

- Addition and Subtraction of Algebraic Expressions
- Multiplication of Algebraic Expressions

Addition and Subtraction of Algebraic Expressions

Algebraic expressions consist of terms formed by variables and constants combined using addition or subtraction. To add or subtract algebraic expressions, align like terms (terms with the same variables and powers) and perform the addition or subtraction on their coefficients.

Formula Derivation

Given two expressions:

$$A = a_1x^m y^n + a_2x^p y^q + \dots$$

$$B = b_1x^m y^n + b_2x^r y^s + \dots$$

The sum $A + B$ is obtained by adding coefficients of like terms:

$$A + B = (a_1 + b_1)x^m y^n + a_2x^p y^q + b_2x^r y^s + \dots$$

Similarly, subtraction is done by subtracting coefficients of like terms.

Worked Illustrations

Example 1: Add $7xy + 5yz - 3zx$, $4yz + 9zx - 4y$, and $-3xz + 5x - 2xy$.

Solution:

Arrange like terms vertically:

$$7xy + 5yz - 3zx$$

$$+4yz + 9zx - 4y$$

$$+(-2xy) - 3zx + 5x$$

Add coefficients of like terms:

$$(7xy - 2xy) + (5yz + 4yz) + (-3zx + 9zx - 3zx) + (-4y) + 5x = 5xy + 9yz + 3zx - 4y + 5x$$

Practice Set

- Level 1: Add $3x + 2y$ and $5x - y$.
- Level 2: Subtract $4a^2 - 3ab + b^2$ from $7a^2 + 2ab - 5b^2$.
- Level 3: Add $2xy - 3yz + 4zx$, $-xy + 5yz - 2zx$, and $3xy - 2yz + zx$.

Answer Key

- Level 1: $8x + y$
- Level 2: $3a^2 - 5ab - 6b^2$
- Level 3: $4xy + 0yz + 3zx = 4xy + 3zx$

Quick Reference

- Align like terms before addition or subtraction.
- Only coefficients of like terms are added or subtracted.

Glossary

- **Algebraic Expression:** Combination of variables and constants using addition, subtraction, and multiplication.
- **Like Terms:** Terms with the same variables raised to the same powers.

Multiplication of Algebraic Expressions

Multiplication of algebraic expressions involves multiplying coefficients and variables using the laws of exponents. This operation is fundamental in finding areas, volumes, and solving algebraic problems.

Formula Derivation

For monomials $A = ax^m y^n$ and $B = bx^p y^q$, their product is:

$$AB = (a \times b)x^{m+p}y^{n+q}$$

For polynomials, multiplication is done term-by-term using the distributive law:

$$(a_1 + a_2 + \dots)(b_1 + b_2 + \dots) = \sum a_i b_j$$

Worked Illustrations

Example 2: Multiply monomials $5x$ and $4x^2$.

Solution:

Multiply coefficients: $5 \times 4 = 20$

Add exponents of x : $x^1 \times x^2 = x^3$

Product: $20x^3$

Example 3: Multiply binomials $(2a + 3b)$ and $(3a + 4b)$.

Solution:

Using distributive law:

$$(2a + 3b)(3a + 4b) = 2a \times 3a + 2a \times 4b + 3b \times 3a + 3b \times 4b$$

$$= 6a^2 + 8ab + 9ab + 12b^2 = 6a^2 + 17ab + 12b^2$$

Practice Set

- Level 1: Multiply $3x$ by $5y + 2$.
- Level 2: Multiply $(x - 4)$ by $(2x + 3)$.
- Level 3: Multiply $(a + 7)$ by $(a^2 + 3a + 5)$.

