ALGEBRAIC EXPRESSIONS 10

10.0 Introduction

In class VI you had already learnt that variables can take on different values and the value of constants is fixed. You had also learnt how to represent variables and constants using letters like x, y, z, a, b , p, m etc. You also came across simple algebraic expressions like $2x - 3$ and so on. You had also seen how these expressions are usefull in formulating and solving problems.

In this chapter, you will learn more about algebraic expressions and their addition and subtraction. However, before doing this we will get acquainted to words like 'terms', 'like terms' and 'unlike terms' and 'coefficients'.

Let us first review what you had learnt in class VI.

Exercise - 1

1. Find the rule which gives the number of matchsticks required to make the following patterns-

   (i) A pattern of letter 'H' (ii) A pattern of letter 'V'

2. Given below is a pattern made from coloured tiles and white tiles.

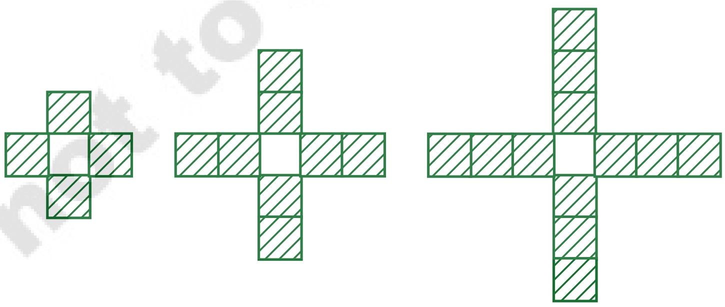


Figure 1 Figure 2 Figure 3

   (i) Draw the next two figures in the pattern above.

   (ii) Fill the table given below and express the pattern in the form of an algebraic expression.

Figure Number	1	2	3	4	5
Number of coloured tiles	4				

(iii) Fill the table given below and express the pattern in the form of an algebraic expression.

Figure Number	1	2	3	4	5
Number of total tiles	5				

3. Write the following statements using variables, constants and arithmetic operations.

(i) 6 more than p

(ii) 'x' is reduced by 4

(iii) 8 subtracted from y

(iv) q multiplied by '-5'

(v) y divided by 4

(vi) One-fourth of the product of 'p' and 'q'

(vii) 5 added to the three times of 'z'

(viii) x multiplied by 5 and added to '10'

(ix) 5 subtracted from two times of 'y'

(x) y multiplied by 10 and added to 13

4. Write the following expressions in statements.

(i) $x + 3$ (ii) $y - 7$ (iii) $10l$

(iv) $\frac{x}{5}$ (v) $3m + 11$ (vi) $2y - 5$

5. Some situations are given below. State the number in situations is a variable or constant?

Example : Our age - its value keeps on changing so it is an example of a variable quantity.

(i) The number of days in the month of January

(ii) The temperature of a day

(iii) Length of your classroom

(iv) Height of the growing plant

10.1 Algebriac Terms. Numeric term

Consider the expression $2x + 9$.

Here 'x' is multiplied by 2 and then 9 is added to it. **Both '$2x$' and '9' are terms in the expression $2x + 9$.** Moreover $2x$ is called algebriac term and 9 is called numeric term.

Consider another expression $3x^2 – 11y$.

$3x^2$ is formed by multiplying 3, x and x. 11y is the product of 11 and y. 11y is then subtracted from $3x^2$ to get the expression $3x^2 – 11y$. **In the expression $3x^2–11y$, $3x^2$ is one term and 11y is the other term.**

> When we multiply x with x we can write this as x^2. This is similar to writing 4 multiplied by 4 as 4^2.
> Similarly when we multiply x three times i.e., $x \times x \times x$ we can write this as x^3. This is similar to writing $6 \times 6 \times 6$ as 6^3.

Do This

In the expressions given below identify all the terms.

(i) $5x^2 + 3y + 7$ (ii) $5x^2y + 3$ (iii) $3x^2y$

(iv) $5x – 7$ (v) $5x + 8 –2(– y)$ (vi) $7x^2 – 2x$

10.1.1 Like and unlike terms

Let us observe the following examples.

