CHAPTER 8

Algebraic Expression and Identities

Learning Objectives

In this chapter you will learn:

- *To Identify the Algebraic expression.*
- *To know about terms and coefficients in algebraic expressions.*
- *To define variable, factors of a term.*
- *To define a polynomial.*
- *To differentiate between an expression and a polynomial.*
- *To define monomial, binomial and trinomial etc.*
- *To identify like and unlike terms.*
- *To solve addition, subtraction and multiplication of algebraic expression and polynomials.*
- *To use multiplication in their life for practical use to find area of a rectangle and volume of rectangular box etc.*
- *To understand about identities and uses of identities in daily life.*

8.1 Meaning of Expressions (Introduction)

In earlier classes, we have learnt about algebraic expressions (or simply expressions). Algebraic expressions are formed by using variables and constants. Some examples of expressions are

$2x + 7$, $7xy - 8$, $\sqrt{x+5}$, $y + 8$, $x^2 + 7$ etc.

The expression $2x + 7$ is formed with variable x and constants 2 and 7, where as the expression $7xy - 8$ is formed with variables x and y and constants 7 and 8. Similarly we can say about other expressions.

8.1.1 Value of an Algebraic Expression

In expression, we can give any value to the variable or variables. The value of the expression changes with the chosen value of the variable or variables, it contains. For example, in expression $2x + 7$ if $x = 2$ then $2x + 7 = 2 \times 2 + 7 = 11$ and if $x = 0$ then $2x + 7 = 2 \times 0 + 7 = 7$ and so on. So we can find different values of expression $2x + 7$ for different values of the variable x.

8.1.2 Number line and an expression (in variable X)

Consider an expression $x + 3$. Let the position of variable x is X on number line (considering x to be +ve). So X may be any where on the number line to the right hand side of the origin. Now place of $x + 3$ will be a point (say A) three units to the right of X.

Similarly, the place of $x - 2$ is two unit left of X.

Now if we want to find the position of $3x + 2$ (taking x positive). The position of 3x (three times x) will be at point B.

So, position of $3x + 2$ is two units right of B i.e at point C.

8.2 Terms, Factors and Coefficients:-

Term is either a single number or variable, or numbers and variables multiplied together. So 4, x, 4x and 4xy all are terms. Terms are added to form expressions.

Let us take three terms 4x, 3y and 8. From these three terms expression is $4x + 3y + 8$. The term 4x is product of 4 and x. 4 and x are **factors** of 4x. Whereas 3y is product of **factors** 3 and y. The term 8 is made from single number 8.

The expression $9xy - 3x$ has two terms 9xy and $-3x$. The term 9xy is product of **factors** 9, x and y. The term $-3x$ is product of factors -3 and x. The numerical factor of a term is called its numerical coefficient or simply coefficient. The coefficient in term 9xy is 9 and in $-3x$ is $-$**3**.

8.3 Monomials,Binomials,Trinomial

An expression containing one or more terms with real coefficients and variables having number whole as exponents is called a **polynomial.**

Examples of polynomials : $3x$, $3x + 2y$, $x^2 + 3x + 5$, $ax + by + cz + d$

- Polynomial that contains: only one term is known as **monomial.**

  e.g. 4, $3x$, $4y$, $7xy$, $8x^2y$, $-4xy^2$

- Polynomial that contains two terms is called a **binomial**.

  e.g. $3x + 4y$, $x - 2y$, $ax + by$

- Polynomial having three terms is **trinomial** and so on.

  e.g. $x^2 - 3x + 5$, $ax + by + cz$

8.4 Like and Unlike terms

Like terms are terms whose variables and their exponents are same (equal). The coefficients can be different. So **3y, –4y, $\frac{21}{8}$y** are like terms. Similarly $3t^2$ and $-11t^2$ are like terms. Also, 4ab, $-21ab$ and 11ab are like terms.

The terms which are not like are known as unlike terms. Here 7x and 4y are unlike because variables are different. Similarly $7x^2$ and 4x are unlike term because exponent are unequal.

8.5 Addition and Subtraction of Algebraic expressions

In earlier classes, we have learnt about addition and subtraction of algebraic expressions. Recall that in addition we write each expression to be added in a separate row. While doing so, we write like terms one below the other and add them.

Also subtraction of numbers is the same as addition of its additive inverse. Therefore subtracting -4 is same as adding $+4$. Similarly, subtracting $5y$ is same as adding $-5y$. Subtracting $-3x^2$ is same as adding $3x^2$ and so on. So in subtraction the sign of each term of the expression, to be subtracted, will be changed. The signs in the third row written below each term in the second row help us in knowing which operation has to be performed. Observe the following examples to clear the concept.

Example 8.1. Add the following expression

(i) $x + y - 2z$ and $2x - 2y + 3z$

(ii) $2x + 3y - 4z$ and $x + y - 4$

(iii) $7xy + 5yz - 3zx$, $4xy + 7zx$ and $3yz + 4$

Sol. Write the expression in separate rows with like terms one below the other, we have

(i)
$$\begin{array}{rrr} x & +\ y & -\ 2z \\ 2x & -\ 2y & +\ 3z \\ \hline 3x & -\ y & +\ z \\ \hline \end{array}$$

(ii)
$$\begin{array}{rrrr} 2x & +\ 3y & -\ 4z & \\ x & +\ y & & -\ 4 \\ \hline 3x & +\ 4y & -\ 4z & -\ 4 \\ \hline \end{array}$$

there is no like terms of $-4z$ and -4

(iii)
$$\begin{array}{rrrr} 7xy & +\ 5yz & -\ 3zx & \\ 4xy & & +\ 7zx & \\ & 3yz & & +\ 4 \\ \hline 11xy & +\ 8yz & +\ 4zx & +\ 4 \\ \hline \end{array}$$

Example 8.2. Subtract

(i) $5a^2 - 3ab + 4b - 7$ from $8a^2 - 3b^2 - 8ab + 9a - 7b$

(ii) $x + 3y - 4z + x^2 - y^2$ from $8x + 5z - x^2 - y^2 + 7$

Sol. Like addition, we will write the expression in separate rows with like terms one below the other and then we will subtract

(i)
$$\begin{array}{rrrrrrr} 8a^2 & -\ 3b^2 & -\ 8ab & +\ 9a & -\ 7b & \\ 5a^2 & & -\ 3ab & & +\ 4b & -\ 7 \\ - & & + & & - & + \\ \hline 3a^2 & -\ 3b^2 & -\ 5ab & +\ 9a & -\ 11b & +\ 7 \\ \hline \end{array}$$

(ii)
$$\begin{array}{rrrrrr} 8x & +\ 5z & -\ x^2 & -\ y^2 & +\ 7 & \\ x & -\ 4z & +\ x^2 & -\ y^2 & & +\ 3y \\ - & + & - & + & & - \\ \hline 7x & +\ 9z & -\ 2x^2 & & +\ 7 & -\ 3y \\ \hline \end{array}$$

Example 8.3. Subtract $x + 3y - 5z + 7$ from the sum of the expressions $2x - 3y + 4z - 2$ and $-3x + 8y + 12z - 4$

Sol. First, we will add the expressions $2x - 3y + 4z - 2$ and $-3x + 8y + 12z - 4$, as we did earlier

$$\begin{array}{rrrr} 2x & -\ 3y & +\ 4z & -\ 2 \\ -\ 3x & +\ 8y & +\ 12z & -\ 4 \\ \hline -\ x & +\ 5y & +\ 16z & -\ 6 \\ \hline \end{array}$$

