

Name: \_\_\_\_\_

Converting to Vertex Form when  $a \neq 1$   
by Completing the Square

Convert each quadratic equation from standard form to vertex form.

**Example (by traditional completing the square)**

$$f(x) = -3x^2 - 60x + 9$$

$$f(x) = -3(x^2 + 20x \quad \quad) + 9$$

$$f(x) = -3(x^2 + 20x + \boxed{100}) + 9 - (-3)\boxed{100}$$

$\div 2$

$$f(x) = -3(x + 10)^2 + 9 + 300$$

$$\boxed{f(x) = -3(x + 10)^2 + 309}$$

**Example (by determining  $h$  &  $k$ )**

$$f(x) = -3x^2 - 60x + 9$$

$$h = \frac{-b}{2a} = \frac{-(-60)}{2(-3)} = \frac{60}{-6} = -10$$

$$k = c - a(h)^2 = 9 - (-3)(-10)^2$$

$$k = 9 - (-3)(100) = 9 + 300 = 309$$

Plug it into vertex form:  $f(x) = a(x - h)^2 + k$

$$\boxed{f(x) = -3(x + 10)^2 + 309}$$

1.  $f(x) = -4x^2 - 8x + 5$

2.  $g(x) = 2x^2 - 8x - 15$

3.  $h(x) = -9x^2 + 72x + 8$

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

5.  $k(x) = -3x^2 - 30x - 3$

6.  $m(x) = 7x^2 + 84x + 2$

7. $n(x) = -x^2 - 10x - 7$	8. $p(x) = 8x^2 - 112x + 7$	9. $r(x) = -10x^2 + 100x$
10. $t(x) = 7x^2 + 42x - 10$	11. $v(x) = -x^2 - 4x + 3$	12. $w(x) = 8x^2 + 64x - 2$

**Answers**

1. $f(x) = -4(x + 1)^2 + 9$	2. $g(x) = 2(x - 2)^2 - 23$	3. $h(x) = -9(x - 4)^2 + 152$	4. $j(x) = -8(x - 6)^2 + 284$
5. $k(x) = -3(x + 5)^2 + 72$	6. $m(x) = 7(x + 6)^2 - 250$	7. $n(x) = -(x + 5)^2 + 18$	8. $p(x) = 8(x - 7)^2 - 385$
9. $r(x) = -10(x - 5)^2 + 250$	10. $t(x) = 7(x + 3)^2 - 73$	11. $v(x) = -(x + 2)^2 + 7$	12. $w(x) = 8(x + 4)^2 - 130$