(i) $5x$ and $8x$ (ii) $7a^2$ and $14a^2$

(iii) $3xy$ and $4xy$ (iv) $3xy^2$ and $4x^2y$

In the first example, both terms contain the same variable i.e. x and the exponent of the variable is also the same i.e. 1

In the second example, both terms contain the same variable i.e. a and the exponent of the variable is also the same i.e. 2

In the third example, both terms contain the same variables i.e. x and y and the exponent of variable x is 1 and the exponent of variable y is 1.

In the fourth example, both terms contain the same variables x and y. However, their exponents are not the same. In the first term, the exponent of x is 1 and in the second it is 2. Similarly, in the first term the exponent of y is 2 and in the second term it is 1.

The first three pairs of terms are examples of 'like terms' while the fourth is a pair of 'unlike terms'.

Like terms are terms which contain the same variables with the same exponents.

7th Maths EM Final 6.9.12.pdf 200 06-09-2012 12:48:37

Do This

1. Group the like terms together.

   $12x$, 12, $25x$, -25, $25y$, 1, x, $12y$, y, $25xy$, $5x^2y$, $7xy^2$, $2xy$, $3xy^2$, $4x^2y$

2. State true or false and give reasons for your answer.

   (i) $7x^2$ and $2x$ are unlike terms

   (ii) pq^2 and $-4pq^2$ are like terms

   (iii) xy, $-12x^2y$ and $5xy^2$ are like terms

10.2 Co-efficient

In 9 xy ; '9' is the co-efficient of 'xy' as $9\ (xy) = 9xy$

'x' is the co-efficient of '$9y$' as $x\ (9y) = 9xy$

'y' is the co-efficient of '$9x$' as $y\ (9x) = 9xy$

'$9x$' is the co-efficient of 'y' as $9x\ (y) = 9xy$

$9y$ is the co-efficient of 'x' as $9y\ (x) = 9xy$

xy is the co-efficient of '9' as $xy\ (9) = 9xy$

Since 9 has a numerical value it is called a numerical coefficient. x, y and xy are literal coefficients because they are variables.

Similarly in '$-5x$', '-5' is the numerical coefficient and 'x' is the literal coefficient.

Try This

(i) What is the numerical coefficient of 'x' ?

(ii) What is the numerical coefficient of '$-y$' ?

(iii) What is the literal coefficient of '$-3z$' ?

(iv) Is a numerical coefficient a constant?

(v) Is a literal coefficient always a variable?

10.3 Expressions

An expression is a single term or a combination of terms connected by the symbols '+' (plus) or '–' (minus).

For example : $6x + 3y$, $3x^2 + 2x + y$, $10y^3 + 7y + 3$, $9a + 5$, $5a + 7b$, $9xy$, $5 + 7 - 2x$, $9 + 3 - 2$

Note: multiplication '×' and division '÷' do not separate terms. For example $2x \times 3y$ and $\dfrac{2x}{3y}$ are single terms.

Do This

1. How many terms are there in each of the following expressions?

(i) $x + y$ (ii) $11x - 3y - 5$ (iii) $6x^2 + 5x - 4$

(iv) $x^2z + 3$ (v) $5x^2y$ (vi) $x + 3 + y$

(vii) $x - \frac{11}{3}$ (viii) $\frac{3x}{7y}$ (ix) $2z - y$ (x) $3x + 5$

10.3.1 Numerical expressions and algebraic expressions

Consider the following examples.

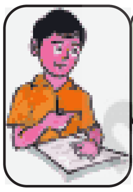
(i) $1 + 2 - 9$ (ii) $-3 - 5$ (iii) $x - \frac{11}{3}$ (iv) $4y$

(v) $9 + (6-5)$ (vi) $3x + 5$ (vii) $(17-5) + 4$ (viii) $2x - y$

Do you find any algebraic terms in the examples (i), (ii), (v) and (vii)?

If every term of an expression is a constant term, then the expression is called numerical expression. If an expression has at least one algebraic term, then the expression is called an algebraic expression.

Which are the algebraic expressions in the above examples?



Try This

Write 3 algebraic expressions with 3 terms each.