Now subtract $x + 3y - 5z + 7$ from $-x + 5y + 16z - 6$

$$\begin{array}{rrrr} -\ x & +\ 5y & +\ 16z & -\ 6 \\ x & +\ 3y & -\ 5z & +\ 7 \\ - & - & + & - \\ \hline -\ 2x & +\ 2y & +\ 21z & -\ 13 \\ \hline \end{array}$$

Exercise 8.1

1. **Give five examples of expressions having one variable and having two variables.**
2. **Construct :-**
   (i) Three polynomials with only x as variable
   (ii) Three binomials with x and y as variables
   (iii) Three monomials with x and y as variables
   (iv) Three polynomials with four or more terms
3. **Write two terms which are like to**
   (i) $7x$ (ii) $3ab$ (iii) $7x^2y$ (iv) $2lm$
4. **Identify the terms, their coefficients for each of the following expressions:**
   (i) $5xy - 3zy$ (ii) $2 + 2x - 3x^2$ (iii) $4x^2y^2 - 4z^2 + 3xy$
   (iv) $ab + bc + abc + 7$ (v) $\frac{x}{6} + \frac{y}{6} + 2xz$ (vi) $0.3a - 0.5ab$
   (vii) $\frac{xy}{2} + 7x + \frac{3}{2}y$ (viii) $0.4a - 0.6ab + 3b^2$ (ix) $3xy^2 + 5xyz - 6y^2$
5. **Classify the following polynomials as monomials, binomials and trinomials. Which polynomials do not fit in any of these three categories? and why?**
   (i) $3x$ (ii) y (iii) 4
   (iv) $3x - 2y$ (v) $\frac{y}{2} + z$ (vi) $x + y + 2z$
   (vii) $2x - y + 7$ (viii) $a + b + c$ (ix) $x - y + 2z$
   (x) $14x^2yz$ (xi) $x^2 - y^2$ (xii) $a^2 + b^2 + c^2$
6. **Add the following**
   (i) $ab + a^2b - 3abc$ and $4abc - 7a^2b + 2ab + 3$
   (ii) $x + y + 3z - 2xyz$ and $-2x + 3y + 4z - 8$
   (iii) $x^2 - y^2, y^2 - z^2, z^2 - x^2$
   (iv) $x - y, -y + z, z - x$
   (v) $2x^2y^2 - 3xy + 4$ and $5 + 7xy - 3x^2y^2$
   (vi) $x^2 + y^2 - z^2, x^2 - y^2 + z^2, -x^2 + y^2 + z^2$
7. **Subtract**
   (i) $5x - 3xy + 7y + 18$ from $13x - 7xy - 6y + 8$
   (ii) $2\ell m + 3mn - 8n\ell$ from $9\ell m + 7mn + 13n\ell$
   (iii) $ab + bc + ca + abc$ from $3ab - 2bc - 4abc$
   (iv) $2x + 3y + 4z + 3xyz$ from $4x - 7xyz$
   (v) $0.3x + 0.2y + 2xyz$ from $0.7x + 0.8y - 9xyz$
   (vi) $ab + bc - cd + abc$ from $2ab - 2bc + 2cd - 2abc$

8. Subtract the third expression from the sum of first two expressions.

(i) $2ab + bc - cd$, $abc + ab - 2bc$, $-2bc + 3ab$

(ii) $2x + 3y - 2z$, $x - y + 3xyz$, $4x + 3y - 4z + 7xyz$

(iii) $0.2x + 0.3y + 0.4xy$, $0.8x + 0.7y$, $x + y - 0.6xy$

(iv) $7xy + 3x + 2y - 3z$, $x + y + 2z$, $4xy - x - y + 4z$

(v) $0.3xy + 0.2yz$, $0.4xy + 0.3zx$, $0.2xy + 0.2yz$

(vi) $0.4xyz + 0.3xy^2$, $0.7xyz + 0.2xy^2$, $xyz + 0.4xy^2$

9. If sides of a triangle are given by expressions, $x^2 - 5x + 6$, $3 - 3x^2 + 7x$ and $11x^2 + 8x - 11$. Find the perimeter of triangle.

10. Multiple Choice Questions :

(i) Identify coefficient of y in $7y-5$.

(a) 7 (b) -5 (c) 5 (d) 12

(ii) Which of following is a monomial?

(a) $7x + 5$ (b) $x + y + z$ (c) $3x^3$ (d) $5x^2 - 7x + 6$

(iii) Identify the binomial.

(a) $5x + 2$ (b) $x + x + 1$ (c) $6z$ (d) $\sqrt{t}$

(iv) Find the trinomial from following expressions.

(a) $5xy-3zy$ (b) $2x-y+7$ (c) $x-y+2z+4$ (d) x^3+3

(v) Out of given expression which are like terms?

(a) $7x$ and $7y$ (b) $3x$ and $3x^2$ (c) x^2 and $3x^2$ (d) $x^3 + 3$

(vi) Addition of $2a - b$ and $a - 2b$ will give:

(a) $a - b$ (b) $2a - 2b$ (c) $3a - 3b$ (d) $a + b$

(vii) What does given diagram represents.

(a) $x + 3$ (b) $2x + 3$ (c) $2x - 3$ (d) $x^2 + 3$

(viii) The expression $3x - 5$ is a:

(a) Monomial (b) Binomial (c) Trinomial (d) None of these

(ix) Identify the terms in expression $-5x + 7xy$.

(a) -5 and 7 (b) $-5x$ and $7x$ (c) $-5x$ and $7xy$ (d) $-5x$ and $7y$

(x) Add $ab - bc$, $bc - ac$, $ac - ab$

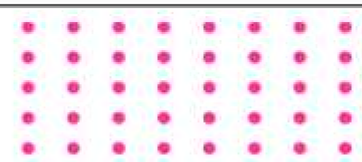
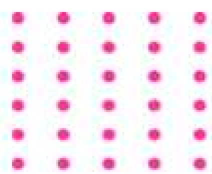
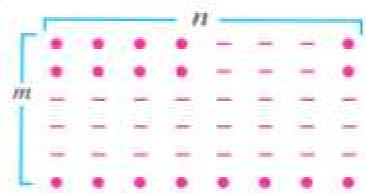
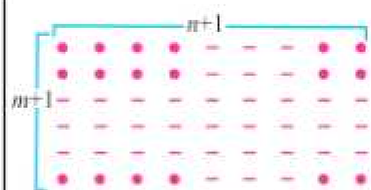
(a) 0 (b) $ab + bc + ac$ (c) abc (d) $a + b + c$

(xi) Find the value of expression $3x-5$ at $x = 5$.

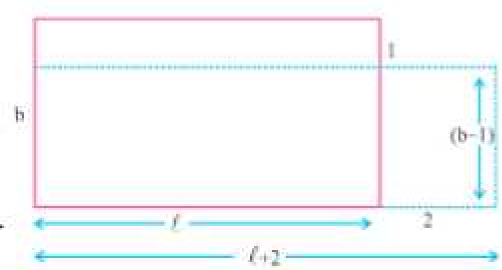
(a) 5 (b) 10 (c) 15 (d) 20

8.6 Multiplication of Algebraic Expressions:-

Introduction :- (i) Look at the followoing pattern of dots

Pattern	Number of rows	Number of Columns	Total Number of dots
	5	8	5× 8 To find total number of dots we have to multiply number of rows to the number of columns
	6	5	6 × 5
	m	n	m × n Here number of rows are m and number of columns are n
	m + 1	n + 1	(m + 1) (n + 1) Here number of rows are (m + 1) and number of columns are (n + 1)

(ii) Let us think of some other situations in which two algebraic expressions have to be multiplied? We know the area of rectangle is $\ell \times b$ where ℓ is length and b is breadth of rectangle. If length of rectangle is increased by 2 units and breadth is reduced by 1 unit then area of new rectangle will be $(\ell + 2) \times (b - 1)$



(iii) For buying things we have to multiply number of things with their unit price.

e.g. let price of one note book = ₹ p

Number of note books required = q

then he has to pay = ₹ (p × q)

Now suppose the price of one notebook is increased by ₹ 1 and number of note books required is 2 more, then

Price of one note book = ₹ (p + 1)

Required number of same note books = q + 2

So he has to pay = ₹ (p + 1) (q + 2)

In all the examples discussed above we need to multiply quantities in the form of algebeic expressions, so now we will learn, how to multiply algebraic expressions. First we will learn multiplication of monomial with another monomial.