Answer Key

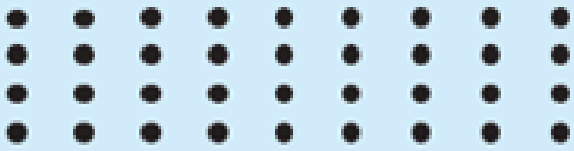
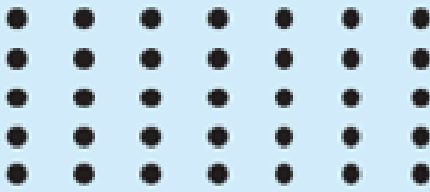
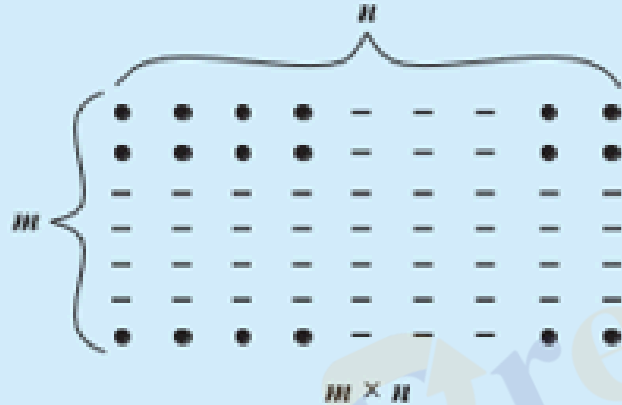
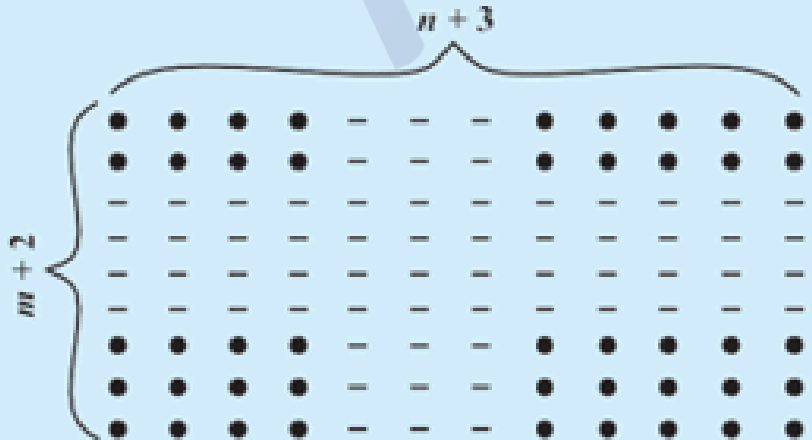
- Level 1: $15xy + 6x$
- Level 2: $2x^2 - 5x - 12$
- Level 3: $a^3 + 10a^2 + 26a + 35$

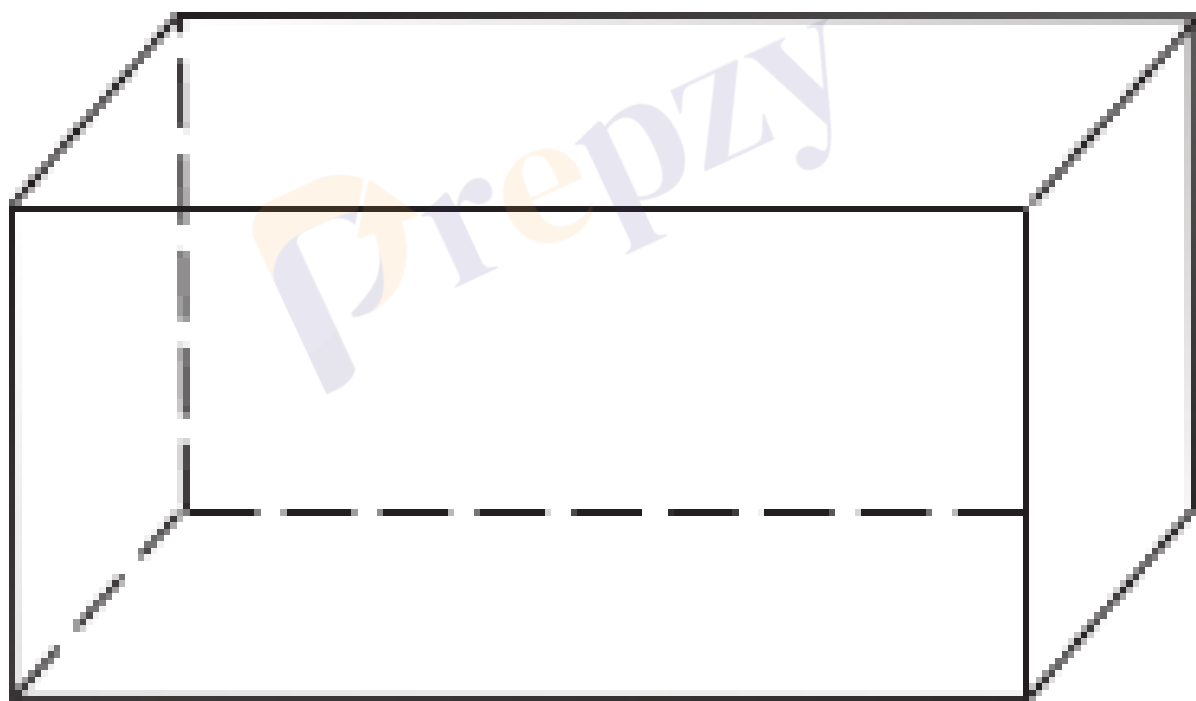
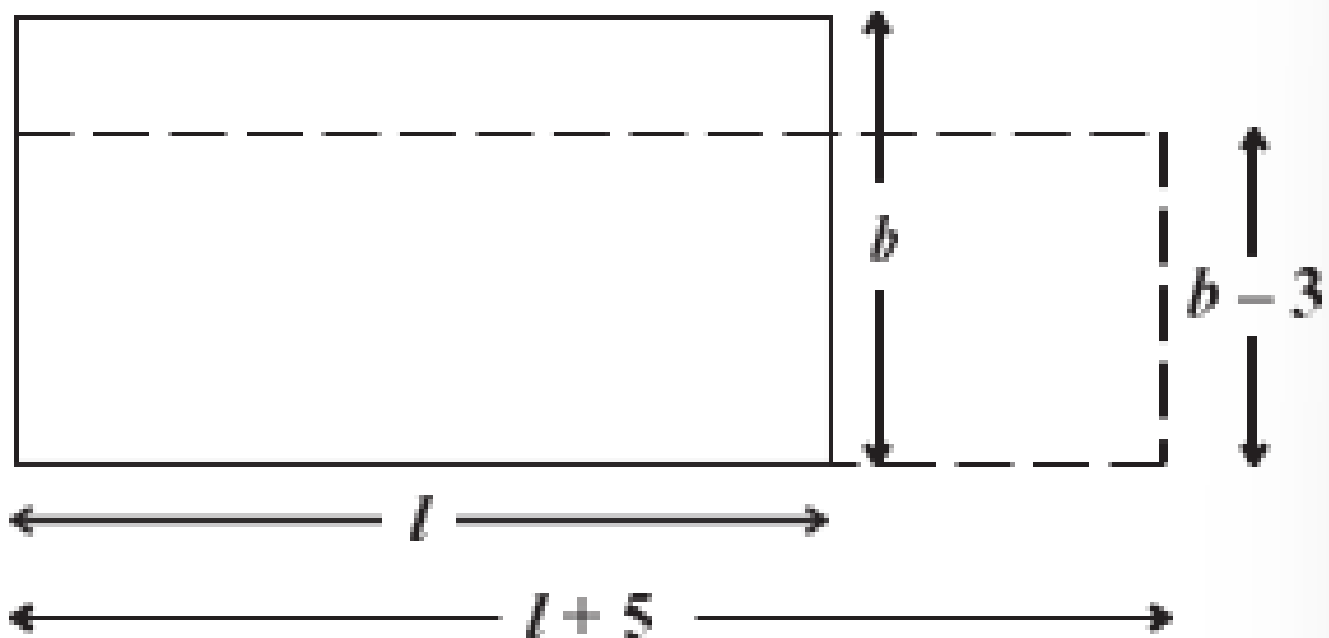
Quick Reference

