11 Algebraic expressions

After studying this chapter you will be able to achieve the competencies in,

★ building up an algebraic expression.
★ simplifying an algebraic expression.
★ substituting a value to an algebraic term.
★ obtaining a value for an algebraic expression.

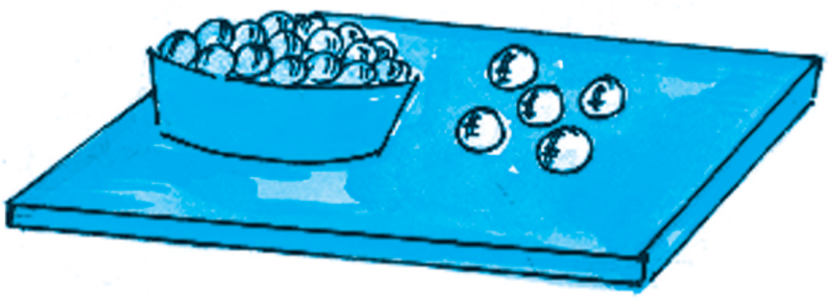
11.1 Building up an Algebraic Expression

Can you say the exact quantities of the materials on either side of the child? It can be easily said that there are three mangoes and two pencils on one side.

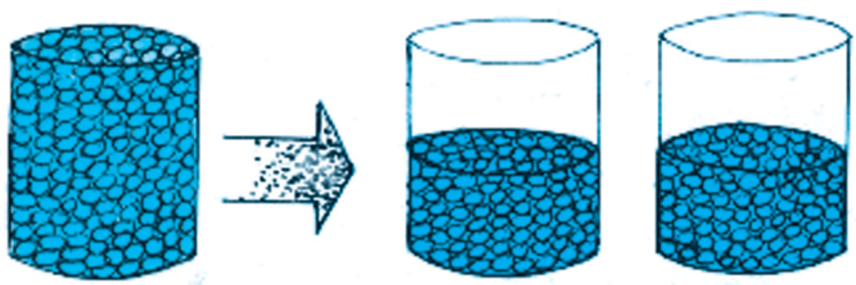
But the quantity of rice or eggs on the other side cannot be said easily. Hence considering them as unknown values, they can be represented by unknowns such as 'x' and 'y'.

♦ 

When the number of eggs in the above basket is taken as ‘x,’ the total number of eggs in the rectangular tray can be represented as ‘$x + 3$.’

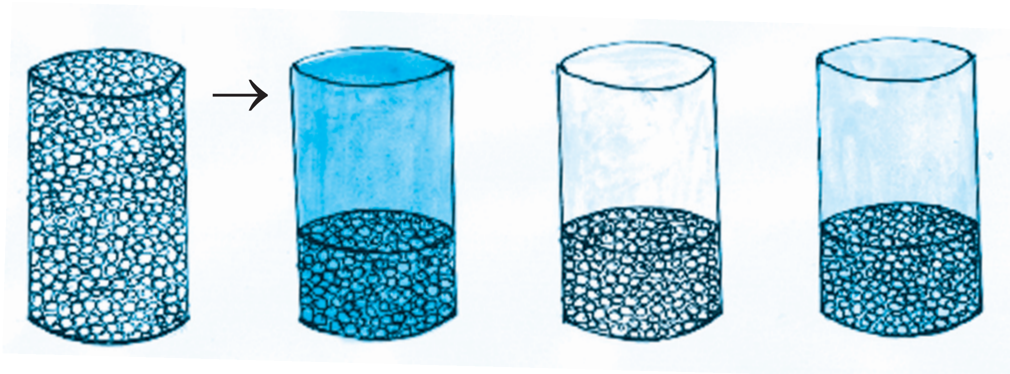
♦ 

When the number of marbles in the circular tray above is taken as y, the total number of marbles in the rectangular tray is ‘$y + 5$.’

♦ 

$\frac{\text{‘}x\text{’}}{2}$

If the total number of marbles in the basket above is ‘x’ and if it is



Similarly if 'y' marbles are divided into three equal parts, the number of marbles in one part is '$\frac{y}{3}$'.