8.7 Multiplying a Monomial by a Monomial

8.7.1 Multiplying two Monomials

We know multiplication is repeated addition

as 4×3 means 4 times 3

i.e. $4 \times 3 = 3 + 3 + 3 + 3 = 12$

Similarly $4 \times (5y) = 5y + 5y + 5y + 5y = 20y$

and $5 \times (3x) = 3x + 3x + 3x + 3x + 3x = 15x$

Now observe some following products:-

(i) $y \times 3x = y \times 3 \times x = 3 \times x \times y = 3xy$

(ii) $5x \times 4y = 5 \times x \times 4 \times y = 5 \times 4 \times x \times y = 20xy$

(iii) $3x \times (-2y) = 3 \times x \times (-2) \times y = 3 \times (-2) \times x \times y = -6xy$

Note that product of two monomials is a monomial

Now observe some following examples

(iv) $5x \times 3x^2 = 5 \times x \times 3 \times x^2$

$= (5 \times 3) \times (x \times x^2) = 15 \times x^3 = 15x^3$

Here we will use the rules of exponents and powers that for any non zero integer a, $a^m \times a^n = a^{m+n}$

(v) $5x^3 \times (-4x^4yz) = (5 \times -4) \times (x^3 \times x^4) \times (yz)$

$= -20\, x^7yz$

8.7.2 Multiplying three or more monomials

Observe the following examples

(i) $2x \times 3y \times 4z = (2x \times 3y) \times 4z = 6xy \times 4z = 24xyz$

(ii) $2xy \times 5x^2y^2 \times 6xy^2 = (2xy \times 5x^2y^2) \times 6xy^2$

$= 10x^3y^3 \times 6xy^2$

$= (10 \times 6)\, x^3y^3 \times xy^2$

$= 60\, (x^3 \times x) \times (y^3 \times y^2) = 60x^4y^5$

It is evident that first of all we multiply first two monomials and answer obtained is multiplied with third monomial to get the final answer.

Note: We can multiply the monomials in any order, result will be same.

Example 8.4. Complete the table to find the area of rectangle with given length and breadth

Length	Breadth	Area
3x	5y	
4x	2x	
2xy	3x	

Sol.

Length	Breadth	Area
$3x$	$5y$	$3x \times 5y = (3 \times 5) \times x \times y = 15xy$
$4x$	$2x$	$4x \times 2x = (4 \times 2) \times (x \times x) = 8x^2$
$2xy$	$3x$	$2xy \times 3x = (2 \times 3) \times (x \times x) \times y = 6x^2y$

Example 8.5. Find the volume of cubiod (rectangular box) whose length, breadth and height are respectively

(i) $2x, 3y, 4z$

(ii) $2ax, 3by, 7cz$

(iii) $2pq, 3qr, 4rp$

Sol. We know volume of cuboid $= l \times b \times h$

So volumes of rectangular boxes (cuboid) are

(i) $2x \times 3y \times 4z = (2 \times 3 \times 4) \times (x) \times (y) \times (z) = 24xyz$

(ii) $2ax \times 3by \times 7cz = (2 \times 3 \times 7) \times (ax) \times (by) \times (cz) = 42abcxyz$

(iii) $2pq \times 3qr \times 4rp = (2 \times 3 \times 4) \times (p \times p) \times (q \times q) \times (r \times r) = 24p^2q^2r^2$

Exercise 8.2

1. (i) The product of two monomials is ....

   (ii) The product of three monomials is ....

2. **Find the product of following pairs of monomials**

   (i) $8x, 3y$ (ii) $4, 2x$ (iii) $-4p, 3q$ (iv) $8p, -3pq$

   (v) $3xy, 0$ (vi) $p^2, 2pq$ (vii) $2p, 3pr$ (viii) $r, 2p$

3. **Find the area of rectangles with following pairs as their length and breadth respectively**

   (x, y), $(2\ell, 4m)$, $(10m, 6n)$, $(3mn, 4n)$, $(9a^2b, 13abc)$

   $(2ax, 3pr)$, $(3mn, 4np)$, $(2p, pqr)$, $(3x^3y, 7xy^2)$

4. **Complete the table of Products**

First Monomial → / Second Monomial ↓	$2x$	$-5y$	$2x^2$	$-3xy$	$7x^2y$	$-9x^2y^2$
$-2y$						
$3x$						
y^2						
$-4xy$						
$2x^2y^2$						

5. **Find the Product of**

   (i) $3x, 4x^2, -7x^3$ (ii) $2zx, 3y, 4z$ (iii) $\frac{a}{2}, \frac{b}{3}, \frac{c}{4}$

   (iv) $ab, abc, abcd$ (v) $\frac{x^2y}{3}, 9y^2z, -8z^2x$ (vi) $-3pq, 4p^2x^2$

6. **Find the volume of rectangular box having length, breadth and height respectively as**

(i) x, y, z (ii) $2x, 3y, 3z$ (iii) $2a, 7b, c$

(iv) $4l, 5m, 6n$ (v) ab^2, bc^2, ca^2 (vi) $\frac{a}{2}, \frac{b}{3}, \frac{c}{4}$

7. **Multiple Choice Questions :**

(i) Multiplying a monomial by a monomial will give you a:

(a) Monomial (b) Binomial (c) Trinomial (d) None of these

(ii) Multiplying a monomial with a binomial will give you a:

(a) Monomial (b) Binomial (c) Trinomial (d) None of these

(iii) Find the product of 3x and 5y.

(a) $3xy$ (b) $15x$ (c) $15xy$ (d) $15y$

(iv) Find the product of 3a and 7ab.

(a) $21a^2+b$ (b) $15a+21ab$ (c) $21a^2b$ (d) $21ab$

(v) If sides of a rectangle are 2ab and 3bc respectively. Then its area is:

(a) $6abc$ (b) $6ab^2c$ (c) $2ab+3bc$ (d) $6+ab+bc$

(vi) Find volume of a cuboid with sides a^2b, b^2c and c^2a.

(a) abc (b) $a^2b^2c^2$ (c) $a^3b^3c^3$ (d) $a^2b + b^2c + c^2a$

8.8 Multiplying a monomial by a polynomial

8.8.1 Multiplying a monomial by a binomial

Let us multiply monomial 4x by binomial (5x + 2y)

i.e. Find $4x \times (5x + 2y)$

Here we will use the distributive law for this multiplication.

So $4x \times (5x + 2y) = (4x \times 5x) + (4x \times 2y)$

$= 20x^2 + 8xy$

Here observe that product of monomial and binomial is a binomial

Similarly $(-4x) \times (-5y + 2x) = (-4x \times -5y) + (-4x \times 2x)$

$= 20xy - 8x^2$

Note:- If we multiply a binomial with a monomial, we will again get a binomial. We can use commutative law for this multiplication.

