GENERAL

how to do basic algebra step by step

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Introduction

Algebra is often described as the bridge between arithmetic and higher mathematics. It provides a systematic way to solve problems that involve unknown values, allowing you to model real world situations with equations and inequalities. Whether you're a high school student, a college freshman, or simply looking to refresh your math skills, understanding the fundamentals of algebra is essential. In this guide, we'll walk you through the core concepts of basic algebra and present a clear, step by step method for solving equations, simplifying expressions, and mastering the language of variables.

What Is Basic Algebra?

At its core, algebra is the study of symbols and the rules for manipulating these symbols. Unlike arithmetic, which deals with concrete numbers, algebra uses letters—commonly **variables** such as **x**, **y**, or **z**—to represent unknown or changing values. By setting up relationships between variables and known constants, we can solve for the unknowns.

Key Terms You'll Encounter

- Variable: a symbol that stands for an unknown number.
- Constant: a fixed value that does not change.
- Expression: a combination of variables, constants, and operations.
- Equation: a statement that two expressions are equal.
- Inequality: a comparison between two expressions using , "d, or "e.
- Coefficient: a number that multiplies a variable.

Why Learning Basic Algebra Is Important

Mastering basic algebra offers several benefits:

- Critical Thinking: Algebra requires logical reasoning and problem solving skills.
- Career Readiness: Many STEM fields, finance, engineering, and data analysis rely heavily on algebraic concepts.
- Everyday Applications: From budgeting to cooking, algebra helps you calculate proportions, rates, and more.
- Academic Success: A strong algebra foundation is a prerequisite for advanced math courses and many college programs.

Step 1: Understanding Algebraic Expressions

Before you can solve equations, you need to be comfortable simplifying expressions. Let's look at a few examples:

1. Combine Like Terms: In the expression 3x + 5x, the terms 3x and 5x are like terms because they contain the same variable raised to the same power. Combine them: 3x + 5x = 8x.
2. Distribute Multiplication: For 2(3x + 4), distribute the 2: 2 * 3x = 6x and 2 * 4 = 8, resulting in 6x + 8.
3. Apply the Order of Operations (PEMDAS/BODMAS): Parentheses/Brackets first, then Exponents/Orders, followed by Multiplication and Division (left to right), and finally Addition and Subtraction (left to right). For example,

2 + 3 * 4 = 2 + 12 = 14.

Practice Exercise

Simplify the following expression: **4(2x – 3) + 5x – 6.**

Solution: First distribute 4: 8x – 12. Then combine like terms: 8x + 5x = 13x. Finally, combine constants: –12 – 6 = –18. Result: **13x – 18.**

Step 2: Setting Up Equations

An equation is a statement that two expressions are equal. For example, **2x + 5 = 13**states that the expression on the left equals the expression on the right. Your goal is to isolate the variable on one side of the equation.

1. Identify the variable you want to solve for.
2. Move terms containing the variable to one side and constants to the other.
3. Use inverse operations to isolate the variable.

Example

Solve **3y – 7 = 2y + 4**.

1. Subtract 2y from both sides: 3y – 2y – 7 = 4 !’ y – 7 = 4.
2. Add 7 to both sides: y = 11.

Step 3: Solving Linear Equations

Linear equations are first degree equations where the variable appears to the power of one. Here’s a systematic approach:

1. Eliminate parentheses by distributing any coefficients.
2. Collect like terms on each side.
3. Isolate the variable by performing inverse operations (addition/subtraction, multiplication/division).
4. Verify the solution by substituting back into the original equation.

Detailed Example

Solve **4(2z + 3) – 5z = 3(4z – 1) + 2.**

1. Distribute: 8z + 12 – 5z = 12z – 3 + 2.
2. Combine like terms: Left side !’ 3z + 12; Right side !’ 12z – 1.
3. Move all variable terms to one side: 3z – 12z = –1 – 12. !’ –9z = –13.
4. Divide by –9: z = 13/9 "H 1.44.
5. Verification: Plug z back into the original equation to confirm both sides equal.

Step 4: Working with Fractions and Decimals in Algebra

When variables appear in fractions or decimals, the same principles apply, but extra care is needed to avoid mistakes.

- Common Denominator: For equations like 1/2x + 1/3 = 5/6, find a common denominator (6) before combining terms.
- Clear Denominators: Multiply every term by the least common multiple (LCM) of the denominators to eliminate fractions.

Example

Solve **1/4x + 1/6 = 3/8.**

1. LCM of 4, 6, and 8 is 24.
2. Multiply every term by 24: 6x + 4 = 9.
3. Subtract 4: 6x = 5.
4. Divide by 6: x = 5/6 "H 0.833.

Step 5: Solving Systems of Equations

Sometimes you have more than one equation with multiple variables. Two common methods are the **substitution method** and the **elimination method**.

Substitution Method

1. Solve one equation for one variable.
2. Substitute that expression into the other equation.
3. Solve for the remaining variable.
4. Back substitute to find the other variable.

Elimination Method

1. Align equations so that adding or subtracting them will cancel one variable.
2. Perform the addition/subtraction.
3. Solve the resulting single variable equation.
4. Substitute back to find the other variable.

Example Using Elimination

Solve the system:

1. 2x + 3y = 12
2. 4x – y = 5

1. Multiply the second equation by 3 to align y terms: 12x – 3y = 15.
2. Add to the first equation: (2x + 12x) + (3y – 3y) = 12 + 15 !’ 14x = 27.
3. Divide: x = 27/14 "H 1.93.
4. Substitute back into 4x – y = 5: 4(27/14) – y = 5 !’ 108/14 – y = 5 !’ y = 108/14 – 5 = (108 – 70)/14 = 38/14 "H 2.71.

Step 6: Introducing Inequalities

Inequalities are similar to equations but use symbols like **<**, **>**, **"d** or **".** Solving them follows the same steps as equations, but you must reverse the inequality sign when multiplying or dividing by a negative number.

1. Isolate the variable on one side.
2. Apply inverse operations, remembering to flip the inequality sign if the operation involves a negative multiplier.
3. Express the solution as a range or interval.

Example

Solve **–3k + 5 > 2.**

1. Subtract 5: –3k > –3.
2. Divide by –3 (flip sign): k < 1.
3. Solution: k (all real numbers less than 1).

Step 7: Common Mistakes and How to Avoid Them

- Forgetting to distribute correctly. Always apply the distributive property when a coefficient multiplies a parenthetical expression.
- Incorrect sign handling. Pay attention to negative signs, especially when moving terms across the equals sign.
- Algebraic errors with fractions. Multiply by the LCM to eliminate denominators before simplifying.
- Skipping verification. Always plug your solution back into the original equation to confirm its validity.

Step 8: Practice Problems With Solutions

Practice is key to mastering algebra. Below are a variety of problems covering the

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