Sub-Domain 6

ALGEBRAIC EXPRESSIONS

Students' Learning Outcomes:

By the end of this sub-domain, students will be able to:

- Recognize simple patterns from various number sequences.
- Use letters to represent numbers, express basic arithmetical processes algebraically.
- Evaluate algebraic expressions, add and subtract linear expressions.
- Simplify linear expressions.

If 'S' stands for samosas, 'F' stands for fries, and there are 8S + 10F in a packet. How many elements would there be if 2 samosas are taken out and 3 fries are added into the packet?

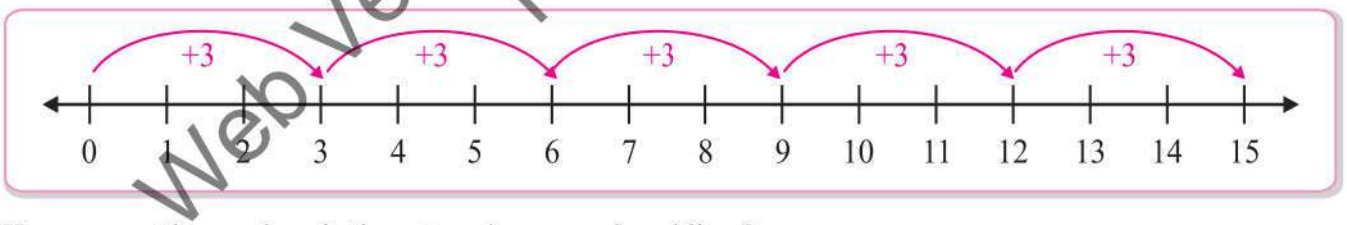
6.1 RECOGNITION OF SIMPLE PATTERNS FROM VARIOUS SEQUENCES

We know that "A pattern is some phenomenon that repeats regularly based on a set rule or condition." In our previous classes we have learnt about different patterns.

6.1.1 Number Pattern/Sequence

Consider the following whole numbers.

0, 3, 6, 9, 12, 15, ...



Here, we get the numbers in the pattern/sequence by adding 3.

To solve the problems related to number patterns, we first need to find the rule followed in the given pattern/sequence, see the difference in the consecutive numbers in the given sequence. It will help you to understand the relationship between the numbers.

Teaching Point

Encourage students to ask questions at any stage during learning process. Students questioning serve a wide variety of purposes. e.g.

- to assess their understanding.
- to keep learners engage during an explanation.
- to develop their thinking or focus their attention on topic.

Example 1 For each of the following number pattern state a rule and find the next two terms:

(i) 17, 22, 27, ... **(ii)** 56, 53, 50, ...

(iii) 729, 243, 81, ... **(iv)** 4, 8, 12, ...

Remember

Each number in the given number sequence is called term.

Solution

(i) 17, 22, 27, ...

Rule Add 5 in the each term to get the next term in the sequence/pattern. So, the next two terms will be 32 and 37.

(ii) 56, 53, 50, ...

Rule Subtract 3 from each term to get the next term in the sequence. So, the next two terms will be 47 and 44.

(iii) 729, 243, 81, ...

Rule Divide each term by 3 to get the next term in the sequence. So, the next two terms will be 27 and 9.

(iv) 4, 8, 16, ...

Rule Multiply each term by 2 to get the next term in the sequence. So, the next two terms will be 32 and 64.

Practice -2 For each of the following sequences, state the rule to find the next two terms.

i. 4, 14, 42, ... ii. –7, –14, –21, ...

Challenge Which number pattern is used in sunflower?

Go Online Visit the link and play the sequence game online.

http://www.mathframe.co.uk/en/resources/resource/42/sequences

Exercise - 6.1

1. For each of the following sequence state a rule and find the next two terms:

(i) 9, 13, 17, ... **(ii)** 277, 287, 297, ... **(iii)** 14, 21, 28, 35, ... **(iv)** –84, –82, –80, ...

2. Write the next three terms in the sequence:

(i) 1, 4, 9, ... **(ii)** 89, 87, 85, ... **(iii)** 12, 16, 20, ... **(iv)** 1, 1, 2, 3, 5, 8, ...