For example $(a-7b) \times 2b$

$= 2b \times (a-7b)$

$= 2b \times a + 2b \times (-7b) = 2ba - 14b^2$

or $2ab - 14b^2$ [$\because$ ab = ba]

8.8.2 Multiplying a monomial by a trinomial

Consider $5a(a^2 + 2a + 3)$ We use distributive property of multiplication over addition.

$$5a(a^2 + 2a + 3) = (5a \times a^2) + (5a \times 2a) + (5a \times 3)$$
$$= 5a^3 + 10a^2 + 15a$$

Example 8.6. Simplify the expressions and evaluate them with given value of variable

(i) $x(x + 3) - 2$ for $x = 2$ (ii) $2y(3y - 7) - 2(y + 4) + 5$ for $y = -3$

Sol. (i) $x(x + 3) - 2 = x^2 + 3x - 2$

for $x = 2$; We have $= (2)^2 + 3 \times 2 - 2 = 4 + 6 - 2 = 8$

(ii) $2y(3y - 7) - 2(y + 4) + 5 = 6y^2 - 14y - 2y - 8 + 5$

$= 6y^2 - 16y - 3$ (Combine like terms)

Now for $y = -3$; We have $= 6(-3)^2 - 16 \times (-3) - 3$

$= 6 \times 9 + 48 - 3$

$= 54 + 48 - 3 = 99$

Example 8.7. Add

(i) $2y(5 - y)$ and $6y^2 + 14y + 7$

(ii) $3x(x^2 + 2x - 5)$ and $2(x^2 + 7x - 2)$

Sol. (i) First expression $= 2y(5 - y) = 2y \times 5 - 2y \times y = 10y - 2y^2 = -2y^2 + 10y$

Now adding first and second expression

$$\begin{array}{rrr} -2y^2 & +10y & \\ +6y^2 & +14y & +7 \\ \hline 4y^2 & +24y & +7 \\ \hline \end{array}$$

(ii) First expression $= 3x(x^2 + 2x - 5)$ $= 3x \times x^2 + 3x \times 2x + 3x \times (-5)$

$= 3x^3 + 6x^2 - 15x$

Second expression $= 2(x^2 + 7x - 2)$ $= 2 \times x^2 + 2 \times 7x + 2 \times (-2)$

$= 2x^2 + 14x - 4$

Now adding first and second expression

$$\begin{array}{rrrr} 3x^3 & +6x^2 & -15x & \\ & +2x^2 & +14x & -4 \\ \hline 3x^3 & +8x^2 & -x & -4 \\ \hline \end{array}$$

Example 8.8. Subtract $2pq(3p - 2q)$ from $3pq(p + q)$.

Sol. Here, $2pq(3p - 2q) = 2pq \times 3p + 2pq \times (-2q)$

$= 6p^2q - 4pq^2$ ________(i)

and $3pq(p + q) = 3pq \times p + 3pq \times q$

$= 3p^2q + 3pq^2$ _________(ii)

Subtracting (i) from (ii), we have

$$\begin{array}{rr} 3p^2q & +3pq^2 \\ 6p^2q & -4pq^2 \\ - & + \\ \hline -3p^2q & +7pq^2 \\ \hline \end{array}$$

Exercise 8.3

1. Multiply each of the following pairs

(i) $4x, x + y$ (ii) $(x-3y), x^2$ (iii) $(x + y), 7xy$

(iv) $(x^2 - 9x), 4x$ (v) $(a + b), 0$ (vi) $(ab + bc), ab$

2. Complete the table

First expression	Second expression	Product
(i) $a^2b^2c^2$	$ab + bc + ca$	
(ii) $x + y + z$	$2xy$	
(iii) $p + q - 2r$	$2p$	
(iv) $b + c - a$	abc	

3. Find the Product of :

(i) a^2 and $(a^2 - b^2)$ (ii) $4xy$ and $(-2x - 3y)$

(iii) a and $(a^2 - 2ab + b^2)$ (iv) $4x^2$ and $(-x^2 - y^2 + 2x)$

4. Simplify the following and find its value with the given value of the variable

(i) $x(3x + 2) - 7$ if $x = 1$ and $x = \frac{1}{2}$ (iii) $xy(x^2y - xy^2)$ if $x = 1, y = 2$

(ii) $y(2y^2 - 7y) + 8$ if $y = 0$ and $y = -1$ (iv) $ab(a + ab + abc)$ for $a = 2, b = 1, c = 0$

5. Add: (i) $x(x - y)$, $y(y - z)$ and $z(z - x)$

(ii) $2x(x - y - z)$ and $2y(z - y - x)$

6. Subtract : (i) $8l(l - 4m + 5n)$ from $9l(10n - 3m + 2l)$

(ii) $2a(a + b - c) - 2c(a + b - c)$ from $2c(-a + b + c)$

7. Subtract sum of $x(2x+7) - 2$ and $3x(x-2) + 7$ from $7x - 1$

8. Add $2xy(x + y + z)$ and $3y(x^2 - xy + xz)$ then subtract from $5x(xy + y^2 - 4yz)$.

9. Multiple Choice Questions :

(i) Product of pqr and $p + q + r$ will be:

(a) pqr (b) $p^2qr + pq^2r + pqr^2$

(c) $pq + qr + pr$ (d) $p^2qr + pqr^2$

(ii) Find value of $x^2 + x$ at $x = 2$.

(a) 4 (b) 6 (c) 8 (d) 10

(iii) Find $y \times y^2 \times y^3 \times y^4$

(a) y (b) y^6 (c) y^{10} (d) y^{25}

(iv) Find the product of $xy + 4z + 3x$ with 0.

(a) $xy+yz+3x$ (b) xyz (c) 0 (d) $x^2y^2z^2$

8.9 Multiplying a Polynomial by a Polynomial

8.9.1 Multiplying a binomial by a binomial

Let us multiply one binomial $(3a + 3b)$ with another binomial $(7a + 4b)$. As we did in earlier cases, we will use distributive law to find the multiplication

$$\begin{aligned}(3a + 3b) \times (7a + 4b) &= 3a \times (7a + 4b) + 3b \times (7a + 4b) \\ &= (3a \times 7a) + (3a \times 4b) + (3b \times 7a) + (3b \times 4b) \\ &= 21a^2 + 12ab + 21ba + 12b^2 \\ &= 21a^2 + 12ab + 21ab + 12b^2 \\ &= 21a^2 + 33ab + 12b^2\end{aligned}$$

(As ab is same as ba, so by combining like terms)

[After doing product of 2 polynomials, we need to look for like terms and must combine them to get result.]

Example 8.9. Multiply

(i) $(7a + b)$ and $(a + 3b)$

(ii) $(2x - y)$ and $(x + 3y)$

Sol. (i) $(7a + b)(a + 3b)$

$= 7a(a + 3b) + b(a + 3b)$

$= (7a \times a) + (7a \times 3b) + (b \times a) + (b \times 3b)$

$= 7a^2 + 21ab + ba + 3b^2$

$= 7a^2 + 21ab + ab + 3b^2$ $[\because ba = ab]$

$= 7a^2 + 22ab + 3b^2$

(ii) $(2x - y) \times (x + 3y) = 2x \times (x + 3y) - y(x + 3y)$

$= (2x \times x) + (2x \times 3y) - (y \times x) - (y \times 3y)$

$= 2x^2 + 6xy - yx - 3y^2$

$= 2x^2 + 6xy - xy - 3y^2$ $[\because yx = xy]$

$= 2x^2 + 5xy - 3y^2$ (combining like terms)

Example 8.10. Multiply

(i) $(a + 6)$ and $(b - 8)$

(ii) $(2a^2 + 3b)$ and $(5a - 3b)$

Sol. (i) $(a + 6) \times (b - 8) = a \times (b - 8) + 6 \times (b - 8)$

$= ab - 8a + 6b - 48$

(ii) $(2a^2 + 3b) \times (5a - 3b) = 2a^2 \times (5a - 3b) + 3b \times (5a - 3b)$

