Name: _____

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

Completing the square is the process of turning a non-perfect square trinomial into a perfect square trinomial by adding in a number (and subtracting it out at the same time).

$f(x) = x^2 - 2x - 15$ $f(x) = (x^2 - 2x) - 15$	Step 1 Separate $ax^2 + bx$ from c by putting them in ( )
$f(x) = (1x^2 - 2x) - 15$ $f(x) = 1(1x^2 \div 1 - 2x \div 1) - 15$ $f(x) = 1(x^2 - 2x) - 15$	Step 2 Factor a out of $(ax^2 + bx)$, creating $a\left(x^2 + \frac{b}{a}x\right) + c$
$f(x) = 1(x^2 - 2x + \square) - 15 - 1(\square)$	Step 3 Add an empty box in the (), and subtract a times an empty box from c. $a\left(x^2 + \frac{b}{a}x + \square\right) + c - a\square$
$f(x) = 1\left(x^2 - 2x + \boxed{\left(\frac{-2}{2(1)}\right)^2}\right) - 15 - 1\left(\boxed{\left(\frac{-2}{2(1)}\right)^2}\right)$ $f(x) = 1\left(x^2 - 2x + \boxed{\left(-\frac{2}{2}\right)^2}\right) - 15 - 1\left(\boxed{\left(-\frac{2}{2}\right)^2}\right)$ $f(x) = 1\left(x^2 - 2x + \boxed{(-1)^2}\right) - 15 - 1\left(\boxed{(-1)^2}\right)$ $f(x) = 1(x^2 - 2x + \boxed{1}) - 15 - 1(\boxed{1})$ $f(x) = 1(x^2 - 2x + 1) - 15 - 1$	Step 4 Insert $\left(\frac{b}{2a}\right)^2$ into each box and simplify.
$f(x) = 1(x^2 - 2x + 1) - 15 - 1$ $-h\ is\ from\ -2x\colon\ -2 \div 2 = -1$ $+k\ is\ from - 15 - 1\colon\ -16$ $\boxed{f(x) = 1(x-1)^2 - 16}$	Step 5 Use the perfect square factor pattern to rewrite the equation. Divide the new b term in half– that is your h *(without switching the sign)*. Simplify the constants added after the ( ) that is your k. $f(x) = a(x-h)^2 + k$

Shortcut

$f(x) = x^2 - 2x - 15$ $a = 1, b = -2, c = -15$	Step 1 Identify a, b, & c.
$h = \frac{-b}{2a} = \frac{-(-2)}{2(1)} = \frac{2}{2} = 1$ $k = c - a(h)^2 = (-15) - (1)(1)^2 = -15 - 1(1) = -15 - 1 = -16$ So, $f(x) = a(x-h)^2 + k$ $f(x) = 1(x-1)^2 - 16$	Step 2 Remember the end result of completing the square: $f(x) = a(x-h)^2 + k$ where $h = \frac{-b}{2a}$ and $k = c - a(h)^2$

Convert each quadratic equation from standard form to vertex form.

1. $f(x) = x^2 - 6x - 7$	2. $g(x) = x^2 + 4x - 20$	3. $h(x) = x^2 + 40x + 6$
4. $j(x) = x^2 + 6x - 16$	5. $k(x) = x^2 + 18x + 8$	6. $m(x) = x^2 + 10x$
7. $n(x) = x^2 - 12x - 28$	8. $p(x) = x^2 + 4x - 45$	9. $r(x) = x^2 - 16$
10. $t(x) = x^2 - 4x - 12$	11. $v(x) = x^2 + 8x$	12. $w(x) = x^2 - 14x + 6$

Answers

1. $f(x) = (x-3)^2 - 16$	2. $g(x) = (x+2)^2 - 24$	3. $h(x) = (x+20)^2 - 394$	4. $j(x) = (x+3)^2 - 25$
5. $k(x) = (x+9)^2 - 73$	6. $m(x) = (x+5)^2 - 25$	7. $n(x) = (x-6)^2 - 64$	8. $p(x) = (x+2)^2 - 49$
9. $r(x) = (x)^2 - 16$	10. $t(x) = (x-2)^2 - 16$	11. $v(x) = (x+4)^2 - 16$	12. $w(x) = (x-7)^2 - 43$