$x+3$, $y+5$, $\frac{x}{2}$ and $\frac{y}{3}$ are said to be algebraic expressions.

Activity 11.1

The age of the grandfather is 80 years.

Mother's age is 40 years.

Mala's age is 10 years.

Father's age is 50 years.

(i) What multiple of Mala's age is grandfather's age?
(ii) What multiple of Mala's age is father's age?
(iii) What multiple of Mala's age is mother's age?

If the age of Mala is taken as 'x' then,

(i) grandfather's age is '$8x$'
(ii) father's age is '$5x$'
(iii) mother's age is '$4x$'

Activity 11.2

- The age of Kamala is 30 years.
- The age of Mala is 15 years.
- The age of Rani is 10 years.
- The age of Nathie is 5 years.

Read the above information and if the age of Kamala is 'y' years, fill in the table given below.

Name	The most suitable expression for the algebraic operation	Algebraic expression
Mala	Divide 'y' by 2	
Rani		
Nathie		

According to this information it is clear that you get the age of Rani as $\frac{'y'}{3}$ and the age of Nathie as $\frac{'y'}{6}$.

Example 1

(I) Add 4 to 'y'.
"$y + 4$"
Subtract 5 from 'y'.
"$y - 5$"

(ii) Add 3 to 2 times 'y'.
"$2y + 3$"

(iii) Subtract an amount 'y' from 10.
"$10 - y$"

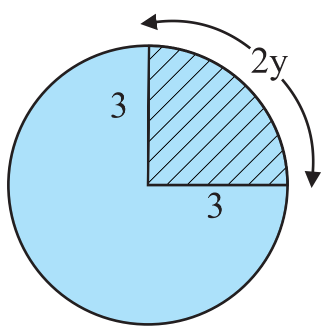
(iv) Divide 'y' by 5 and add 2 to it.
"$\frac{y}{5} + 2$"

(v) Write the expression $4 - \frac{y}{2}$ in words.
" Subtract $\frac{y}{2}$ from 4"

Divide 'y' by 2 and subtract it from four.

"$4 - \frac{y}{2}$"

(vi)



What is the perimeter of the shaded part of the figure?
$3 + 3 + 2y$
"$2y + 6$"

Exercise 11.1

(1) Write suitable algebraic expressions for the following statements.

(a) Add 5 to 'x'

(b) Subtract 3 from 'y'

(c) Multiply 'x' by 2

(d) Divide 'y' by 4

(e) Add 2 to 'y' and multiply the answer by 3.

(f) Divide 'x' by 3 and add 4 to it.

(2) Write the following algebraic expressions in words.

(a) $a+7$ (b) $\frac{a}{4}$ (c) $2a+3$

(d) $3a+2$ (e) $5-a$ (f) $2-\frac{a}{3}$ (g) $\frac{a}{4}+5$

(3) The length of a rectangle is twice as its breadth. If the breadth is 'x' write the length in terms of 'x'.

(4) The length of one side of a square is 'a'. What is its perimeter?

(5) The height of a building is $\frac{1}{3}$ of its length. If its length is 'x', express its height in terms of 'x'.

(6) The price of a pencil is 'x' rupees less than the price of a pen. If the price of the pen is 'p' rupees, write an algebraic expression for the price of the pencil.

(7) A father gives 'x' rupees to his son and 'y' rupees to his daughter for their monthly school expences. Express by an algebraic expression the amount of money the father allocates for the school expences of his two children.

(8) The lengths of two sides of a triangle are 'x' units and 'y' units. The length of the third side is less than the sum of the lengths of the above two sides by 3. Write the length of the third side as an algebraic expression.

Activity 11.3

Complete the table given below.

Algebraic expression	Terms	Number of terms
$x+3$	$x, 3$	2
$4x$	......	......
$x-2$	......	......
$2x+3$	$2x, 3$	......
$x+y$	x, y	.....
$x+5$	$x, 5$	2
$x+7$	......	......
$3x+y$	$3x, y$	....
$\frac{a}{4}$	....	....
$2x + 3y - 2$	....	....
$5m - 3n - k$	....	....