$= (2a^2 \times 5a) + (2a^2 \times (-3b)) + (3b \times 5a) + (3b \times (-3b))$

$= 10a^3 - 6a^2b + 15ba - 9b^2$

8.8.2 Multiplying a Binomial by a trinomial

In this multiplication, we shall have to multiply each of the two terms of binomials by each of the three terms of trinomial. We will get total 6 terms. which may reduce to 5 or less, if like terms appears in multiplication. Consider

$(2x + 3y) \times (x + 2y + 5) = 2x \times (x + 2y + 5) + 3y\,(x + 2y + 5)$ (using distributive law)

$= 2x^2 + 4xy + 10x + 3yx + 6y^2 + 15y$

$= 2x^2 + 7xy + 10x + 6y^2 + 15y$ (as $xy = yx$)

Example 8.11. Simplify $(a + b)(2a + 3b - 2c)$

Sol. $(a + b)(2a + 3b - 2c)$

$= a\,(2a + 3b - 2c) + b\,(2a + 3b - 2c)$

$= 2a^2 + 3ab - 2ac + 2ab + 3b^2 - 2cb$

$= 2a^2 + 5ab - 2ac - 2bc + 3b^2$

Exercise 8.4

1. **Find the product of**

(i) $(x + 5)$ and $(x + 4)$

(ii) $(2x + 3)$ and $(x - 7)$

(iii) $(x - 8)$ and $(x + 3)$

(iv) $(2x - 3)$ and $(x - 4)$

(v) $(2x + 3y)$ and $(x + 2y)$

(vi) $(x + y)$ and $(x - 3y)$

(vii) $(p - q)$ and $(p + 3q)$

(viii) $(2p - 3q)$ and $(4p - 3q)$

(ix) $(a^2 - b)$ and $(a + b^2)$

(x) $\left(\frac{7}{2}x + y^2\right)$ and $\left(x^2 - \frac{2}{7}y\right)$

(xi) $(0.2x + 0.5y)$ and $(3xy - 5y^2)$

(xii) $(p^2 - q)$ and $(p^2 + q)$

2. **Simplify:-**

(i) $(y - 3)(y + 3) + 28$

(ii) $(a^2 - 3)(b^2 + 5) - 8$

(iii) $(y^2 - 7)(x + y) + 13y$

(iv) $(3x - y)(x + 5y) - 14xy$

(v) $(a + b)(a - b) + (b + c)(b - c) + (c + a)(c - a)$

(vi) $\left(\frac{3}{2}x + y\right)\left(x + \frac{1}{2}y\right) - \left(\frac{1}{2}x + y\right)\left(x + \frac{3}{2}y\right)$

(vii) $(p - q)(p + q) + (p + q + r)(p + q - r)$

(viii) $(x+y)(x-y+xy) - 3xy(x+y)$ (ix) $(\ell + m)(\ell - m + n) - (\ell^2 + m^2)$

(x) $(2x^2 - 5x + 7)(x - 6) + 42$

8.10 What is an Identity ?

Consider the equality $(x-5)(x+1) = x^2 - 4x - 5$ We will solve both sides of equality for same value of x say x = 7.

for x = 7, LHS $= (7-5)(7+1) = 2 \times 8 = 16$

RHS $= (7)^2 - 4\times 7 - 5 = 49 - 28 - 5$

$= 49 - 33$

$= 16$

So for x = 7 the values of the two sides of equality are same

Let us take a new value $x = -3$

LHS $= (-3-5)(-3+1) = -8 \times -2 = 16$

RHS $= (-3)^2 - 4(-3) - 5 = 9 + 12 - 5 = 16$

Thus for $x = -3$; LHS = RHS

We find that for any value of x, LHS = RHS.

Any equality which is true for every value of variable in it, is called an identity.

So $(x-5)(x+1) = x^2 - 4x - 5$ is an identity.

Difference between an identity and equation

Consider an equation $x^2 - 5x + 6 = 0$

Now for x = 1

LHS $= (1)^2 - 5 \times 1 + 6 = 1 - 5 + 6 = 7 - 5 = 2$

RHS $= 0$

LHS $\neq$ RHS

For x = 2

LHS $= (2)^2 - 5 \times 2 + 6 = 4 - 10 + 6 = 10 - 10 = 0$

RHS $= 0$

LHS = RHS

For x = 3

LHS $= (3)^2 - 5 \times 3 + 6 = 9 - 15 + 6 = 15 - 15 = 0$

RHS $= 0$

LHS = RHS

For x = 0

$$\text{L.H.S} = (0)^2 - 5 \times 0 + 6 = 6$$

$$\text{R.H.S} = 0$$

$$\text{L.H.S} \neq \text{R.H.S}$$

We observe that equation $x^2-5x+6=0$ is true for $x = 2$ and 3 only and is not true for any other value of x.

We can say that equation is true for some specific values of variables only i.e. it is not true for all values of variable involved in it. Therefore it is not an identity.

8.11 Standard Identities

Now we shall study three identities which are very useful. The identities are obtained by actual multiplication of a binomial with same or another binomial.

(a) Let us first consider $(a + b)(a + b)$ or $(a + b)^2$

Now $(a + b)^2 = (a + b)(a + b)$

$= a(a + b) + b(a + b)$

$= a^2 + ab + ba + b^2$

$= a^2 + 2ab + b^2$ ($\because ab = ba$)

So $(a + b)^2 = a^2 + 2ab + b^2$ __________ (I)

We can verify the above identity with different values of a and b. The values of two sides will be same.

(b) Now consider $(a - b)^2$

$(a - b)^2 = (a - b)(a - b) = a(a - b) - b(a - b)$

$= a^2 - ab - ba + b^2 = a^2 - 2ab + b^2$

So $(a - b)^2 = a^2 - 2ab + b^2$__________(II)

(c) Now consider $(a + b)(a - b)$

Now $(a + b)(a - b) = a(a - b) + b(a - b)$

$= a^2 - ab + ba - b^2$

So $(a + b)(a - b) = a^2 - b^2$ _________(III)

The above three identities (I), (II) and (III) are known as **standard Identities**.

(d) Now we shall discuss one more useful identity

$(x + a)(x + b) = x(x + b) + a(x + b)$

$= x^2 + bx + ax + ab$

$= x^2 + (a + b)x + ab$

or $(x + a)(x + b) = x^2 + (a + b)x + ab$ ____________(IV)

Activity: To verify $(a+b)^2 = a^2 + 2ab + b^2$ by paper cutting activity.

Material Required : Coloured paper, glue, scissor, geometry box, card board.

Procedure: 1. From coloured paper cut out figures of following dimensions.

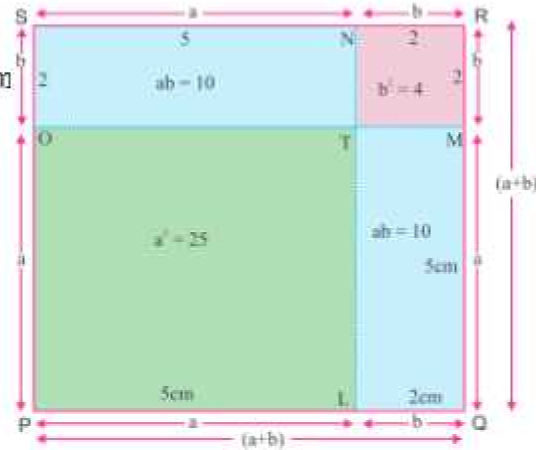
(i) A square of side a = 5cm.