Aryabhata (India)

475 - 550 AD

He wrote an astronomical treatise, Aryabhatiyam (499AD). He was the first Indian mathematician who used algebraic expressions. India's first satellite was named Aryabhata.

10.3.2 Types of algebraic expressions

Algebraic expressions are named according to the number of terms present in them.

No. of terms	Name of the Expression	Examples
One term	Monomial	(a) x (b) $7xyz$ (c) $3x^2y$ (d) qz^2
Two unlike terms	Binomial	(a) $a + 4x$ (b) $x^2 + 2y$ (c) $3x^2 - y^2$
Three unlike terms	Trinomial	(a) $ax^2 + 4x + 2$ (b) $7x^2 + 9y^2 + 10z^3$
More than one unlike terms	Multinomial	(a) $4x^2 + 2xy + cx + d$ (b) $9p^2 - 11q + 19r + t$

Note: Binomial, trinomials are also multinomial algebraic expressions.

Do This

1. Give two examples for each type of algebraic expression.
2. Identify the expressions given below as monomial, binomial, trinomial and multinomial.

(i) $5x^2 + y + 6$ (ii) $3xy$

(iii) $5x^2y + 6x$ (iv) $a + 4x - xy + xyz$

10.4 Degree of algebraic expressions

Before discussing the degree of algebraic expressions let us understand what we mean by the degree of a monomial.

10.4.1 Degree of a monomial

Consider the term $9x^2y^2$

1. What is the exponent of 'x' in the above term?
2. What is the exponent of 'y' in the above term?
3. What is the sum of these two exponents?

The sum of all exponents of the variables present in a monomial is called the degree of the term or degree of the monomial.

Study the following table.

S. No.	Monomial	Exponents			Degree of the monomial
		x	y	z	
1	x	1	-	-	1
2	$7x^2$	2	-	-	2
3	-3xyz	1	1	1	$1 + 1 + 1 = 3$
4	$8y^2z^2$	-	2	2	$2 + 2 = 4$

10.4.2 Degree of constant terms

Let us discuss the degree of the constant term 5.

Since $x^o = 1$, we can write 5 as $5x^o$. Therefore, the degree of 5 is '0'.

Degree of constant term is zero.

10.4.3 Degree of algebraic expressions

Study the following table.

S. No.	Algebraic Expression	Degree of each term				Highest Degree
		First term	Second term	Third term	Fourth term	
1.	$7xy^2$	3	-	-	-	3
2	$3y - x^2y^2$	1	4	-	-	4
3	$4x^2 + 3xyz + y$	2	3	1	-	3
4	$pq - 6p^2q^2 - p^2q + 9$	2	4	3	0	4

In the second example the highest degree of one of the terms is 4. Therefore, the degree of the expression is 4. Similarly, the degree of the third expression is 3 and the degree of the fourth expression is 4.

The highest of the degrees of all the terms of an expression is called the degree of the expression.

Exercise 2

1. Identify and write the like terms in each of the following groups.

(i) $a^2, b^2, -2a^2, c^2, 4a$ (ii) $3a, 4xy, -yz, 2zy$

(iii) $-2xy^2, x^2y, 5y^2x, x^2z$ (iv) $7p, 8pq, -5pq, -2p, 3p$

2. State whether the expression is a numerical expression or an algebraic expression.

(i) $x + 1$ (ii) $3m^2$ (iii) $-30 + 16$

(iv) $4p^2-5q^2$ (v) 96 (vi) x^2-5yz

(vii) $215x^2yz$ (viii) $95 \div 5 \times 2$ (ix) $2 + m + n$

(x) $310 + 15 + 62$ (xi) $11a^2+6b^2-5$

3. State whether the algebraic expression given below is monomial, binomial, trinomial or multinomial.

(i) y^2 (ii) $4y - 7z$ (iii) $1 + x + x^2$

(iv) $7mn$ (v) $a^2 + b^2$ (vi) 100 xyz

(vii) $ax + 9$ (viii) $p^2 - 3pq + r$ (ix) $3y^2 - x^2 y^2 + 4x$

(x) $7x^2 - 2xy + 9y^2 - 11$

4. What is the degree of each of the monomials.

(i) $7y$ (ii) $-xy^2$ (iii) xy^2z^2

(iv) $-11y^2z^2$ (v) $3mn$ (vi) $-5pq^2$

5. Find the degree of each algebraic expression.

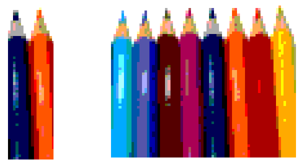
(i) $3x-15$ (ii) $xy + yz$ (iii) $2y^2z + 9yz -7z - 11x^2y^2$