An expression having one term is defined as a "monomial" expression.

Activity 11.4

Complete the following table.

Algebraic expression	Algebraic term	coefficient of the algebraic term
x	x	1
$4x$	....	4
$\frac{-x}{2}$	....	....
$x + 3$	....	....
$2y - 3$	$2y$	....
$\frac{y}{2} -4$	....	....

Activity 11.5

lgebraic term is the number that comes with the variable. The coefficient of an algebraic term can also be a fraction.

4 , 6 , + , x

11.2 Like Terms and Unlike Terms

W iven four cards. State the coefficient of 'x' in each.

- There are three eggs in one container and two eggs in another. What is the total of the two ? It is 5.

♦ There are 3 pens in one container and 2 books in another. What is the total?

It cannot be answered as 5 pens or 5 books. In the former instance all were eggs. Since they are of the same kind they could be added to get the total. Now we have two different kinds.That is pens and books. Hence the total has to be given as, 3 pens + 2 books.
This is applicable even to unknowns such as 'x', 'y', 't' ...

Let us investigate more about this.

♦ Terms with the same unknown such as '$4x$', '$3x$', 'x' ... are called **like terms.**

♦ Terms with different unknowns such as '$2x$', 'y', 't' are called as **unlike terms.**

Activity 11.6

Given below is a poster exhibited in a bank in a school. Read the poster and d

If money is deposited for one week at the rate of "p" rupees per day, you will get a school bag free.

The two children 'A' and 'B' calculated as shown on the next page the amount of money that should be deposited to get a prize.

Child A	
Monday	p
Tuesday	p
Wednesday	p
Thursday	p
Friday	p
Saturday	p
Sunday	p
Total	$7p$

Child B

There are 7 days for a week.
Hence the amount of money needed is $= P \times 7$
$= 7p$

This algebraic expression is written as '$7p$' and not as '$p7$'.

Now let us consider simplification of algebraic expressions.

Activity 11.7

Fill in the blanks.

(a) $2x + 3x \quad = 2x + 3x$
$= 5x$

(b) $2x + 3x + 7x \quad = \boxed{}\, x + 7x$
$= \underline{}\, x$

(c) $2x + 3y + 4x + y \quad = 2x + 4x + 3y + y$
$= \underline{}\, x + \underline{}\, y$

(d) $5x - 2x \quad = 5x - 2x$
$= \underline{}\, x$

(e) $7x - 3x - 2x \quad = \square\ x - 2x$

$= \underline{\underline{\square\ x}}$

(f) $6x + 4y - 3x - 2y \quad = 6x - 3x + 4y - 2y$

$= \underline{\underline{\square\ x + \square\ y}}$

(g) $5x + 2 - 3x \quad = 5x - 3x + 2$

$= \underline{\underline{\square\ x + 2}}$

(h) $2x + 3y + 5x \quad = 2x + 5x + 3y$

$= \underline{\underline{\square x + \square\ y}}$

Discuss with your group or with your teacher the answers you obtained through this activity and verify their accuracy.

> When an algebraic expression is simplified the following steps should be followed.
> (1) Arrange the like terms close to each other.
> (2) Do the addition or subtraction of the like terms.
> (3) Since unlike terms cannot be added or subracted let them be as they are.

L **Example 2** wing example .

(i) $2x + 3y$ This cannot be simplified further.

(ii) $2x + 4x + 3y \quad = 6x + 3y$

(iii) $4x + 2 + 3x \quad = 4x + 3x + 2$

$= 7x + 2$

(iv) $3x + 5y + 4x - 2y \quad = 3x + 4x + 5y - 2y$

$= 7x + 3y$

(v) $4x - 2y$ This cannot be simplified further.

Exercise 11.2

(1) Simplify.

(i) p + p (ii) $a + a + a + a$ (iii) $5x + 7x$

(iv) $3x - x$ (v) $6x - 6x$ (vi) $y + 3y - 2y$

(vii) $7y - y - 3y$ (viii) $4x - 3x$ (ix) $9x - 5x$

(x) $5x + 3x + x$ (xi) $3x - x$ (xii) $14x - 3x$

(2) Simplify.