(ii) A square of side b = 2cm

(iii) Two rectangles of length 5cm and breadth 2cm

2. Paste these squares and rectangles on card board as shown.

3. As it is evident from figure that:



Area of square PQRS = Sum of areas of 4 figures.

Area of square PLTO = $a \times a = a^2$

Area of 2 rectangles = $2 \times a \times b = 2ab$

Area of square MTNR = $b \times b = b^2$

Sum of areas = $a^2 + 2ab + b^2$

Side of square PQRS = $a+b$

Area of square PQRS = $(a+b)(a+b) = (a+b)^2$

$\therefore$ As area of square PQRS = Sum of area of 4 figures

$\therefore \quad (a + b)^2 = a^2 + 2ab + b^2$

Result : $(a + b)^2 = a^2 + 2ab + b^2$

VIVA VOCE:

Q.1. Write the expression for $(a+b)^2$.

Ans : $a^2 + 2ab + b^2$

Q.2. Expand $(3x+2y)^2$ using the identity $(a+b)^2 = a^2 + 2ab + b^2$

Ans: $9x^2 + 12xy + 4y^2$

Q.3. Find the value of 101^2 using identity $(a+b)^2 = a^2 + 2ab + b^2$

Ans: 10201

8.12 Applying Identities

Now we will see how these identities are useful in calculating multiplication of various expression in simple and efficient manner.

Example 8.12. Using identity (I) Find

(i) $(x + 2y)^2$ (ii) $(107)^2$ (iii) $(2x + 2y)^2$ (iv) $(10.1)^2$

Sol. (i) $(x + 2y)^2 = (x)^2 + 2(x)(2y) + (2y)^2$ $[(a+b)^2 = a^2 + 2ab + b^2]$

$= x^2 + 4xy + 4y^2$

(ii) $(107)^2 = (100 + 7)^2 = (100)^2 + 2 \times 100 \times 7 + (7)^2$ $[(a+b)^2 = a^2 + 2ab + b^2]$

$= 10000 + 1400 + 49$

$= 11449$

(iii) $(2x + 2y)^2 = (2x)^2 + 2 \times (2x)(2y) + (2y)^2$ $[(a+b)^2 = a^2 + 2ab + b^2]$

$= 4x^2 + 8xy + 4y^2$

(iv) $(10.1)^2 = (10+0.1)^2 = (10)^2 + 2 \times 10 \times 0.1 + (0.1)^2$ $[(a+b)^2 = a^2 + 2ab + b^2]$

$= 100 + 2 + 0.01$

$= 102.01$

Note: See that method of using identity is more convenient than the direct multiplication.

Example 8.13. **Using identity find :**

(i) $(2p - 3q)^2$ **(ii)** $(x - 3y)^2$ **(iii)** $(98)^2$ **(iv)** $(9.9)^2$

Sol. (i) $(2p - 3q)^2 = (2p)^2 - 2(2p)(3q) + (3q)^2$ $[(a - b)^2 = a^2 - 2ab + b^2]$

$= 4p^2 - 12pq + 9q^2$

(ii) $(x - 3y)^2 = (x)^2 - 2(x)(3y) + (3y)^2$ $[(a - b)^2 = a^2 - 2ab + b^2]$

$= x^2 - 6xy + 9y^2$

(iii) $(98)^2 = (100-2)^2 = (100)^2 - 2(100)(2) + (2)^2$ $[(a - b)^2 = a^2 - 2ab + b^2]$

$= 10000 - 400 + 4$

$= 9604$

(iv) $(9.9)^2 = (10-0.1)^2 = (10)^2 - 2 \times 10 \times 0.1 + (0.1)^2$ $[(a - b)^2 = a^2 - 2ab + b^2]$

$= 100 - 2 + 0.01$

$= 98.01$

Example 8.14. **Using identity find :**

(i) $991^2 - 9^2$ **(ii)** 198×202

(iii) $(3 + 2x)(3 - 2x)$ **(iv)** $\left(\frac{3}{4}m + \frac{3}{2}n\right)\left(\frac{3}{4}m - \frac{3}{2}n\right)$

Sol. (i) $991^2 - 9^2 = (991 + 9)(991 - 9)$ $[(a+b)(a-b) = a^2 - b^2]$

$= 1000 \times 982$

$= 982000$

(ii) $198 \times 202 = (200 - 2)(200 + 2)$

$= (200)^2 - (2)^2$ $[(a+b)(a-b) = a^2 - b^2]$

$= 40000 - 4$

$= 39996$

(iii) $(3 + 2n)(3 - 2n) = (3)^2 - (2n)^2$ $[(a+b)(a-b) = a^2 - b^2]$

$= 9 - 4n^2$

(iv) $\left(\frac{3}{4}m + \frac{3}{2}n\right)\left(\frac{3}{4}m - \frac{3}{2}n\right)$

$= \left(\frac{3}{4}m\right)^2 - \left(\frac{3}{2}n\right)^2$ $[(a+b)(a-b) = a^2 - b^2]$

$= \frac{9}{16}m^2 - \frac{9}{4}n^2$

Example 8.15. **Use identity $(x + a)(x + b) = x^2 + (a + b)x + ab$ to find the following :**

(i) 104×107 **(ii)** 501×503 **(iii)** 97×104 **(iv)** $(2y + 3)(2y + 6)$

(v) $(3p - 7)(3p + 8)$

Sol. (i) $104 \times 107 = (100 + 4)(100 + 7)$

$= (100)^2 + (4 + 7) \times 100 + 4 \times 7$ [Here $x = 100, a = 4, b = 7$]

$= 10000 + 1100 + 28$

$= 11128$

(ii) $501 \times 503 = (500 + 1) \times (500 + 3)$

$= (500)^2 + (1 + 3) \times 500 + 1 \times 3$ [Here $x = 500, a = 1, b = 3$]

$= 250000 + 2000 + 3$

$= 252003$

(iii) $97 \times 104 = (100 - 3) \times (100 + 4)$

$= (100)^2 + (-3 + 4) \times 100 + (-3)(4)$ [Here $x = 100, a = -3, b = 4$]

$= 10000 + 100 - 12$

$= 10088$

(iv) $(2y+3)(2y+6) = (2y)^2 + (3+6)(2y) + 3 \times 6$ [Here $x = 2y, a = 3, b = 6$]

$= 4y^2 + 9 \times 2y + 18$

$= 4y^2 + 18y + 18$

(v) $(3p-7)(3p+8) = (3p)^2 + (-7+8)(3p) + (-7) \times (8)$ [Here $x = 3p, a = -7, b = 8$]

$= 9p^2 + 1 \times 3p - 56$

$= 9p^2 + 3p - 56$

Example 8.16. Simplify:

(i) $(3p+2q)^2 - (3p-2q)^2$ (ii) $(2ab + 3bc)^2 - 12ab^2c$ (iii) $(x+5y)^2 - (x+y)(x-y)$

Sol. (i) $(3p+2q)^2 - (3p-2q)^2$

$= [(3p)^2 + (2q)^2 + 2 \times 3p \times 2q] - [(3p)^2 + (2q)^2 - 2 \times 3p \times 2q]$

