Equation Solving Toolbox

Linear Equations

Addition and Subtraction Property of Equality

Use to isolate a variable term.

$$\begin{aligned} 3x + 7 &= 20 \\ -7 \quad &\;\; -7 \\ \hline 3x &= 13 \end{aligned}$$

Multiplication and Division Property of Equality

Use to isolate a variable.

$$5x = 70$$
$$\frac{5x}{5} = \frac{70}{5}$$
$$x = 14$$

Systems of Equations

Substitution Method

Use when a variable is isolated or can be easily isolated.

$$y = 6x + 8$$
$$2x + 4y = 30$$
$$2x + 4(6x + 8) = 30$$

Elimination Method

Use when the equations are in general form.

$$5x - 7y = 42$$
$$2x + 4y = 30$$
$$4(5x - 7y) = 4(42)$$
$$7(2x + 4y) = 7(30)$$
$$\begin{aligned} 20x - 28y &= 168 \\ 14x + 28y &= 210 \\ \hline 34x \qquad &= 378 \end{aligned}$$

Linear Inequalties

Addition and Subtraction Properties of Inequalities

Use to isolate a variable term.

$$\begin{aligned} 4x + 5 &< 21 \\ -5 \quad &\;\; -5 \\ \hline 4x &< 16 \end{aligned}$$

Multiplication and Division Properties of Inequalities

Use to isolate a variable. When multiplying or dividing by a negative number, reverse the inequality symbol.

$$-3x < 21 \qquad\qquad 5x < 45$$
$$\frac{-3x}{-3} > \frac{21}{-3} \qquad\qquad \frac{5x}{5} < \frac{45}{5}$$
$$x > -7 \qquad\qquad x < 9$$

Absolute Value Equations

Make Two Equations

Isolate the absolute value and rewrite as two equations; one positive and one negative.

$$|2x - 5| = 20$$
$$2x - 5 = 20 \quad \text{or} \quad 2x - 5 = -20$$

Absolute Value Inequalities

Absolute Value Less Than a Number

Isolate the absolute value and rewrite as two inequalities; one less than and the other great than the opposite. Write the inequalities separated by the word **and** or as a compound inequality.

$$|3x - 7| < 18$$
$$3x - 7 < 18 \quad \text{and} \quad 3x - 7 > -18$$
$$-18 < 3x - 7 < 18$$

Absolute Value Greater Than a Number

Isolate the absolute value and rewrite as two inequalities; one greater than and the other less than the opposite.Write the inequalities separated by the word **or**.

$$|5x + 8| > 12$$
$$5x + 8 > 12 \quad \text{or} \quad 5x + 8 < -12$$

Quadratic Equations

Square Root Property

Use when there is a squared term but no first degree term. Isolate the squared term and use a plus or minus symbol to indicate both answers.

$$x^2 = 25$$
$$x = \pm\sqrt{25}$$
$$x = \pm 5$$

Completing the Square

Use if the vertex form is required. Finish solving with the square root property.

$$x^2 + 6x + 4 = 0$$
$$x^2 + 6x = -4$$
$$x^2 + 6x + 9 = -4 + 9$$
$$x^2 + 6x + 9 = 5$$
$$(x + 3)^2 = 5$$

Factoring

Use when the quadratic equation has small coefficients that factor easily. Set the quadratic equal to zero, factor and then use the zero factor property to write two or more simpler equations.

$$x^2 + 7x + 10 = 0$$
$$(x + 5)(x + 2) = 0$$
$$x + 5 = 0 \quad or \quad x + 2 = 0$$

Quadratic Formula

Use when the quadratic equation has fractions, decimals or large numbers. Set the quadratic equal to zero.

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Power Equations

Raise Both Sides to the Reciprocal Exponent

Isolate the power and raise both sides to the reciprocal exponent. If it is an even power use plus/minus to indicate two solutions.

$$x^6 = 200 \qquad\qquad x^3 = 17$$
$$(x^6)^{1/6} = \pm(200)^{1/6} \qquad (x^3)^{1/3} = (17)^{1/3}$$

Logarithmic Equations

Rewrite into Exponential Form

Isolate the logarithm and rewrite the logarithm into exponential form.

$$\log(x + 2) = 4$$
$$10^4 = x + 2$$

Exponential Equations

Rewrite into Logarithmic Form

Isolate the exponential base and exponent and rewrite into logarithmic form.

$$5^x + 20 = 300$$
$$5^x = 280$$
$$\log_5 280 = x$$

Take the Logarithm of Both Sides and Use the Power Rule for Logarithms

Isolate the exponential base and exponent and take the logarithm of both sides. Use the power rule for logarithms to bring down the exponent and solve.

$$2^{x+5} = 140$$
$$\log 2^{x+5} = \log 140$$
$$(x + 5)\log 2 = \log 140$$
$$x + 5 = \frac{\log 140}{\log 2}$$

Rational Equations

Multiply by the LCD

Multiply both sides of the equation by the least common denominator. This will clear all fractions from the equation.

$$\frac{3}{x + 1} = \frac{2}{x}$$
$$(x + 1)(x)\cdot\frac{3}{x + 1} = \frac{2}{x}\cdot(x + 1)(x)$$
$$3x = 2x + 2$$

Radical Equations

Raise Both Sides to the Reciprocal Exponent

Isolate a radical on one side of the equation and then raise both sides of the equation to the reciprocal exponent. This may need to be done more than once to clear multiple radicals.

$$\sqrt{x + 2} - 7 = 2$$
$$\sqrt{x + 2} = 9$$
$$(\sqrt{x + 2})^2 = 9^2$$
$$x + 2 = 81$$

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