Project - 1 Make a poster of polygons in sequence according to the number of sides.

Teaching Point Ask students to arrange in an increasing or decreasing order to give practice on sequences. You can use snacks or cereal to make a sequence of any pattern.

6.2 USE OF LETTERS TO REPRESENT NUMBERS

We are very familiar about the natural numbers 1, 2, 3, ... and the use of basic four operations (addition, subtraction, multiplication and division) in arithmetic. In algebra, letters replace the numbers.

History

A muslim Arab Mathematician Al – khawrzmi (780 – 850 AD) is founder of modern algebra. He was one of the first to study algebraic expression. The word algebra is derived from the word Al – Jabr. He wrote a book named Al – Jaber – Wa – Al – Muqabala in 820 AD. He is known as the father of algebra.

To know more about him, visit the link: http://www.famousscientists.org/muhammad-ibn-musa-al-khwarizmi

In Arithmetic: Numerals such as 1, 2, 3, … etc are used, with each numeral having a fixed value.

(i) $5 + 3 = 8$ means that the sum of 5 and 3 is equal to 8.

(ii) $13 - 5 = 8$ means that the difference of 13 and 5 is 8.

In Algebra: A letter can symbolize any numeral, or any value assigned to it for example.

(i) $a + b = c$ means that the sum of two numbers are represented by a and b is equal to c.

(ii) $c - a = b$ means that the difference of two numbers are represented by c minus a equal to b.

If $a = 5$ and $b = 3$ then $c = 8$. If $a = 5$ and $c = 12$ then $b = 7$ i.e. $c - a = b$
$12 - 5 = 7$

6.2.1 Explanation for Variable and Constant

i Variable

We know that in algebra, both numerals and letters of alphabet $a, b, c, ..., z$ are used. These letters of alphabet do not have any fix value.

So, "*A variable is a symbol or letter of alphabet that represents a quantity the value of which is not known*".

ii Constant

A constant is a quantity whose value remains unchanged (fixed).

Example 2 Identify variable and constants in the following:

(i) $n + 8 = 7$ **(ii)** $n + m + 4$ **(iii)** $\ell - 14 = 34$

Solution

	Expression	Variable	Constants
(i)	$n + 8 = 7$	n	7, 8
(ii)	$m + n + 4$	m, n	4
(iii)	$\ell - 4 = 34$	ℓ	$-4, 34$

Did You Know?

The number 9 is a mysterious number. It can be found in every ones birth date either it contains 9 or not. As, I was born on 22-04-2001. The number 9 is hidden in this date. To find it, let's rewrite birth date as 22042001.

- Now, rearrange the digits any order such as 20010422.
- Subtract smaller number from greater e.g.

$$\begin{array}{r} 22042001 \\ -20010422 \\ \hline 2031579 \end{array}$$

- Add the digits of your result. $2 + 0 + 3 + 1 + 5 + 7 + 9 = 27$
- Add $2 + 7 = 9$, similarly, find the number 9 in your birth date.

Exercise - 6.2

1. Write the following sentences symbolically:

(i) The sum of numbers n and 6 is 20.
(ii) The difference of numbers n and 27 is 5.
(iii) Four times a number n is less than 7.
(iv) Two times a number n is more than 25.

2. Which of the following statements are true and which are false?

(i) Sum of five and eight is twenty.
(ii) Product of three and ten is thirty.
(iii) $9 + 19 = 28$.
(iv) $6 + (8 - 2) = 0$.
(v) $\frac{7}{8} + 3 > 16$.

3. Write the values of unknown which satisfy the following statements:

(i) $\square + 18 = 36$
(ii) $3 : 5 :: \square : 10$
(iii) 20% of 2000 = $\square$
(iv) $\frac{2}{5} + \square = \frac{1}{10}$
(v) $\frac{7}{11} + \frac{1}{22} = \square$

Project - 2

Create atleast 5 algebraic sentences and separate variables and constants from your sentences.