$= [9p^2 + 4q^2 + 12pq] - [9p^2 + 4q^2 - 12pq]$

$= 9p^2 + 4q^2 + 12pq - 9p^2 - 4q^2 + 12pq$

$= 24pq$

(ii) $(2ab + 3bc)^2 - 12ab^2c$

$= (2ab)^2 + (3bc)^2 + 2 \times 2ab \times 3bc - 12ab^2c$

$= 4a^2b^2 + 9b^2c^2 + 12ab^2c - 12ab^2c$

$= 4a^2b^2 + 9b^2c^2$

(iii) $(x+5y)^2 - (x+y)(x-y)$

$= [x^2 + (5y)^2 + 2 \times x \times 5y] - [x^2 - y^2]$

$= x^2 + 25y^2 + 10xy - x^2 + y^2$

$= 26y^2 + 10xy$

Exercise 8.5

1. Use suitable identity to get each of the following products :

(i) $(x + y)(x + y)$ (ii) $(y + 2x)(y + 2x)$ (iii) $(a + 7b)(a + 7b)$

(iv) $(2a - b)(2a - b)$ (v) $(2x - 3y)(2x - 3y)$ (vi) $\left(x - \frac{1}{2}y\right)\left(x - \frac{1}{2}y\right)$

(vii) $(2x + 3y)(2x + 3y)$ (viii) 101×99 (ix) $\left(x + \frac{y}{10}\right)\left(x - \frac{y}{10}\right)$

(x) $61^2 - 39^2$ (xi) $\left(\frac{x}{2} + \frac{3y}{4}\right)\left(\frac{x}{2} + \frac{3y}{4}\right)$ (xii) 54×46

(xiii) $(q + p)(p - q)$

2. Use the identity $(x + a)(x + b) = x^2 + (a + b)x + ab$ to find the following :

(i) $(x + 2)(x + 3)$ (ii) $(x + 2)(x - 5)$ (ii) $(x - 7)(x + 3)$

(iv) $(4x + 5)(4x + 1)$ (v) $(7p + 6)(7p - 3)$ (vi) $(5y^2 - 1)(5y^2 + 2)$

3. Solve the following squares by using the identities :

(i) $(xy + 3z)^2$ (ii) $\left(\frac{2}{3}x - \frac{3}{2}y\right)^2$

(iii) $(-a + c)(-a + c) = (-a + c)^2$ (iv) $(1.2p - 1.5q)^2$

(v) $(x^2 + 3y^2)^2$ (vi) $(x - y^2z)^2$

4. Simplify :

(i) $(x^2 + 3y)^2 + (3 + x^2y)^2$ (ii) $(2m + 5n)^2 + (2n + 5m)^2$

(iii) $(ab + bc)^2 - 2ab^2c$ (iv) $(9p - 5q)^2 - (9p + 5q)^2$

5. Prove that :

(i) $(a + b)^2 - (a - b)^2 = 4ab$

(ii) $(2x + 3y)(2x - 3y) + (3y - 5z)(3y + 5z) + (5z - 2x)(5z + 2x) = 0$

(iii) $(2x + 5)^2 - 40x = (2x - 5)^2$

(iv) $(x - y)^2 + (x + y)^2 = 2(x^2 + y^2)$

6. Using identities, evaluate :

(i) 99^2 (ii) 103^2 (ii) 5.1^2

(iv) 9.8^2 (v) 71×69 (vi) 1.02×0.98

7. Using $a^2 - b^2 = (a + b)(a - b)$ evaluate

(i) $153^2 - 147^2$ (ii) $64^2 - 36^2$

(iii) $(1.05)^2 - (.95)^2$ (iv) $12.1^2 - 7.9^2$

8. Using $(x + a)(x + b) = x^2 + (a + b)x + ab$, find :

(i) 105×102 (ii) 5.1×5.2 (iii) 46×49

(iv) 103×94 (v) 9.3×9.2 (vi) 10.3×9.8

9. Multiple Choice Questions :

(i) Complete the identity $(a + b)^2 =$

(a) $a^2 - b^2$ (b) $a^2 + b^2 + 2ab$ (c) $a^2 + b^2 - 2ab$ (d) $a^2 + b^2$

(ii) Complete the identity: $a^2 - 2ab + b^2 =$ ....

(a) $(a-b)^2$ (b) $a-b^2$ (c) $a-b$ (d) a^2-b^2

(iii) Complete the identity : $(a+b)(a-b)$:

(a) a^2+b^2 (b) a^2-b (c) a^2-b^2 (d) $a-b$

(iv) Complete the identity: $(x+a)(x+b) = x^2+$ .... $x +$ ....

(a) a^2b, $a+b$ (b) $(a+b)$, ab (c) a^2+b^2, a^2b^2 (d) $a-b$, ab

(v) To solve $(y+5)(y-5)$ identify the suitable identity:

(a) $(a + b)^2 = a^2 + 2ab + b^2$ (b) $(a - b)^2 = (a^2 - 2ab + b^2)$

(c) $(a + b)(a - b) = a^2 - b^2$ (d) $a^2 + b^2 = ab$

(vi) Solve: $\left(\frac{3}{2}p + \frac{2}{3}q\right)\left(\frac{3}{2}p - \frac{2}{3}q\right)$

(a) $\frac{3}{2}p^2 - \frac{2}{3}q^2$ (b) $\frac{9}{4}p^2 - \frac{4}{9}q^2$ (c) $\frac{3}{2}p^2 - \frac{2}{3}q$ (d) $\frac{9}{4}p^2 + \frac{4}{9}q^2$

(vii) To multiply $(2x-3)(2x+5)$, identify the identity that should be used:

(a) $(a + b)(a - b) = a^2 - b^2$ (b) $(a + b)^2 = a^2 + 2ab + b^2$

(c) $(x + a)(x + b) = x^2 + (a+b)x + ab$ (d) $(a-b)^2 = a^2 - 2ab + b^2$

(viii) If $(2p+3q)$ and $(2p-3q)$ are sides of rectangle than its area is:'

(a) $2p^2+3q^2$ (b) $4p^2+3q^2$ (c) $4p^2-9q^2$ (d) $6p^2q^2$

Learning Outcomes

After compeletion of the chapter students are able to:

- *Identify Algebraic expression, its terms and their co-efficients.*
- *Identify variable and factors of a term.*
- *Define a Polynomial.*
- *Differentiate between an expression and polynomial.*
- *Define a monomial, Binomial and Trinomial.*
- *Differentiate between like and unlike terms.*
- *Apply operations of addition, subtraction and multiplication over polynomials and algebraic expressions.*
- *Apply multiplication of algebraic expression to find area of rect-angle and volume of cuboid.*
- *Understand about identities and use identities in their daily life.*

Answers

Excercise 8.1

4.

(i)

Term	Coefficient
5xy	5
–3zy	–3

(ii)

Term	Coefficient
2	2
2x	2
$-3x^2$	–3

(iii)

Term	Coefficient
$4x^2y^2$	4
$-4z^2$	–4
3xy	3

(iv)

Term	Coefficient
ab	1
bc	1
abc	1
7	7

(v)

Term	Coefficient
$\frac{x}{6}$	$\frac{1}{6}$
$\frac{y}{6}$	$\frac{1}{6}$
2xz	2

(vi)

Term	Coefficient
0.3a	0.3
–0.5ab	–0.5

(vii)

Term	Coefficient
$\frac{xy}{2}$	$\frac{1}{2}$
7x	7
$\frac{3}{2}y$	$\frac{3}{2}$

(viii)

Term	Coefficient
0.4a	0.4
–0.6ab	–0.6
$3b^2$	3

(ix)

Term	Coefficient
$3xy^2$	3
5xyz	5
$-6y^2$	–6

5. (i) monomial (ii) monomial (iii) monomial (iv) binomial (v) binomial
(vi) trinomial (vii) trinomial (viii) trinomial (ix) trinomial (x) monomial
(xi) binomial (xii) trinomial