(iv) $2y^2z + 10yz$ (v) $pq + p^2q - p^2q^2$ (vi) $ax^2 + bx + c$

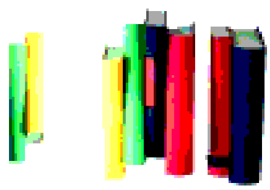
6. Write any two Algebraic expressions with the same degree.

10.5 Addition and subtraction of like terms

Consider the following problems.



1. Number of pencils with Vinay is equal to 4 times the pencils with Siddu. What is the total number of pencils both have together?



2. Tony and Basha went to a store. Tony bought 7 books and Basha bought 2 books. All the books are of same cost. How much money did Tony spend more than Basha?

To find answers to such questions we have to know how to add and subtract like terms. Let us learn how.

1. Number of pencils with Siddhu is not given in the problem, we shall take the number as 'x'.

   Vinay has 4 times of Siddu i.e., $4 \times x = 4x$

   To find the total number of pencils, we have to add x and $4x$

   Therefore, the total number of pencils $= x + 4x = (1 + 4)\,x = 5x$ (distributive law)

2. Since the cost of each book is not given, we shall take it as 'y'.

   Therefore, Tony spends $7 \times y =$ ₹$7y$

   Basha spends $2 \times y =$ ₹$2y$

   To find how much more Tony spends,we have to subtract 2y from $7y$

   Therefore, the amount spent more $= 7y - 2y = (7-2)y =$ ₹$5y$ (distributive law)

Thus, we can conclude that.

The sum of two or more like terms is a like term with a numerical coefficient equal to the sum of the numerical coefficients of all the like terms in addition.

The difference between two like terms is a like term with a numerical coefficient equal to the difference between the numerical coefficients of the two like terms.

Do This

1. Find the sum of the like terms.

   (i) $5x, 7x$ (ii) $7x^2y, -6x^2y$ (iii) $2m, 11m$

   (iv) $18ab, 5ab, 12ab$ (v) $3x^2, -7x^2, 8x^2$ (vi) $4m^2, 3m^2, -6m^2, m^2$

   (vii) $18pq, -15pq, 3pq$

2. Subtract the first term from the second term.

   (i) $2xy, 7xy$ (ii) $5a^2, 10a^2$ (iii) $12y, 3y$

   (iv) $6x^2y, 4x^2y$ (v) $6xy, -12xy$

10.5.1 Addition and subtraction of unlike terms

$3x$ and $4y$ are unlike terms. Their sum can be wirtten as $3x + 4y$.

However, 'x' and 'y' are different variables so we can not apply distributive law and thus cannot add them.

10.6 Simplification of an algebraic expression

Consider the expression $9x^2 - 4xy + 5y^2 + 2xy - y^2 - 3x^2 + 6xy$

We can see that there are some like terms in the expression. These are $9x^2$ and $-3x^2$; $5y^2$ and y^2 and $2xy$ and $+6xy$. On adding the like terms we get an algebraic expression in its simplified form. Let us see how the expression given above is simplified.

S.No.	Steps	Process
1.	Write down the expression	$9x^2 - 4xy + 5y^2 + 2xy - y^2 - 3x^2 + 6xy$
2.	Group the like terms together	$(9x^2 - 3x^2) + (2xy - 4xy + 6xy) + (5y^2 - y^2)$
3.	Addding the like terms	$(9-3)x^2 + (2-4+6)xy + (5-1)y^2 = 6x^2 + 4xy + 4y^2$

Note : If no two terms of an expression are alike then it is said to be in the simplified form.

