Name: _____   Date: _____

Learning Goal 3.3	Convert standard form of the quadratic equation to vertex form by completing the square.

Standard Form   →   Vertex Form

$$ax^2 + bx + c$$ $$a(x-p)^2 + q$$

Results in just one extra step:

Example: $f(x) = 5x^2 + 30x + 41$

    0. Factor.

$$= 5(x^2 + 6x) + 41$$

    1. Group and Complete the Square:

$$\left(\frac{6}{2}\right)^2 = (3)^2 = 9$$

    2. Add in the rest of the equation:

$$= 5(x^2 + 6x + 9 - 9) + 41$$

    3. Isolate the Perfect Square Trinomial:

$$= 5(x^2 + 6x + 9) - 45 + 41)$$

    4. Simplify

$$f(x) = 5(x+3)^2 - 4$$

Example Convert the following quadratic equations to vertex form.

a. $f(x) = 3x^2 - 12x - 9$

0. $= 3(x^2 - 4x) - 9$

1. $\left(-\dfrac{4}{2}\right)^2 = (-2)^2 = 4$

2. $= 3(x^2 - 4x + 4 - 4) - 9$

3. $= 3(x^2 - 4x + 4) - 12 - 9$

4. $f(x) = 3(x-2)^2 - 21$

b. $g(x) = -5x^2 - 70x + 24$

0. $= -5(x^2 + 14x) + 24$

1. $\left(\dfrac{14}{2}\right)^2 = (7)^2 = 49$

2. $= -5(x^2 + 14x + 49 - 49) + 24$

3. $= -5(x^2 + 14x + 49) + 245 + 24$

4. $= -5(x+7)^2 + 269$

c. $h(x) = 2x^2 - 20x + 0$

0. $= 2(x^2 - 10x)$

1. $\left(-\dfrac{10}{2}\right)^2 = (-5)^2 = 25$

2. $= 2(x^2 - 10x + 25 - 25)$

3. $= 2(x^2 - 10x + 25) - 50$

4. $= 2(x-5)^2 - 50$

d. $y = -3x^2 - 8x - 24$

0. $= -3\left(x^2 + \dfrac{8}{3}x\right) - 24$

$\dfrac{8}{3} \times \dfrac{1}{2}$

1. $\left(\dfrac{8/3}{2/1}\right)^2 = \left(\dfrac{8}{6}\right)^2 = \left(\dfrac{4}{3}\right)^2 = \dfrac{16}{9}$

2. $= -3\left(x^2 + \dfrac{8}{3}x + \dfrac{16}{9} - \dfrac{16}{9}\right) - 24$

3. $= -3\left(x^2 + \dfrac{8}{3}x + \dfrac{16}{9}\right) + \dfrac{16}{3} - 24\,\dfrac{\cancel{72}}{3}$

4. $y = -3\left(x + \dfrac{4}{3}\right)^2 - \dfrac{56}{3}$