(i) $2x + 7 + 4x + 3$ (ii) $5x - 3 + 6x - 4$

(iii) $2x - 4 + x + 6$ (iv) $4x + 4y - 2x$

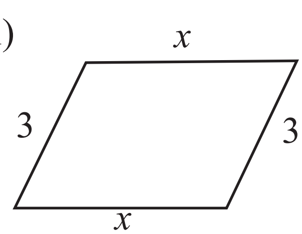
(v) $5x + 4y - 3x + 2y$ (vi) $7x + 6y - 5y - 2x$

(vii) $6 + 4x - 4 - 2x$ (viii) $5x + 5y - 2y - 2x$

(ix) $2x + 3y + 3x - 2y$ (x) $6x + 7y - 3 - 4x - 3y$

(3) Form algebraic expressions for the perimeters of the following figures and simplify them as much as possible.

(i)



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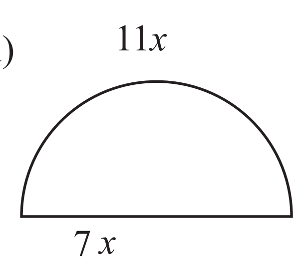

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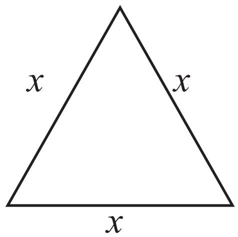

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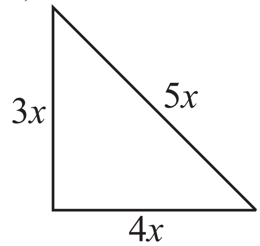

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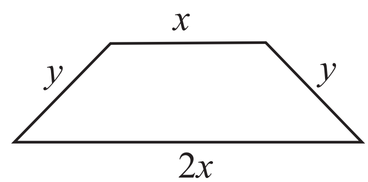

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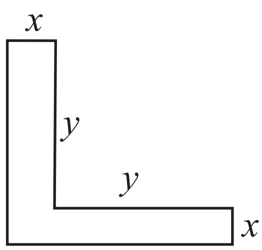

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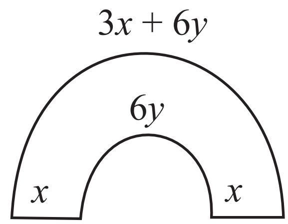
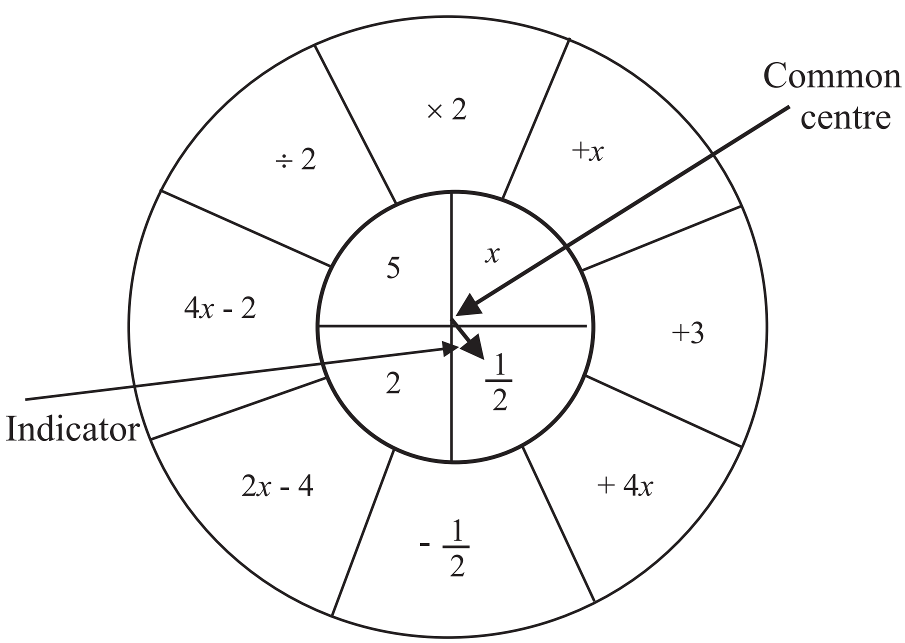


(4) With two pieces of card board, prepare two concentric circles as shown in the figure. Fix up the two circles so that they can be rotated about the common centre and fix up an indicator at the centre.



