By the end of the lesson, we will be able to:

$x^2 = 0$

~ Solve quadratic equations by completing the square.

Look for a pattern...

Multiply:

a.) $(x+9)^2$

$= (x+9)(x+9)$

$= x^2+9x+9x+81$

$= x^2+18x+81$

b.) $(x+12)^2$

$= (x+12)(x+12)$

$= x^2+24x+144$

Look for a pattern...

Multiply:

c.) $(x+2)^2$

$= (x+2)(x+2)$

$= x^2+4x+4$

d.) $(x+5)^2$

$= x^2+10x+25$

Have you noticed a pattern between the middle term and the last term?

$C = \left(\frac{b}{2}\right)^2$

Have you noticed a pattern between the middle term and the last term?

$$ax^2 + bx + c, \quad where \; c = \left(\frac{b}{2}\right)^2$$

Find the missing part (k).

Then put in $(x + \frac{b}{2})^2$ form.

a.) $x^2 + 4x + k$

$k = \left(\frac{b}{2}\right)^2$

$k = \left(\frac{4}{2}\right)^2$

$= (2)^2$

$k = 4$

$(x+2)^2$

b.) $x^2 - 6x + k$

$b = -6$

$k = \left(\frac{-6}{2}\right)^2$

$= (-3)^2$

$k = 9$

$(x-3)^2$

Steps for Solving Quadratics by Completing the Square:

$ax^2+bx+c=0$

Step 0:	Divide everything by "a" if "a" is something other than 1.
Step 1:	Move the constant to the right side of the equation. → no x's
Step 2:	Identify "b". Divide "b" by 2. $\left(\frac{b}{2}\right)$
Step 3:	Square $\left(\frac{b}{2}\right)$. Add $\left(\frac{b}{2}\right)^2$ to both sides of the equation.

Steps for Solving Quadratics by Completing the Square:

Step 4:	Factor the left side. Hint: It will look like $(x + \frac{b}{2})^2 =$ _____.
Step 5:	Combine terms on right side. (You are adding the numbers together).
Step 6:	Solve for x. Hint: Start by taking the square root of both sides. Remember to put $\pm$ with the square root.

Solve the equation by completing the square:

Example 1: $x^2 - 6x = 40$

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

$(x-3)^2 = 49$

$\sqrt{(x-3)^2} = \pm\sqrt{49}$

$x - 3 = \pm 7$

$+3 \quad +3$

$x = 3 \pm 7$ → $x = 3+7$ $x = 10$ $x = 3-7$ $x = -4$

$b = -6$

$\frac{b}{2} = -3$

$\left(\frac{b}{2}\right)^2 = 9$

Solve the equation by completing the square:

Example 2: $x^2 + 7x - 17 = 0$

$+17 \quad +17$

$x^2 + 7x + \frac{49}{4} = 17\frac{.4}{.4} + \frac{49}{4}$

$b = 7$

$\frac{b}{2} = \frac{7}{2}$

$\left(\frac{b}{2}\right)^2 = \frac{49}{4}$

$\left(x + \frac{7}{2}\right)^2 = \frac{68}{4} + \frac{49}{4}$

$\sqrt{\left(x+\frac{7}{2}\right)^2} = \pm\sqrt{\frac{117}{4}}$

$x + \frac{7}{2} = \pm\frac{\sqrt{117}}{2}$

$x + \frac{7}{2} = \pm\frac{3\sqrt{13}}{2}$

$$x + \frac{7}{2} = \pm\frac{3\sqrt{13}}{2}$$

$$-\frac{7}{2} \qquad -\frac{7}{2}$$

$$x = \frac{-7}{2} \pm \frac{3\sqrt{13}}{2}$$

or

$$x = \frac{-7 \pm 3\sqrt{13}}{2}$$

Solve the equation by completing the square:

Example 3: $x^2 + 8x + 20 = 0$

$-20 \quad -20$

$x^2 + 8x + 16 = -20 + 16$

$b = 8$

$\frac{b}{2} = 4$

$\left(\frac{b}{2}\right)^2 = 16$

$\sqrt{(x+4)^2} = \pm\sqrt{-4}$

$x + 4 = \pm 2i$

$-4 \quad -4$

$x = -4 \pm 2i$

Solve the equation by completing the square:

Example 4: $\frac{2x^2}{2} + \frac{8x}{2} + \frac{22}{2} = \frac{0}{2}$

$x^2 + 4x + 11 = 0$

$-11 \quad -11$

$x^2 + 4x + 4 = -11 + 4$

$b = 4$

$\frac{b}{2} = 2$

$\left(\frac{b}{2}\right)^2 = 4$

$\sqrt{(x+2)^2} = \pm\sqrt{-7}$

$x + 2 = \pm i\sqrt{7}$

$-2 \quad -2$

$x = -2 \pm i\sqrt{7}$

Solve the equation by completing the square:

Example 5: $x^2 + 6x + 9 = 0$

$b = 6$

$\frac{b}{2} = 3$

$\left(\frac{b}{2}\right)^2 = 9$

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

$\sqrt{(x+3)^2} = \pm\sqrt{0}$

$x + 3 = \pm 0$

$-3 \quad -3$

$x = -3$ $\quad x = 3$

Solve the equation by completing the square:

Example 6: $\frac{ax^2}{a} + \frac{bx}{a} + \frac{c}{a} = \frac{0}{a}$

$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$

$-\frac{c}{a} \quad -\frac{c}{a}$

$b = \frac{b}{a}$

$\frac{b}{2} = \frac{b}{2a}$

$\left(\frac{b}{2}\right)^2 = \frac{b^2}{4a^2}$

$x^2 + \frac{b}{a}x + \frac{b^2}{4a^2} = -\frac{c}{a} \cdot \frac{4a}{4a} + \frac{b^2}{4a^2}$