4. Identify the constants and variables.

(i) $n + 9 = 0$
(ii) $7p + 2 = 9$
(iii) $\frac{1}{3}xy$
(iv) $7i + 4 = 9$
(v) $m + n + 8$
(vi) $9x + y - 37$

6.3 ALGEBRAIC EXPRESSIONS

An algebraic expression is an expression built up by the combination of constants, and variable by the basic algebraic operations $(+, -, \times, \div)$ for example $x + y$ and $4x + 5y + 5$ are algebraic expressions.

Example 3 Write the following statements in an algebraic expression:

(i) The sum of an integer and 17
(ii) The difference of 15 and double of a number n.
(iii) Product of a and $\frac{1}{2b}$
(iv) Divide p by $4q$

Solution

(i) Let the integer be 'n'
So, $n + 17$

(ii) Let the required number be 'n'
So, $15 - 2n$

(iii) $a \times \frac{1}{2b}$

(iv) $p \div 4q$

Example 4 Alishah is x years old. Write an algebraic expression for the following.

(i) Alishah's age before six years.

(ii) Six times Alishah's age after five years.

(iii) Half of Alishah's age six years ago.

(iv) The present age of Alishah's younger sister if her age was 5 years less than the half of Alishah's age three years ago.

Solution

(i) Alishah's present age = x years

Alishah's age before six years = $x - 6$

(ii) $6(x + 5)$

(iii) $\frac{1}{2}(x - 6)$

(iv) Alishah's younger sister's age = $\frac{1}{2}(x - 3) - 5$

6.3.1 Terms of Algebraic Expression

Remember

Operation of multiplication (×) and division (÷) never connect the terms of algebraic expressions.

Different parts of an algebraic expression are connected with each other by an addition (+) or subtraction (−) signs.
Each separated part of the expression is known as term.
For example, $m + 3n + 6$ is an algebraic expression, here m, $3n$ and 6 are the first, second and third terms respectively.

Example 5 Separate each term of the following algebraic expressions.

(i) $a + b$

(ii) $3a + 5b + 9$

(iii) $8x + 4yz - 3$

(iv) $\frac{x}{y} + 4t + 1$

Solution

	Algebraic expression	Terms of algebraic expression	Number of terms
(i)	$a + b$	a, b	2
(ii)	$3a + 5b + 9$	$3a, 5b, 9$	3
(iii)	$8x + 4yz - 3$	$8x, 4yz, -3$	3
(iv)	$\frac{x}{y} + 4t + 1$	$\frac{x}{y}, 4t, 1$	3

Note

- If any term of an algebraic expression consists of a numeral only, it is known as constant term i.e 9, –3 and 1 in example 5 (ii, iii, iv).
- If any term of an algebraic expression contains variables only, it is known as variable term i.e a, b in example 8 (i).

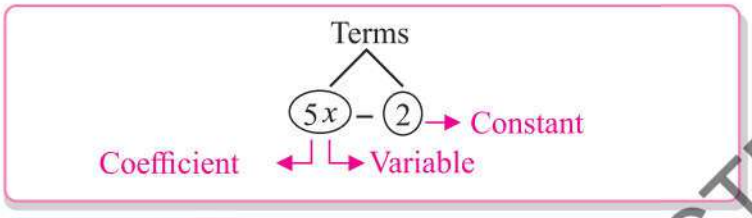
6.3.2 Explain the Terms, Coefficients and Constants in an Algebraic Expression

Coefficients

In algebraic expression we always use a number or symbol to multiply with variable, that number or symbol is called multiplying factor of variable.

"The multiplying factor of any variable in an algebraic expression is known as coefficient".

Look at the below diagram.



Remember

Any variable with no number have a coefficient 1 i.e x is realy 1 x.

Example 6 Write the coefficients of each term of the expressions.

(i) $3a + 4b + c$ **(ii)** $4x + y - 3z$

Note Sometimes in an algebraic expression alphabet letters represent coefficients. i.e. In expression $ax + bx + cx$, x is variable and 'a' , 'b' and 'c' are coefficients.

