3.3 Completing the Square

Monday, November 30, 2015 8:37 AM

Pre-Calculus 11 Notes

3.3 Using Square Roots to Solve Quadratic Equations & Completing the Square

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$a \neq 0$

In a quadratic equation $ax^2+bx+c=0$, when $b=0$ it becomes the equation $ax^2+c=0$. If this equation has a solution, it can be solved by using square roots.

Example 1: Solve each equation. Verify the solution

a. $3x^2 - 7 = 8$

$3x^2 = 15$

$\frac{3x^2}{3} = \frac{15}{3}$

$\sqrt{x^2} = \sqrt{5}$

$x = \pm\sqrt{5}$

check.

$3(\sqrt{5})^2 - 7 = 8$

$15 - 7 = 8$

$8 = 8$ ✓

$3(-\sqrt{5})^2 - 7 = 8$

$15 - 7 = 8$

$8 = 8$ ✓

b. $\sqrt{(x+3)^2} = \sqrt{20}$ solve using $\sqrt{\ }$

$x+3 = \pm\sqrt{20}$ -3

-3

$x = -3 \pm \sqrt{20}$

check

$(-3+\sqrt{20}+3)^2 = 20$

$20 = 20$ ✓

$(-3-\sqrt{20}+3)^2 = 20$

$20 = 20$ ✓

★ [Not all quadratic equations have roots that are real numbers. Some quadratic equations, for example $x^2-10x+3=0$, cannot be solved by factoring. We use the strategy of completing the square to try to solve the equation.] ★

ex: $3x^2 + 18 = 0$

$\frac{3x^2}{3} = \frac{-18}{3}$

$\sqrt{x^2} = \sqrt{-6}$

↑ can't have a negative inside!

* has no roots.

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negative inside!

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Steps for Completing the Square: $x^2 - 10x + 3 = 0$

1. Remove the coefficient of x^2 term by multiplying or dividing none here

$$x^2 - 10x + 3 = 0$$

2. Move the constant term to the other side of the equation.

$$x^2 - 10x = -3$$

always!

3. Complete the square by dividing the x term by 2 and squaring it to both sides of the equation.

$\frac{-10}{2} = -5$

$(-5)^2 = 25$

$$x^2 - 10x + 25 = -3 + 25$$

4. Factor the perfect square and simplify the side of the equation with constants.

$$x^2 - 10x + 25 = 22$$

$(x-5)(x-5) \rightarrow (x-5)^2 = 22$

5. Lastly, take the square root of both sides.

$$\sqrt{(x-5)^2} = \sqrt{22}$$

$$x - 5 = \pm\sqrt{22}$$

$$x = 5 \pm \sqrt{22}$$

Example 2: Solve each equation by completing the square.

a. $x^2 + 4x - 3 = 0$ YOU TRY.

$\frac{4}{2} = 2$

$2^2 = 4$

$$x^2 + 4x = 3$$

$$x^2 + 4x + 4 = 3 + 4$$

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

$$x + 2 = \pm\sqrt{7}$$

$$x = -2 \pm \sqrt{7}$$

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b. $-5x^2 - 10x + 2 = 0$

$\frac{-5x^2}{-5} \; \frac{-10x}{-5} \; \frac{+2}{-5} = \frac{0}{-5}$

$x^2 + 2x - \frac{2}{5} = 0$

$\frac{2}{2} = 1$, $1^2 = 1$

$x^2 + 2x = \frac{2}{5}$

$x^2 + 2x + 1 = \frac{2}{5} + 1 \leftarrow \frac{5}{5}$

$\sqrt{(x+1)^2} = \sqrt{\frac{7}{5}}$

$x + 1 = \pm\sqrt{\frac{7}{5}}$

$x = -1 \pm \sqrt{\frac{7}{5}} \cdot \frac{\sqrt{5}}{\sqrt{5}}$ Rationalize the denominator!

$= -1 \pm \frac{\sqrt{35}}{5}$

$= \frac{-5 \pm \sqrt{35}}{5}$

Aside $\frac{\sqrt{7}}{\sqrt{5}}$

c. $2\left(\frac{1}{2}x^2 + 3x - \frac{9}{2} = 0\right)$

$x^2 + 6x - 9 = 0$

You can finish

Assignment p. 206-211 #4bd, 5bd, 8bd, 9, 10bd, 11, 15