Let us study another example: $5x^2y + 2x^2y + 4 + 5xy^2 - 4x^2y - xy^2 - 9$

Step 1: $5x^2y + 2x^2y + 4 + 5xy^2 - 4x^2y - xy^2 - 9$

Step 2: $(5x^2y + 2x^2y - 4x^2y) + (5xy^2 - xy^2) + (4-9)$ (bringing the like terms together)

Step 3: $3x^2y + 4xy^2 - 5$

Do This

1. Simplify the following.

(i) $3m + 12m - 5m$ (ii) $25yz - 8yz - 6yz$

(iii) $10m^2 - 9m + 7m - 3m^2 - 5m - 8$ (iv) $9x^2 - 6 + 4x + 11 - 6x^2 - 2x + 3x^2 - 2$

(v) $3a^2 - 4a^2b + 7a^2 - b^2 - ab$ (vi) $5x^2 + 10 + 6x + 4 + 5x + 3x^2 + 8$

10.7 Standard form of an expression

Consider the expression $3x + 5x^2 - 9$. The degrees of first, second and third terms are 1, 2, and 0 respectively. Thus, the degrees of terms are not in the descending order.

By re-arranging the terms in such a way that their degrees are in descending order; we get the expression $5x^2 + 3x - 9$. Now the expression is said to be in standard form.

Let us consider 3c + 6a –2b. Degrees of all the terms in the expression are same. Thus the expression is said to be already in standard form. If we write it in alphabetical order as 6a –2b + 3c it looks more beautiful.

In an expression, if the terms are arranged in such a way that the degrees of the terms are in descending order then the expression is said to be in standard form.

Examples of expressions in standard form (i) $7x^2+2x+11$ (ii) $5y^2-6y-9$

Do This

1. Write the following expressions in standard form.

   (i) $3x+18+4x^2$ (ii) $8-3x^2+4x$

   (iii) $-2m+6-3m^2$ (iv) $y^3+1+y+3y^2$

2. Identify the expressions that are in standard form?

   (i) $9x^2+6x+8$ (ii) $9x^2+15+7x$

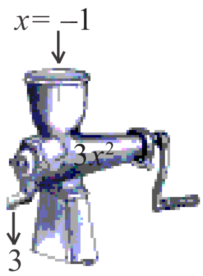
   (iii) $9x^2+7$ (iv) $9x^3+15x+3$

   (v) $15x^2+x^3+3x$ (vi) $x^2y+xy+3$

   (vii) $x^3+x^2y^2+6xy$

3. Write 5 different expressions in standard form.

10.8 Finding the value of an expression



Example 1: Find the value of $3x^2$ if $x=-1$

Solution : Step 1: $3x^2$ (write the expression)

Step 2 : $3(-1)^2$ (substitute the value of variable)

Step 3 : $3(1) = 3$

Example 2 : Find the value of x^2-y+2 if $x=0$ and $y=-1$

Solution : Step 1 : x^2-y+2 (write the expression)

Step 2 : $0^2-(-1)+2$ (substitute the value of variable)

Step 3 : $1+2=3$

Example 3 : Area of a triangle is given by $A=\frac{1}{2}bh$. If $b=12$ cm and $h=7$cm find the area of the triangle.

Solution : Step 1: $A=\frac{1}{2}bh$

Step 2: $A=\frac{1}{2}\times12\times7$

Step 3: $A=42$ sq. cm.

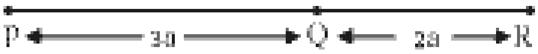
7th Maths EM Final 6.9.12.pdf 208 06-09-2012 12:48:38

Try This

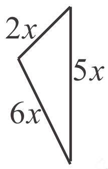
1. Find the value of the expression '$-9x$' if $x = -3$.
2. Write an expression whose value is equal to -9, when $x = -3$.

Exercise - 3

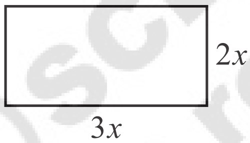
1. Find the length of the line segment PR in the following figure in terms of 'a'.



2. (i) Find the perimeter of the following triangle.



(ii) Find the perimeter of the following rectangle.



