Beginning & Intermediate Algebra

11.1—Square Root Principle & Completing the Square

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Solve by Factoring

$x^2 - 81 = 0$

$x^2 - 9^2 = 0$

$(x+9)(x-9) = 0$

$x = -9, 9$

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The Square Root Principle

$x^2 - 81 = 0$

$\sqrt{x^2} = \sqrt{81}$

What number(s) when squared will give you 81?

$x = \pm 9$

$9, -9$

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What is the SQUARE ROOT PRINCIPLE?

When can you use the square root principle?

Anytime you have (something)² = #

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Examples

$a^2 = 20$

$\sqrt{a^2} = \pm\sqrt{20}$ (4, 5)

$a = \pm 2\sqrt{5}$

$2\sqrt{5}, -2\sqrt{5}$

$\sqrt{(a+6)^2} = \sqrt{9}$

$a+6 = \pm 3$

$a+6 = 3$: $-6 \quad -6$: $a = -3$

$a+6 = -3$: $-6 \quad -6$: $a = -9$

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Examples

$(5m+1)^2 - 9 = -2$

$+9 \quad +9$

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

$5m+1 = \pm\sqrt{7}$

$-1 \quad -1$

$\frac{5m}{5} = \frac{-1 \pm \sqrt{7}}{5}$

$m = \frac{-1 \pm \sqrt{7}}{5}$

$\frac{-1+\sqrt{7}}{5}$

$\frac{-1-\sqrt{7}}{5}$

$\sqrt{(t-5)^2} = \sqrt{-28}$ (4, 7)

$t-5 = \pm\sqrt{-28}$

$t-5 = \pm 2i\sqrt{7}$

$+5 \quad +5$

$t = 5 \pm 2i\sqrt{7}$

$5+2i\sqrt{7}$

$5-2i\sqrt{7}$

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Factor the Following Expressions

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

$y^2-14y+49$ $(y-7)^2$

$x^2-18x+81$ $(x-9)^2$

$x^2+20x+100$ $(x+10)^2$

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What is a **PERFECT SQUARE TRINOMIAL?**

$(\text{Binomial})^2$

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Turn these into Perfect Square Trinomials

$x^2+10x+\underline{25}$ $(x+5)^2$

$x^2-6x+\underline{9}$ $(x-3)^2$

$x^2-24x+\underline{144}$ $(x-12)^2$

$x^2+9x+\underline{\frac{81}{4}}$ $\left(x+\frac{9}{2}\right)^2$

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Solve by **COMPLETING THE SQUARE**

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

$-10 \quad -10$

$x^2-10x+\boxed{25}=-10+\boxed{25}$

$(x-5)^2=\sqrt{15}$

$x-5=\pm\sqrt{15}$

$+5 \quad +5$

$x=5\pm\sqrt{15}$

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Why Complete the Square?

Completing the square let's us use the **SQUARE ROOT PROPERTY**

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Steps for Completing the Square

1. Make sure the coefficient of the squared term is **ONE.**
2. Put in proper form: **VARIABLE** terms on the left, **CONSTANTS** on the right. (Placeholder if you like)
3. **COMPLETE** the square
   a) Divide **the FIRST DEGREE** term by **2**
   b) **SQUARE** it
   c) **ADD** it to both sides
4. Use the **SQUARE ROOT** Principle to solve.

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Examples

$x^2 - 14x - 29 = 0$

$x^2 - 14x + 49 = 29 + 49$

$\sqrt{(x-7)^2} = \sqrt{78}$

$x - 7 = \pm\sqrt{78}$

$+7 \quad +7$

$x = 7 \pm \sqrt{78}$

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Examples

$\frac{2x^2}{2} + \frac{6x}{2} - \frac{5}{2} = \frac{0}{2}$

$3 \cdot \frac{1}{2} = \frac{3}{2}$

$x^2 + 3x - \frac{5}{2} = 0$

$x^2 + 3x + \frac{9}{4} = \frac{5}{2} + \frac{9}{4}$

$\sqrt{(x+\frac{3}{2})^2} = \frac{10}{4} + \frac{9}{4}$

$x + \frac{3}{2} = \pm\frac{\sqrt{19}}{4}$

$-\frac{3}{2} \quad -\frac{3}{2}$

$x = \frac{-3 \pm \sqrt{19}}{2}$

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Examples

$\frac{3x^2}{3} + \frac{4x}{3} - \frac{2}{3} = \frac{0}{3}$

$\frac{4}{3} \cdot \frac{1}{2} = \frac{2}{3}$

$x^2 + \frac{4}{3}x + \frac{4}{9} = \frac{2}{3} + \frac{4}{9}$

$+\frac{6}{9}$

$\sqrt{(x+\frac{2}{3})^2} = \sqrt{\frac{10}{9}}$

$x + \frac{2}{3} = \pm\frac{\sqrt{10}}{3}$

$-\frac{2}{3} \quad -\frac{2}{3}$

$x = \frac{-2 \pm \sqrt{10}}{3}$

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What is the **RULE OF 3's**?

$\frac{16 \pm 4\sqrt{3}}{24}$

$\frac{4 \pm \sqrt{3}}{6}$

$\frac{4+\sqrt{3}}{6}$

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$\sqrt{8x+4} - 2 = 4$

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