- Multiply coefficients separately.
- Add exponents of like variables.
- Use distributive law for polynomials.
- Combine like terms after multiplication.

Glossary

- **Monomial:** An algebraic expression with one term.
- **Binomial:** An algebraic expression with two terms.
- **Trinomial:** An algebraic expression with three terms.
- **Polynomial:** An algebraic expression with one or more terms.
- **Distributive Law:** $a(b + c) = ab + ac$
- **Coefficient:** Numerical factor in a term.
- **Exponent:** Power to which a variable is raised.

Pattern of dots	Total number of dots
	4×9
 	5×7 $m \times n$
	$(m + 2) \times (n + 3)$



Note that $5 \times 4 = 20$

i.e., coefficient of product = coefficient of first monomial \times coefficient of second monomial;

and $x \times x^2 = x^3$

i.e., algebraic factor of product = algebraic factor of first monomial \times algebraic factor of second monomial.

We can find the product in other way also.

$$4xy \times 5x^2y^2 \times 6x^3y^3$$

$$= (4 \times 5 \times 6) \times (x \times x^2 \times x^3) \times (y \times y^2 \times y^3)$$

$$= 120 x^6y^6$$

length	breadth	area
$3x$	$5y$	$3x \times 5y = 15xy$
$9y$	$4y^2$
$4ab$	$5bc$
$2l^2m$	$3lm^2$

	length	breadth	height
(i)	$2ax$	$3by$	$5cz$
(ii)	m^2n	n^2p	p^2m
(iii)	$2q$	$4q^2$	$8q^3$

We commonly use distributive law in our calculations. For example:

$$7 \times 106 = 7 \times (100 + 6)$$

$$= 7 \times 100 + 7 \times 6$$

$$= 700 + 42 = 742$$

(Here, we used distributive law)

$$7 \times 38 = 7 \times (40 - 2)$$

$$= 7 \times 40 - 7 \times 2$$

$$= 280 - 14 = 266$$

(Here, we used distributive law)

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