3. Subtract the second term from first term.

(i) $8x, 5x$ (ii) $5p, 11p$ (iii) $13m^2, 2m^2$

4. . Find the value of following monomials, if $x = 1$.

(i) $-x$ (ii) $4x$ (iii) $-2x^2$

5. Simplify and find the value of $4x + x - 2x^2 + x - 1$ when $x = -1$.

6. Write the expression $5x^2 - 4 - 3x^2 + 6x + 8 + 5x - 13$ in its simplified form. Find its value when $x = -2$

7. If $x = 1$; $y = 2$ find the values of the following expressions

(i) $4x - 3y + 5$ (ii) $x^2 + y^2$ (iii) $xy + 3y - 9$

8. Area of a rectangle is given by $A = l \times b$. If $l = 9$cm, $b = 6$cm, find its area?

9. Simple interest is given by $I = \dfrac{PTR}{100}$. If P = ₹. 900, T = 2 years; and R = 5%, find the simple interest.

7th Maths EM Final 6.9.12.pdf 209 06-09-2012 12:48:38

10. The relationship between speed (s), distance (d) and time (t) is given by $s = \frac{d}{t}$. Find the value of s, if d = 135 meters and t = 10 seconds.

10.9 Addition of algebraic expressions

Consider the following problems.

1. Sameera has some mangoes. Padma has 9 more than Sameera. Mary says that she has 4 more mangoes than the number of mangoes Sameera and Padma have together. How many mangoes does Mary have?

Since we do not know the number of mangoes that Sameera has, we shall take them to be x mangoes.

Padma has 9 more mangoes than Sameera.

Therefore, the number of mangoes Padma has = $x + 9$ mangoes

Mary has 4 more mangoes than those Sameera and Padma have together.

Therefore, the number of mangoes Mary has = $x + (x + 9) + 4$ mangoes

= $2x + 13$ mangoes

2. In a Mathematics test Raju got 11 marks more than Imran. Rahul got 4 marks less than what Raju and Imran got together. How much did Rahul score?

Since we do not know Imran's marks, we shall take them to be x marks.

Hint : Why are we taking Imran's marks as x?

Raju got 11 more marks than Imran = $x + 11$ marks

Rahul got 4 marks less than the marks Raju and Imran scored together = $x + x + 11 – 4$ marks

= $2\,x + 7$ marks

In both the above situations we have to add and subtract algebraic expressions. There are number of real life situations in which we need to do this. Let us now learn how to add or subtract algebraic expressions.

7th Maths EM Final 6.9.12.pdf 210 06-09-2012 12:48:38

10.9.1 Addition of Expressions

The sum of expressions can be obtained by adding like terms. This can be done in two ways.

(i) Column or Vertical Method

(ii) Row or Horizontal Method

(i) Column or Vertical Method

Example 4 : Add $3x^2+5x-4$ and $6+6x^2$

Solution:

S. No.	Steps	Process
1	Write the expressions in standard form if necessary	(i) $3x^2+5x-4=3x^2+5x-4$ (ii) $6+6x^2=6x^2+6$
2	Write one expression below the other such that the like terms come in the same column	$3x^2+5x-4$ $6x^2\qquad+6$
3.	Add the like terms column wise and write the result just below the concerned column	$3x^2+5x-4$ $6x^2\qquad+6$ $9x^2+5x+2$

Example 5 : Add $5x^2+9x+6, 4x+3x^2-8$ and $5-6x$

Solution: Step 1 :

$$5x^2+9x+6 = 5x^2+9x+6$$
$$4x+3x^2-8 = 3x^2+4x-8$$
$$5-6x = -6x+5$$

Step 2 :

$$\begin{array}{r} 5x^2+9x+6 \\ 3x^2+4x-8 \\ -6x+5 \end{array}$$

Step 3 :

$$\begin{array}{r} 5x^2+9x+6 \\ 3x^2+4x-8 \\ -6x+5 \\ \hline 8x^2+7x+3 \\ \hline \end{array}$$