Solution

	Algebraic expression	Terms of algebraic expression	Coefficients
(i)	$3a + 4b + c$	$3a, 4b, c$	3, 4 and 1
(ii)	$4x + y - 3z$	$4x, y, -3z$	4, 1 and –3

Constant terms

Look at the following cases.

Case – I: Consider the algebraic expression

$5a + 2b + 4$. If $a = 5$ and $b = 3$ then $5a + 2b + 4 = 5(5) + 2(3) + 4$

$= 25 + 6 + 4$

Case – II: If $a = 2$ and $b = 4$ then

$5a + 2b + 4 = 5(2) + 2(4) + 4$

$= 10 + 8 + 4$

In both cases we can observe that the third term does not change because 4 is constant. Similarly, in expressions $4x + 5$ and $2p + 4q + 1$, the numbers 5 and 1 are constants. Similarly, in expressions $3x + 2$ and $4p + 5q + 1$, the numbers 2 and 1 being independent of variable are constants.

Thus,

"In an algebraic expression number appearing independent of a variable is called a constant term".

Example 7 Identify the variable, constant and coefficients of each term in the following algebraic expressions. **(i)** $8x + 9y + 6$ **(ii)** $3a + 4b - 2$ **(iii)** $4xy - 3$

Solution

(i) $8x + 9y + 6$
Variables: x, y
Constant: 6
Coefficients: 8, 9

(ii) 3a + 4b – 2
Variables: a, b
Constant: –2
Coefficients: 3, 4

(iii) $4xy - 3$
Variables: xy
Constant: –3
Coefficient: 4

6.3.3 Like and Unlike Terms

Thinking Time

Can you write 2 × 9 as 29? Explain.

Like terms

Look at the following:

Aleezey takes away an order of three packets of samosas from a samosa's shop.

2 samosas + 4 samosas + 5 samosas = 11 samosas

As, all three packets contain samosas, if she put all packets of samosas in large packet then the large packet will contain 11 samosas.

In algebra Aleezey can write it as: $2s + 4s + 5s = 11s$

So, *"The terms having the same variables with same indexes are known as like terms."* The like terms can be combined to give a single term.

Remember

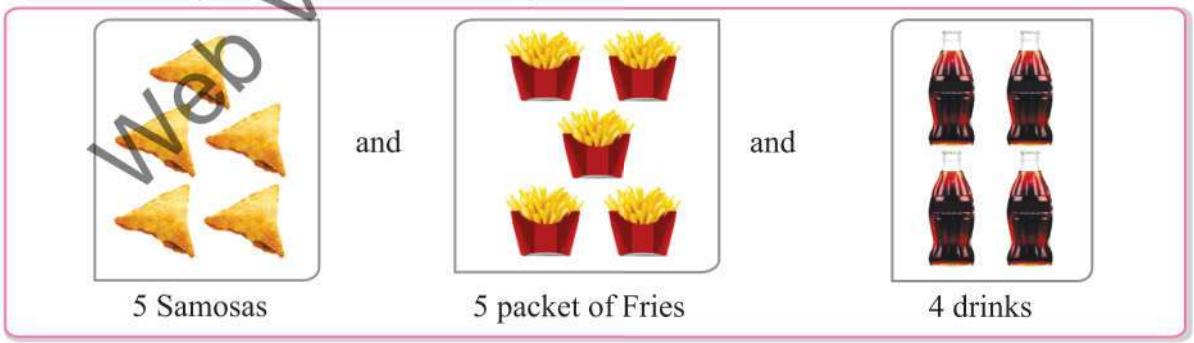
In an algebraic expression the addition and subtraction can only be performed with like terms.

Note

In the above expression, the power of variable in each term is 1. Each term is different by their variable.

Unlike terms

Shahbaz takes away an order of the following terms from a restaurant.



5 Samosas | 5 packet of Fries | 4 drinks

As all three packets contain different items. If he put all three packets of different items in a large packet then the large packet will contain 5 samosas, 5 packet of fries and 4 drinks.

In algebra Shahbaz can write it as: $5s + 5f + 4d = 5s + 5f + 4d$

So, *"The terms having the different variables are known as unlike terms."*

Unlike terms can never combine to give the single term.