6. (i) $3ab - 6a^2b + abc + 3$

(ii) $-x + 4y + 7z - 2xyz - 8$

(iii) 0

(iv) $-2y + 2z$

(v) $-x^2y^2 + 4xy + 9$

(vi) $x^2 + y^2 + z^2$

7. (i) $8x - 4xy - 13y - 10$
   (ii) $7\ell m + 4mn + 21n\ell$
   (iii) $2ab - 3bc - ca - 5abc$
   (iv) $2x - 3y - 4z - 10xyz$
   (v) $0.4x + 0.6y - 11xyz$
   (vi) $ab - 3bc + 3cd - 3abc$

8. (i) $abc + bc - cd$ (ii) $-x - y + 2z - 4xyz$ (iii) xy
   (iv) $3xy + 5x + 4y - 5z$ (v) $0.5xy + 0.3zx$ (vi) $0.1xyz + 0.1xy^2$

9. $9x^2 + 10x - 2$

10. (i) a (ii) c (iii) a (iv) b (v) c (vi) c (vii) b
    (viii) b (ix) c (x) a (xi) b

Excercise 8.2

1. (i) monomial (ii) monomial
2. (i) $24xy$ (ii) $8x$ (iii) $-12pq$ (iv) $-24p^2q$ (v) 0 (vi) $2p^3q$ (vii) $6p^2r$ (viii) $2pr$
3. xy ; $8\ell m$; $60mn$; $12mn^2$; $117\ a^3b^2c$; $6axpr$; $12mn^2p$; $2p^2qr$; $21x^4y^3$
4.

First monomial →	$2x$	$-5y$	$2x^2$	$-3xy$	$7x^2y$	$-9x^2y^2$
Second monomial ↓						
$-2y$	$-4xy$	$10y^2$	$-4x^2y$	$6xy^2$	$-14x^2y^2$	$18x^2y^3$
$3x$	$6x^2$	$-15xy$	$6x^3$	$-9x^2y$	$21x^3y$	$-27x^3y^2$
y^2	$2xy^2$	$-5y^3$	$2x^2y^2$	$-3xy^3$	$7x^2y^3$	$-9x^2y^4$
$-4xy$	$-8x^2y$	$20xy^2$	$-8x^3y$	$12x^2y^2$	$-28x^3y^2$	$36x^3y^3$
$2x^2y^2$	$4x^3y^2$	$-10x^2y^3$	$4x^4y^2$	$-6x^3y^3$	$14x^4y^3$	$-18x^4y^4$

5. (i) $-84x^6$ (ii) $24xyz^2$ (iii) $\frac{abc}{24}$ (iv) $a^3b^3c^2d$ (v) $-24x^3y^3z^3$ (vi) $-12p^3qx^2$

6. (i) xyz (ii) $24xyz$ (iii) $14abc$ (iv) $120lmn$ (v) $a^3b^3c^3$ (vi) $\frac{abc}{24}$

7. (i) a (ii) b (iii) c (iv) c (v) b (vi) c

Excercise 8.3

1. (i) $4x^2 + 4xy$ (ii) $x^3 - 3x^2y$ (iii) $7x^2y + 7xy^2$ (iv) $4x^3 - 36x^2$ (v) 0 (vi) $a^2b^2 + ab^2c$
2. (i) $a^3b^3c^2 + a^2b^3c^3 + a^3b^2c^3$ (ii) $2x^2y + 2xy^2 + 2xyz$
   (iii) $2p^2 + 2pq - 4pr$ (iv) $ab^2c + abc^2 - a^2bc$
3. (i) $a^4 - a^2b^2$ (ii) $-8x^2y - 12xy^2$ (iii) $a^3 - 2a^2b + ab^2$ (iv) $-4x^4 - 4x^2y^2 + 8x^3$

4. (i) $3x^2 + 2x - 7$; -2 ; $\frac{-21}{4}$ (iii) $x^3y^2 - x^2y^3$; -4

(ii) $2y^3 - 7y^2 + 8$; 8 ; -1 (iv) $a^2b + a^2b^2 + a^2b^2c$; 8

5. (i) $x^2 - xy + y^2 - yz + z^2 - xz$

(ii) $2x^2 - 4xy - 2xz + 2yz - 2y^2$

6. (i) $10l^2 + 50ln + 5lm$

(ii) $4bc - 2ab + 2ac - 2a^2$

7. (i) $-5x^2 + 6x - 6$ 8. $6xy^2 - 25xyz$

9. (i) b (ii) b (iii) c (iv) c

Excercise 8.4

1. (i) $x^2 + 9x + 20$ (vi) $x^2 - 2xy - 3y^2$

(ii) $2x^2 - 11x - 21$ (vii) $p^2 + 2pq - 3q^2$

(iii) $x^2 - 5x - 24$ (viii) $8p^2 - 18pq + 9q^2$

(iv) $2x^2 - 11x + 12$ (ix) $a^3 + a^2b^2 - ab - b^3$

(v) $2x^2 + 7xy + 6y^2$ (x) $\frac{7}{2}x^3 - xy + x^2y^2 - \frac{2}{7}y^3$

(xi) $0.6x^2y + 0.5xy^2 - 20y^3$ (xii) $p^4 - q^2$

2. (i) $y^2 + 19$ (ii) $a^2b^2 + 5a^2 - 3b^2 - 23$

(iii) $y^2x + y^3 - 7x + 6y$ (iv) $3x^2 - 5y^2$

(v) 0 (vi) $x^2 - y^2$

(vii) $2p^2 + 2pq - r^2$ (viii) $x^2 - y^2 - 2x^2y - 2xy^2$

(ix) $ln + mn - 2m^2$ (x) $2x^3 - 17x^2 + 37x$

Excercise 8.5

1. (i) $x^2 + 2xy + y^2$ (ii) $y^2 + 4xy + 4x^2$

(iii) $a^2 + 14ab + 49b^2$ (iv) $4a^2 - 4ab + b^2$

(v) $4x^2 - 12xy + 9y^2$ (vi) $x^2 - xy + \frac{1}{4}y^2$

(vii) $4x^2 + 12xy + 9y^2$ (viii) 9999

(ix) $x^2 - \frac{y^2}{100}$ (x) 2200

(xi) $\frac{x^2}{4} + \frac{3xy}{4} + \frac{9y^2}{16}$ (xii) 2484

(xiii) $p^2 - q^2$

2. (i) $x^2 + 5x + 6$ (ii) $x^2 - 3x - 10$

(iii) $x^2 - 4x - 21$ (iv) $16x^2 + 24x + 5$

(v) $49p^2 + 21p - 18$ (vi) $25y^4 + 5y^2 - 2$

3. (i) $x^2y^2 + 6xyz + 9z^2$ (ii) $\frac{4}{9}x^2 - 2xy + \frac{9}{4}y^2$

(iii) $a^2 - 2ac + c^2$ (iv) $1.44p^2 - 3.6pq + 2.25q^2$

(v) $x^4 + 9y^4 + 6x^2y^2$ (vi) $x^2 + y^4z^2 - 2xy^2z$

4. (i) $x^4 + x^4y^2 + 12x^2y + 9y^2 + 9$ (ii) $29m^2 + 29n^2 + 40mn$

(iii) $a^2b^2 + b^2c^2$ (iv) $-180pq$

6. (i) 9801 (ii) 10609

(iii) 26.01 (iv) 96.04

(v) 4899 (vi) 0.9996

7. (i) 1800 (ii) 2800

(iii) 0.20 (iv) 84

8. (i) 10710 (ii) 26.52

(iii) 2254 (iv) 9682

(v) 85.56 (vi) 100.94

9. (i) b (ii) a (iii) c (iv) b (v) c (vi) b

(vii) c (viii) c