

Operations with Algebraic Expressions: Addition and Subtraction of Monomials

A **monomial** is an algebraic expression that consists of one term.

Two or more monomials can be added or subtracted only if they are **LIKE TERMS**.

Like terms are terms that have exactly the **SAME variables and exponents** on those variables. The coefficients on like terms may be different.

Example:

$7x^2y^5$ and $-2x^2y^5$ These are like terms since both terms have the same variables and the same exponents on those variables.

$7x^2y^5$ and $-2x^3y^5$ These are NOT like terms since the exponents on x are different.

Note: the **order** that the variables are written in does NOT matter. The different variables and the coefficient in a term are **multiplied together** and the order of multiplication does NOT matter (For example, 2×3 gives the same product as 3×2).

Example:

$8a^3bc^5$ is the *same* term as $8c^5a^3b$.

To prove this, evaluate both terms when $a = 2$, $b = 3$ and $c = 1$.

$$\begin{aligned}8a^3bc^5 &= 8(2)^3(3)(1)^5 \\ &= 8(8)(3)(1) \\ &= 192\end{aligned}$$

$$\begin{aligned}8c^5a^3b &= 8(1)^5(2)^3(3) \\ &= 8(1)(8)(3) \\ &= 192\end{aligned}$$

As shown, both terms are equal to 192.

To add two or more monomials that are like terms, add the coefficients; keep the variables and exponents on the variables the same.

To subtract two or more monomials that are like terms, subtract the coefficients; keep the variables and exponents on the variables the same.

Addition and Subtraction of Monomials

Example 1:

Add $9xy^2$ and $-8xy^2$

$$\begin{aligned}9xy^2 + (-8xy^2) &= [9 + (-8)] xy^2 \\ &= 1xy^2 \\ &= xy^2\end{aligned}$$

Add the coefficients. Keep the variables and exponents on the variables the same.

Note: By convention, a coefficient of 1 does not have to be explicitly written. If there is no coefficient on a term, it is assumed to be a coefficient of 1. Likewise, if there is no exponent on a variable in a term, it is assumed to be an exponent of 1.

Example 2:

Subtract. $10y^2 - (-xy^2) - 17y^2 - xy^2$

$$10y^2 - (-xy^2) - 17y^2 - xy^2$$

Step 1: Only like terms can be subtracted. In this algebraic expression, like terms are $10y^2$ and $17y^2$ and $-xy^2$ and xy^2 .

$$= 10y^2 - 17y^2 - (-1xy^2) - 1xy^2$$

Step 2: Subtract the coefficients of like terms.

$$= -7y^2 + 0xy^2$$

Step 3: Simplify $0xy^2$ to 0 since 0 multiplied by anything equals 0.

$$= -7y^2 + 0$$

Step 4: $-7y^2$ plus 0 is just $-7y^2$

$$= -7y^2$$

Practice Questions

1. Simplify, if possible.

a) $13x + 7y - 8x + 20y$

b) $22x^3 - 19 + 14x^4 - 9x^3 + 20$

c) $-2x^3y^2 + 18y^2x^3 - y^2 + 2x^3$

d) $2a^7 + 5b^7 + 19a^7b^7$

e) $-s^3q + 20qs^2 - 9qs^3 + 2s^2 - 34s^2q$

f) $x^2 + 7 + 6x + (x^2 - 3)$

g) $10x^2 + 14 + 9x^2 + 3 - 8x^2 + 6$

h) $-x^3 + 4y^3 - 10x^3y + 7y^3 - x^3$

Answers.

1. a) $7x + 27y$

b) $14x^4 + 13x^3 + 1$

c) $16x^3y^2 + 2x^3 - y^2$

d) not possible to simplify further

e) $-10s^3q - 14s^2q + 2s^2$

f) $2x^2 + 6x + 4$

g) $11x^2 + 23$

h) $-10x^3y - 2x^3 + 11y^3$