(ii) Row or Horizontal Method

Example 6 : Add $3x^2 + 5x - 4$ and $6 + 6x^2$

S. No.	Steps	Process
1	Write all expressions with addition symbol in between them.	$3x^2 + 5x - 4 + 6 + 6x^2$
2	Re-arrange the term by grouping the like terms together.	$(3x^2 + 6x^2) + (5x) + (-4 + 6)$
3	Simplify the coefficients	$(3+6)\, x^2 + 5x + 2$
4	Write the resultant expression in standard form.	$9x^2 + 5x + 2$

Do This

1. Add the following expressions.

   (i) $x - 2y,\ 3x + 4y$

   (ii) $4m^2 - 7n^2 + 5mn,\ 3n^2 + 5m^2 - 2mn$

   (iii) $3a - 4b,\ 5c - 7a + 2b$

10.9.2 Subtraction of algebraic expressions

10.9.2(a) Additive inverse of an expression

If we take a positive number '9' then there exists '–9' such that $9 + (-9) = 0$.

Here we say that '–9' is the additive inverse of '9' and '9' is the additive inverse of '–9'.

Thus, for every positive number, there exists a negative number such that their sum is zero. These two numbers are called the additive inverse of the each other.

Is this true for algebraic expressions also? Does every algebraic expression have an additive inverse?

If so, what is the additive inverse of '$3x$'?

For '$3x$' there also exists '$-3x$' such that $3x + (-3x) = 0$

Therefore, '$-3x$' is the additive inverse of '$3x$' and '$3x$' is the additive inverse of '$-3x$'.

Thus, for every algebraic expression there exists another algebraic expression such that their sum is zero. These two expressions are called the additive inverse of the each other.

Example 6 : Find the additive inverse of the expression ($6x^2 – 4x + 5$).

Solution: Additive inverse of $6x^2 – 4x + 5 = – (6x^2 – 4x + 5) = –6x^2 + 4x – 5$

10.9.2(b) Subtraction

Let A ad B be two expressions, then A – B = A + (–B)

i.e. to subtract the expression B from A, we can add the additive inverse of B to A.

Now, let us subtract algebraic expressions using both column and row methods-

(i) Column or Vertical Method

Example 7 : Subtract $3a + 4b – 2c$ from $3c + 6a – 2b$

Solution:

S. No.	Steps	Process
1	Write both expressions in standard form if necessary	$3c+6a-2b = 6a-2b+3c$ $3a+4b-2c = 3a+4b-2c$
2	Write the expressions one below the other such that the expression to be subtracted comes in the second row and the like terms come one below the other.	$6a-2b+3c$ $3a+4b-2c$
3	Change the sign of every term of the expression in the second row to get the additive inverse of the expression.	$6a-2b+3c$ $3a+4b-2c$ (–) (–) (+)
4	Add the like terms, column-wise and write the result below the concerned column.	$6a-2b+3c$ $3a+4b-2c$ (–) (–) (+) $3a-6b+5c$

Example 8 : Subtract $4+3m^2$ from $4m^2+7m-3$

Solution: Step 1: $4m^2+7m-3 = 4m^2+7m-3$

$4+3m^2 = 3m^2+4$

Step 2: $4m^2+7m-3$

$3m^2 \quad +4$

Step 3: $\begin{array}{l} 4m^2 + 7m - 3 \\ 3m^2 \quad\quad + 4 \\ - \quad\quad\quad - \end{array}$

Step 4: $\begin{array}{l} 4m^2 + 7m - 3 \\ 3m^2 \quad\quad + 4 \\ - \quad\quad\quad - \\ \hline m^2 + 7m - 7 \\ \hline \end{array}$

(ii) Row or Horizontal Method

Example 9 : Subtract $3a + 4b - 2c$ from $3c + 6a - 2b$

Solution:

S. No.	Steps	Process
1	Write the expressions in one row with the expression to be subtracted in a bracket with assigning negative sign to it.	$3c + 6a - 2b - (3a + 4b - 2c)$
2	Add the additive inverse of the second expression to the first expression	$3c + 6a - 2b - 3a - 4b + 2c$
3	Group the like terms and add or subtract (as the case may be)	$(3c + 2c) + (6a - 3a) + (-2b - 4b)$ $= 5c + 3a - 6b$
4	Write in standard form.	$3a - 6b + 5c$