Now rotate the circles and note down the terms in the two circles that the indicator points. In this way rotate the circles as many times as possible and form algebraic expressions and simplify them as much as possible. Note down the coefficients of 'x' in the terms relevant to each of the expressions in front of it.

11.3 Substitution

The value of a given algebraic expression or an expression built up can be found by substituting values for the relevant unknowns. Let us study the examples given below.

Example 3

Find the value of $2x - 5$, when $x = 3$.

$$2x - 5 = 2 \times 3 - 5$$
$$= 6 - 5$$

Example 4

Find the value of $\frac{x}{3} + 2$, when $x = 12$.

$$\frac{x}{3} + 2 = \frac{12}{3} + 2$$
$$= 4 + 2$$

Example 5

Find the value of $\frac{x}{2} + y$, when $x = 4$ and $y = 3$.

$$\frac{x}{2} + y = \frac{4}{2} + 3$$
$$= 2 + 3$$
$$= 5$$

Example 6

Find the value of $5xy$, when $x = 2$ and $y = 3$.

$$\begin{aligned} 5xy &= 5 \times 2 \times 3 \\ &= \underline{\underline{30}} \end{aligned}$$

Exercise 11.3

(1) Find the value of each of the following, when $x = 3$.

(i) $x + 7$ (ii) $x - 2$ (iii) $2x - 3$ (iv) $3x - \frac{3}{4}$ (v) $3x - 1$

(vi) $\frac{x}{3} + 1$ (vii) $15 - 5x$ (viii) $2x + \frac{x}{6}$ (ix) $\frac{4x}{3}$

(2) Find the value of each of the following algebraic expressions when $x = 2$ and $y = 1$.

(i) $x + y$ (ii) $x - y$ (iii) $2x + y$ (iv) $\frac{x}{2} + 2y$

(v) $2 + xy$ (vi) $2x + 4y$ (vii) $\frac{2x}{3} - \frac{y}{3}$ (viii) $\frac{2}{3}x + \frac{y}{3}$

(ix) $\frac{x}{4} - \frac{y}{7}$

(3) Find the value of each of the following algebraic expressions when $x = 5$ and $y = 2$.

(i) $x - y$ (ii) $2x - y$ (iii) $\frac{2x}{5} - y$ (iv) $\frac{x}{5} + y$

(v) $2x + 4y$ (vi) $\frac{x}{3} + \frac{y}{3}$

(4) Values assigned to each of the letters of the English alphabet are given below.

a	b	c	d	e	f	g	h	i	j	k	l	m
1	2	3	4	5	6	7	8	9	10	11	12	13
n	o	p	q	r	s	t	u	v	w	x	y	z
14	15	16	17	18	19	20	21	22	23	24	25	26

Applying the above values for each of the letters, find the value of each of the following expressions.

(i) $c + 10$ (ii) $c - b$ (iii) $q + 3$ (iv) $\frac{d}{2} + 7$ (v) wh

(vi) $\frac{c}{6} + \frac{1}{3}$ (vii) $\frac{h}{2} - \frac{3}{4}$ (viii) $\frac{i}{4} + \frac{5}{12}$ (ix) $2y + 2p$ (x) $5d + \frac{x}{4} - b$

Summary

- ✶ The simple letters of the English alphabet are used to indicate unknown values.
- ✶ Expressions having algebraic terms are known as algebraic expressions.
- ✶ The number with an algebraic term is known as its coefficient.
- ✶ Like terms can be simplified.
- ✶ Unlike terms cannot be simplified.
- ✶ The value of an algebraic expression can be found by substituting given values to the algebraic terms.