 2 = \boxed{11, 7}$$

3.  $x^2 + 6x - 72 = -8$

$$x^2 + 6x = 64$$

$$x^2 + 6x + 9 = 64 + 9$$

$$(x + 3)^2 = 73$$

$$x + 3 = \pm\sqrt{73}$$

$$x = -3 \pm \sqrt{73}$$

4.  $x^2 + 20x - 73 = 2$

$$x^2 + 20x = 75$$

$$x^2 + 20x + 100 = 75 + 100$$

$$(x + 10)^2 = 175$$

$$x + 10 = \pm\sqrt{175}$$

$$\boxed{x = -10 \pm 5\sqrt{7}}$$

5.  $x^2 + 6x = 12$

$$x^2 + 6x + 9 = 12 + 9$$

$$(x + 3)^2 = 21$$

$$x + 3 = \pm\sqrt{21}$$

$$x = -3 \pm \sqrt{21}$$

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

$$x^2 + 20x = -6$$

$$x^2 + 20x + 100 = -6 + 100$$

$$(x + 10)^2 = 94$$

$$x + 10 = \pm\sqrt{94}$$

$$\boxed{x = -10 \pm \sqrt{94}}$$

Try these on your own.

Solve each equation.

1.  $x^2 + 2x - 3 = 0$

$$x^2 + 2x = 3$$

$$x^2 + 2x + 1 = 3 + 1$$

$$(x+1)^2 = 4$$

$$x+1 = \pm 2$$

$$x = -1 \pm 2 = \boxed{1, -3}$$

2.  $x^2 = 6x + 4$

$$x^2 - 6x = 4$$

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

$$(x-3)^2 = 13$$

$$x-3 = \pm \sqrt{13}$$

$$x = 3 \pm \sqrt{13}$$

3.  $x^2 - 14x - 75 = 8$

$$x^2 - 14x = 83$$

$$x^2 - 14x + 49 = 83 + 49$$

$$(x-7)^2 = 132$$

$$x-7 = \pm \sqrt{132}$$

$$x = 7 \pm 2\sqrt{33}$$

4.  $x^2 - 16x - 56 = 6$

$$x^2 - 16x = 62$$

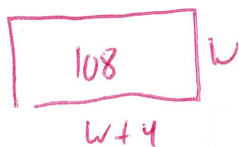
$$x^2 - 16x + 64 = 62 + 64$$

$$(x-8)^2 = 126$$

$$x-8 = \pm \sqrt{126}$$

$$x = 8 \pm 3\sqrt{14}$$

5. The length of a rectangle is 4 cm greater than its width. If the area of the rectangle is  $108 \text{ cm}^2$ , what are the approximate dimensions of the rectangle?



$$w(w+4) = 108$$

$$w^2 + 4w = 108$$

$$w^2 + 4w + 4 = 108 + 4$$

$$w^2 + 4w + 4 = 112$$

$$w+2 = \pm \sqrt{112}$$

$$w = -2 \pm 4\sqrt{7}$$

6. If the volume of this box is  $96 \text{ cm}^3$ , find the dimensions of the box.

$$2(x-2)(x-4) = 96$$

$$2(x^2 - 4x - 2x + 8) = 96$$

$$2x^2 - 8x - 4x + 16 = 96$$

$$2x^2 - 12x + 16 = 96$$

$$\frac{2x^2}{2} - \frac{12x}{2} + \frac{16}{2} = \frac{96}{2}$$

$$x^2 - 6x + 8 = 48$$

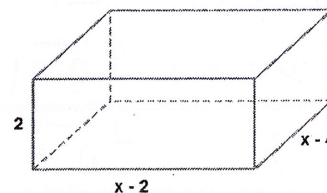
$$x^2 - 6x = 40$$

$$x^2 - 6x + 9 = 40 + 9$$

$$(x-3)^2 = 49$$

$$x-3 = \pm 7$$

$$x = 3 \pm 7 = 10, \cancel{4}$$



$$\boxed{2 \times 8 \times 6}$$