Example 10 : Subtract $3m^3 + 4$ from $6m^3 + 4m^2 + 7m - 3$

Solution: Step 1: $6m^3 + 4m^2 + 7m - 3 - (3m^3 + 4)$

Step 2: $6m^3 + 4m^2 + 7m - 3 - 3m^3 - 4$

Step 3: $(6m^3 - 3m^3) + 4m^2 + 7m - 3 - 4$

$= 3m^3 + 4m^2 + 7m - 7$

Step 4: $3m^3 + 4m^2 + 7m - 7$

Exercise - 4

1. Add the following algebraic expressions using both horizontal and vertical methods. Did you get the same answer with both methods.

   (i) $x^2 - 2xy + 3y^2$; $5y^2 + 3xy - 6x^2$

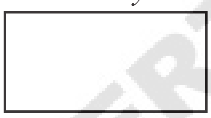
   (ii) $4a^2 + 5b^2 + 6ab$; $3ab$; $6a^2 - 2b^2$; $4b^2 - 5ab$

   (iii) $2x + 9y - 7z$; $3y + z + 3x$; $2x - 4y - z$

   (iv) $2x^2 - 6x + 3$; $-3x^2 - x - 4$; $1 + 2x - 3x^2$

2. Simplify: $2x^2 + 5x - 1 + 8x + x^2 + 7 - 6x + 3 - 3x^2$

3. Find the perimeter of the following rectangle?



4. Find the perimeter of a triangle whose sides are $2a + 3b$, $b–a$, $4a–2b$.

5. Subtract the second expression from the first expression

   (i) $2a+b$, $a–b$

   (ii) $x+2y+z$, $–x–y–3z$

   (iii) $3a^2–8ab–2b^2$, $3a^2–4ab+6b^2$

   (iv) $4pq–6p^2–2q^2$, $9p^2$

   (v) $7–2x–3x^2$, $2x^2–5x–3$

   (vi) $5x^2–3xy–7y^2$, $3x^2–xy–2y^2$

   (vii) $6m^3+4m^2+7m–3$, $3m^3+4$

6. Subtract the sum of $x^2–5xy+2y^2$ and $y^2–2xy–3x^2$ from the sum of $6x^2–8xy–y^2$ and $2xy–2y^2–x^2$.

7. What should be added to $1+2x–3x^2$ to get $x^2–x–1$?

8. What should be taken away from $3x^2 - 4y^2 + 5xy + 20$ to get $-x^2 - y^2 + 6xy + 20$.

9. The sum of 3 expressions is $8 + 13a + 7a^2$. Two of them are $2a^2 + 3a + 2$ and $3a^2 - 4a + 1$. Find the third expression.

10. If
$$A = 4x^2 + y^2 - 6xy;$$
$$B = 3y^2 + 12x^2 + 8xy;$$
$$C = 6x^2 + 8y^2 + 6xy$$

Find (i) $A + B + C$ (ii) $(A - B) - C$

Looking Back

- An algebraic expression is a single term or a combination of terms connected by the symbols '+' (plus) or '–' (minus).
- If every term of an expression is a constant term, then the expression is called a numerical expression. If an expression has at least one algebraic term, then the expression is called an algebraic expression.
- An algebraic expression contaning one term is called a monomial. An algebraic expression contaning two unlike terms is called a binomial. An algebraic expression contaning three unlike terms is called a trinomial. An algebraic expression contaning more than three unlike terms is called a multinomial.
- The sum of all the exponents of the variables in a monomial is called the degree of the term or degree of monomial.
- The degree of any constant term is zero.
- The highest of the degrees of all the terms of the expression is called the degree of the expression.
- If no two terms of an expression are alike then the expression is said to be in its simplified form.
- In an expression, if the terms are arranged in a manner such that the degrees of the terms are in descending order then the expression is said to be in standard form.
- The sum of two or more like terms is a like term with a numerical coefficient equal to the sum of the numerical coefficients of all the like terms.
- The difference between two like terms is a like term with a numerical coefficient equal to the difference between the numerical coefficients of the two like terms.