L6 Completing the Square

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Lesson 6 Converting to Standard Form - Completing the Square

Recall:

General form $y = ax^2 + bx + c$

$(x+5)(x+5)$
$x^2 + 10x + 25$

Standard form $y = a(x-h)^2 + k$

When the equation of a quadratic function is in general form, most characteristics of the graph cannot be identified. Therefore it is useful to convert from general form to standard form by ***completing the square***.

Example 1
Convert $y = x^2 - 6x + 11$ to standard form.

$y = (x^2 - 6x + 9) + 11 - 9$

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

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

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

Step 1: Bracket the terms with "x".

Step 2: Complete the square. Divide b (the coefficient of x) by 2 and square it to create a perfect square trinomial. Balance the equation. ← sum

* Take half the sum (b) and square.

Step 3: Rewrite the perfect square trinomial as a binomial squared.

Example 2
Convert $y = x^2 - 4x + 10$ to standard form.

$y = (x^2 - 4x + 4) + 10 - 4$

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

Example 3
Convert $y = 2x^2 - 8x - 7$ to standard form.

$y = 2(\underbrace{x^2 - 4x + 4}_{8}) - 7 - 8$

$y = 2(x-2)^2 - 15$

Step 1: Bracket the terms with "*x*" and factor out the numerical coefficient "a" value (include the sign)

Step 2: Complete the square. Divide *b* (the coefficient of *x*) by 2 and square it to create a perfect square trinomial.

Step 3: Balance the equation (multiply the number added in step 2 by the coefficient)

Step 4: Rewrite the perfect square trinomial as a binomial squared.

Example 4
Write in standard form: $y = -\frac{1}{2}x^2 - 3x + 5$

$y = -\frac{1}{2}(\underbrace{x^2 + 6x + 9}_{-\frac{9}{2}}) + 5 + \frac{9}{2}$

$y - \frac{9}{2} = -\frac{1}{2}(\underbrace{x^2 + 6x + 9}_{-\frac{9}{2}})$

$y = -\frac{1}{2}(x+3)^2 + \frac{10}{2} + \frac{9}{2}$

$y = -\frac{1}{2}(x+3)^2 + \frac{19}{2}$

Example 5

Identify the y-intercept~~s~~, the equation of the axis of symmetry, and the coordinates of the vertex of the graph of

a.) $y = 3x^2 - 12x + 7$

$y = 3(x^2 - 4x + 4) + 7 - 12$

$y = 3(x-2)^2 - 5$

$V(\overset{h}{2}, \overset{k}{-5})$

y-int
$x = 0$

$y = 3(0)^2 - 12(0) + 7$

$y = 7$

a.o.s $\longrightarrow x = h$

$x = 2$

b.) $y = -2x^2 + 10x - 3$

$\left(\frac{-5}{2}\right)^2$

$\frac{25}{4}$

$y = -2\underbrace{(x^2 - 5x + \tfrac{25}{4})}_{-2\left(\frac{25}{4}\right)} - 3 + \cancel{2}\left(\frac{25}{\cancel{4}_2}\right)$

$y = -2\left(x - \frac{5}{2}\right)^2 - 3 + \frac{25}{2}$

$y = -2\left(x - \frac{5}{2}\right)^2 - \frac{6}{2} + \frac{25}{2}$

$y = -2\left(x - \frac{5}{2}\right)^2 + \frac{19}{2}$

y-int
$x = 0$

$y = -2(0)^2 + 10(0) - 3$

$= -3$

$V\left(\frac{5}{2}, \frac{19}{2}\right)$

a.o.s $x = \frac{5}{2}$

Assign
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\# 1 c, f
2 d, f
4 c, d, f, i
5 g, j
6 a, d

$y = 3x^2 + 18x - 4$

$y = -2x^2 + 8x - 1$

Challenge:
convert $y = ax^2 + bx + c$ to standard

5 g, j
6 a, d

Challenge:
Convert $y = ax^2 + bx + c$ to standard form.