$\left(x + \frac{b}{2a}\right)^2 = \frac{-4ac}{4a^2} + \frac{b^2}{4a^2}$

$\left(x + \frac{b}{2a}\right)^2 = \frac{b^2 - 4ac}{4a^2}$

$$\sqrt{\left(x+\frac{b}{2a}\right)^2} = \pm\sqrt{\frac{b^2-4ac}{4a^2}}$$

$$x+\frac{b}{2a} = \pm\frac{\sqrt{b^2-4ac}}{2a}$$

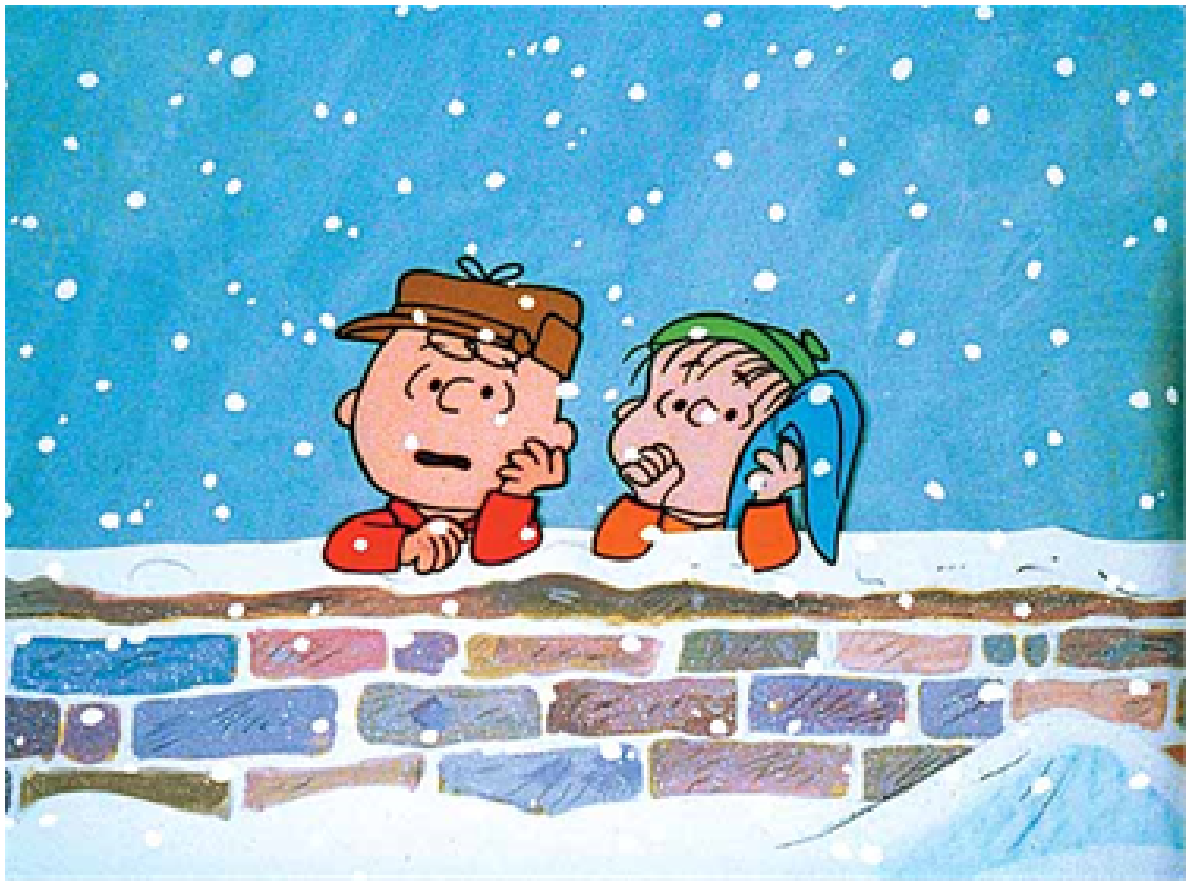
$$-\frac{b}{2a} \quad -\frac{b}{2a}$$

$$\boxed{x = \frac{-b\pm\sqrt{b^2-4ac}}{2a}}$$

By the end of the lesson, we will be able to:

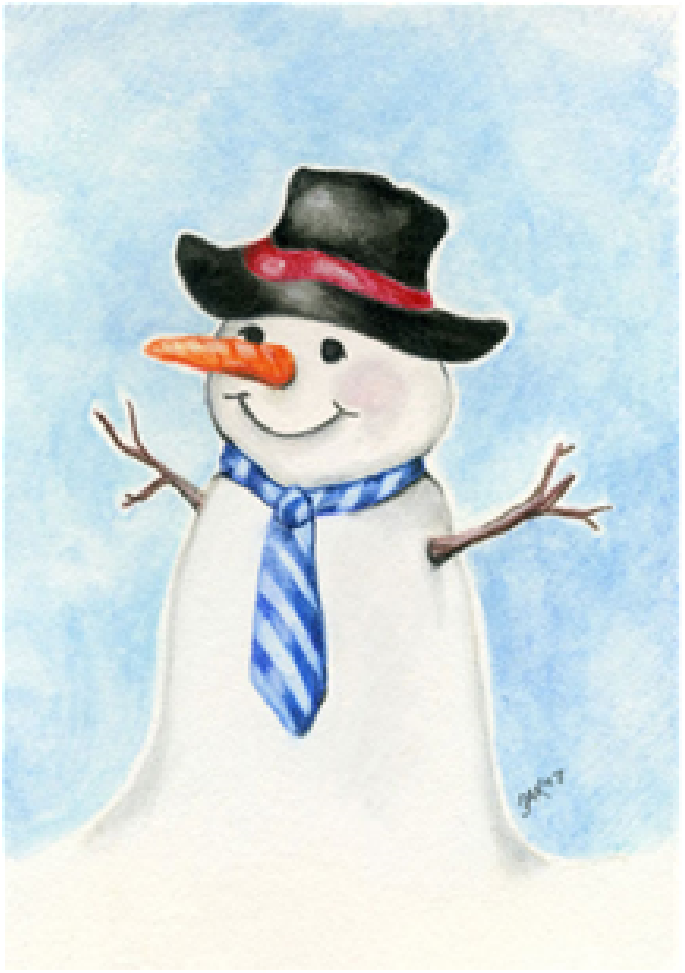
~ Solve quadratic equations by completing the square.

Can you?



Homework:

Assignment 30



Additional examples: (with A=something other than 1.

$4x^2 - 5x - 21 = 0$

$2x^2 - 7x + 12 = 0$