# Simplification of Algebraic Expressions

## i. Definition and Explanation

**What is an Algebraic Expression?** An algebraic expression is a mathematical phrase that includes numbers, variables (letters like x or y), and operation signs (+, -, ×, ÷). It does not have an equals sign (=), which makes it different from an equation.

- Example: 3x + 7, 5y - 2a + 10, 4(z - 1)

**What does it mean to "Simplify" an Expression?** Simplifying an algebraic expression means rewriting it in the most compact or efficient way possible, without changing its value. Think of it like tidying up a messy room—you group similar items together to make it neater and easier to understand.

The main way we simplify is by combining like terms.

## ii. Key Points and Important Terms

To understand simplification, you must know the parts of an expression:

**Term:** A single number, a single variable, or a combination of numbers and variables multiplied together. Terms are separated by + or - signs.

- In the expression 5x - 3y + 8, the terms are 5x, -3y, and 8.

**Variable:** A letter used to represent an unknown number.

- Examples: x, y, a, m.

**Coefficient:** The number that is multiplied by a variable.

- In 5x, the coefficient is 5.
- In -3y, the coefficient is -3.
- In a, the coefficient is an "invisible" 1.

**Constant:** A term that is just a number and has no variable. Its value never changes.

- In 5x - 3y + 8, the constant is 8.

**Like Terms:** This is the most important concept! Like terms are terms that have the exact same variable(s) raised to the exact same power(s). The coefficients can be different.

**Examples of Like Terms:**

- 7x and 2x (same variable x)

- -5a and a (same variable a)

- 4y² and 9y² (same variable y to the same power 2)

- 8 and -3 (both are constants)

**Examples of Unlike Terms:**

- 7x and 7y (different variables)

- 5x and 5x² (different powers)

- 3a and 10 (one has a variable, one is a constant)

The Golden Rule of Simplification: You can only add or subtract like terms.

## iii. Detailed Examples with Solutions

**Example 1:** Basic Combination Simplify: 4a + 9a

**Solution:**

Identify if the terms are "like terms." (Yes, both have the variable a).

Add their coefficients: 4 + 9 = 13.

Keep the variable the same.

**Answer:** 13a

**Example 2:** Combining with Subtraction Simplify: 10x - 3x + 2

**Solution:**

Identify the like terms: 10x and -3x. The term 2 is a constant and has no other like terms.

Combine the like terms by subtracting their coefficients: 10 - 3 = 7.
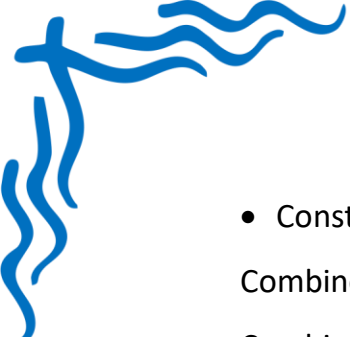
Keep the variable x.

Bring down the constant term.

**Answer:** 7x + 2

**Example 3:** Grouping Multiple Like Terms Simplify: 3y + 8 + 5y - 2

**Solution:**

Identify and group the like terms. It helps to circle or underline them.

- Variable terms: 3y and +5y

- Constant terms: +8 and -2

Combine the y terms: 3y + 5y = 8y.

Combine the constant terms: 8 - 2 = 6.

**Answer:** 8y + 6

**Example 4:** Using the Distributive Property The Distributive Property states that a(b + c) = ab + ac. You "distribute" the term outside the parentheses to every term inside.

Simplify: 5(x + 2)

**Solution:**

Multiply the 5 by the first term inside, x: 5 × x = 5x.

Multiply the 5 by the second term inside, +2: 5 × 2 = 10.

Combine the results.

**Answer:** 5x + 10

**Example 5:** Putting It All Together Simplify: 4(2m - 3) + 3m

**Solution:**

**Step 1:** Distribute. Apply the distributive property first.

- 4 × 2m = 8m

- 4 × -3 = -12

- The expression becomes: 8m - 12 + 3m

**Step 2:** Identify and combine like terms.

- The like terms are 8m and +3m.

- 8m + 3m = 11m

**Step 3:** Write the final simplified expression.

- Bring down the constant term -12.

**Answer:** 11m - 12

## iv. Summary of Main Concepts

- **Goal:** To make an algebraic expression shorter and simpler by combining terms.

- **Like Terms:** Terms with the exact same variable and exponent. This is the key to simplification.

- **The Process:**

  - **Distribute:** If there are parentheses, multiply the outside term by every term inside.

  - **Identify:** Find and group all the like terms. Remember to keep the sign with the term.

  - **Combine:** Add or subtract the coefficients of the like terms. The variable part stays the same.

- **The Golden Rule:** You can ONLY add or subtract like terms. You cannot combine x with y, or x with $x^2$.