**9.5 Notes** **Completing the Square** **Name** _____

What do we need to add to these expressions to complete the square (create a perfect square)?

1. $x^2+6x+\underline{9}=(x+3)^2$

$x^2+3x+3x+9=(x+3)(x+3)$

2. $x^2-8x+\underline{16}=(x-4)^2$

$x^2-4x-4x+16=(x-4)(x-4)$

3. $x^2+10x+\underline{25}=(x+\underline{5})^2$

$\frac{10}{2}$ → 5

4. $x^2-12x+\_\_\_\_=(x-\_\_\_)^2$

How did you find the c value in $ax^2+bx+c$ ?

Divide b by 2 and square the result

How do you get the constant in $(x+\_\_\_)^2$ ?

→ $\left(\frac{b}{2}\right)$

**Ex. 1: Solve by completing the square.**

$x^2-14x+16=0$

$-16 \quad -16$

$x^2-14x+\underline{49}=-16+49$

$\left(\frac{-14}{2}\right)=-7 \qquad (-7)^2=49$

$\sqrt{(x-7)^2}=\sqrt{33}$

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

$+7 \quad +7$

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

1) Isolate the $ax^2+bx$ on one side.

2) Determine what you need to add to the left side to complete the square. **To keep the equation balanced, you need to add the same amount to each side.**

3) Write the left side as a squared binomial.

4) Solve the quadratic by taking the square root of both sides and continue to solve.

**Ex. 2: Solve by completing the square.**

$x^2+10x-9=0$

$+9 \quad +9$

$x^2+10x+\underline{25}=9+25$

$\frac{10}{2}=5 \qquad 5^2=25$

$\sqrt{(x+5)^2}=\sqrt{34}$

$x+5=\pm\sqrt{34}$

$-5 \quad -5$

$\boxed{x=-5\pm\sqrt{34}}$

**You Try! Solve by completing the square.**

$x^2 - 8x - 6 = 0$

$+6 \quad +6$

$x^2 - 8x + 16 = 6 + 16$

$\frac{-8}{2} = -4 \quad (-4)^2 = 16$

$\sqrt{(x-4)^2} = \sqrt{22} \rightarrow x - 4 = \pm\sqrt{22}$

$\boxed{x = 4 \pm \sqrt{22}}$

**Ex. 3: Write in Vertex Form by Completing the Square.**

**Vertex Form:** $y = a(x-h)^2 + k$

Standard Form: $y = ax^2 + bx + c$

$y = x^2 - 8x + 11$

$y = (x^2 - 8x + 16) + 11 - 16$

$\frac{-8}{2} = -4 \quad (-4)^2 = 16$

$y = (x-4)^2 - 5$

Vertex: $(4, -5)$

1) Isolate the $(ax^2 + bx)$
2) Complete the square in the parenthesis. **Subtract outside the parenthesis to keep the equation balanced.**
3) Simplify the parenthesis to a squared binomial

**Ex. 4: Write in vertex form and graph.**

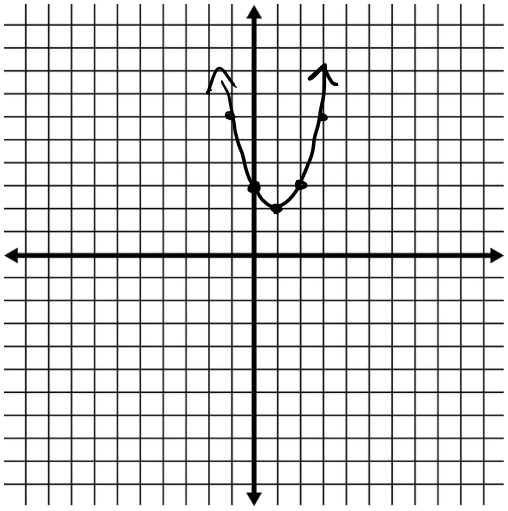
$y = (x^2 - 2x) + 3$

$y = (x^2 - 2x + 1) + 3 - 1$

$\frac{-2}{2} = -1 \quad (-1)^2 = 1$

$y = (x-1)^2 + 2$

vertex: $(1, 2)$



**Ex. 4: Write in vertex form and graph.**

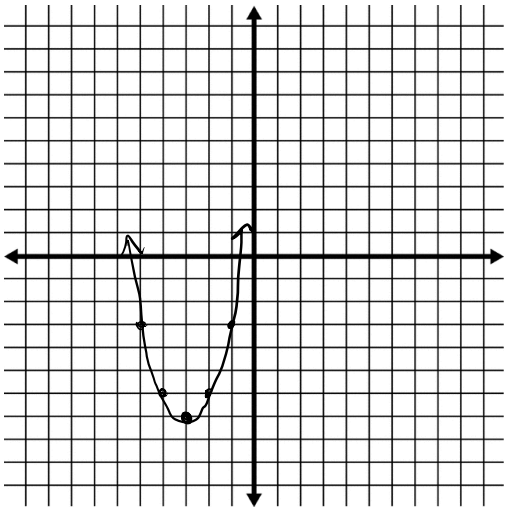
$y = x^2 + 6x + 2$

$y = (x^2 + 6x + 9) + 2 - 9$

$\frac{6}{2} = 3 \quad 3^2 = 9$

$y = (x+3)^2 - 7$

vertex: $(-3, -7)$



**You Try! Write in vertex form and graph.**

$y = x^2 - 4x + 1$

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

$\frac{-4}{2} = -2 \quad (-2)^2 = 4$

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

vertex: $(2, -3)$