Remember In an algebraic expression the unlike terms cannot perform addition or subtraction.

Go Online Visit the below link and play online games to identify algebraic terms.
http://www.mathgames.com/skill/6.6-identify-terms-coefficients-and-monomials

Exercise - 6.3

1. Write the following statements in algebraic expressions:

(i) The sum of $3a$ and 8 **(ii)** Difference of $5p$ and 5 **(iii)** Divide $5a$ by $8b$

(iv) Product of a number n and four times a variable y.

(v) Cost of n litres of cooking oil at Rs. 170 per litre.

2. Waseem is two times as old as Umar and Umar is three years older than Amir. If Umar is n years old then write an algebraic expression of:

(i) Waseem's age **(ii)** Umar's age **(iii)** Amir's age

3. Write the algebraic terms of the following expressions:

(i) $n + 3$ **(ii)** $2n + 6m$ **(iii)** $\ell \times m \times n$ **(iv)** $4xy + 6y - 5$ **(v)** $ab + 2$

4. Write the coefficients of each term in the following algebraic expressions:

(i) $4a + 3b$ **(ii)** $23ab$ **(iii)** $\frac{2}{5}xyz$ **(iv)** $pqr + 85$ **(v)** $15p + 81q + 9$

5. Separate the constants, variables and coefficients of each term in the following algebraic expressions:

(i) $8a + 1$ **(ii)** $3a + 2b - 4$ **(iii)** pq **(iv)** $ax + by + c$ **(v)** $3a + 4b + c$

6. Saparate like terms in the following:

$3a,\ 21m,\ 5a,\ 8p,\ 4m,\ 2s,\ 3p,\ 8\ell,\ 9a,\ 76a,\ 17bc,\ 9cb.$

7. Write the algebraic expressions by adding the following terms:

(i) x, y **(ii)** $a, 2a, 3a$ **(iii)** $x, -y, 3x$ **(iv)** p, pq, q, r

(v) $12a^2, 3b^2$ **(vi)** $\frac{1}{y}, \frac{2}{x}, \frac{3}{2}$ **(vii)** $2xy, yz, 4zx$ **(viii)** $4x, 5x, 6x^2$

8. There are 25 girls and 27 boys in grade 6 in a school, and 30 boys and 23 girls in grade 7 in the same school. Write an algebraic expression to find the sum of girls and boys in both the grades.

9. Arslan is working at a burger shop. On Monday, he sold 40 burgers, 25 fries and 60 cold drinks. On Tuesday, he sold 35 burgers, 28 fries and 54 cold drinks. Write an algebraic expression and find how many burgers, fries and cold drinks did he sell in both the days?

Teaching Point

Take a simple example like $2x + 2y - 9$ to explain the coefficients, variables and constants. Begin by asking students to identify the terms in the expression and then use the expression to draw attention to coefficient, variables and constants.

Project - 3 Visit your nearest market. Choose any two or three food items and form at least two expressions, using the concept of like and unlike terms.

6.4 ADDITION AND SUBTRACTION OF GIVEN ALGEBRAIC EXPRESSIONS

Addition

In the given algebraic expressions only like terms can be added to give a single term.

Look at the following examples for the procedure of addition.

Example 8 Add $4xy$, $3xy$ and $21xy$.

Solution

Vertical method of addition	Horizontal method of addition
$4xy$ $3xy$ $+\ 21xy$ $28xy$	$4xy + 3xy + 21xy$ $= (4 + 3 + 21)xy$ $= 28xy$

Remember

- While adding vertically, like terms are arranged in same coloums and then added.
- While adding horizontally like terms are arranged together and added.

Example 9 Find the sum of following algebraic expressions using vertical method of addition.

$(8a + 4b - 2)$, $(8a + 7b - 4)$ and $(23a + 3b - 7)$

Solution

Vertical method of addition.

$$\begin{array}{r} 8a + 4b - 2 \\ 8a + 7b - 4 \\ +\ 23a + 3b - 7 \\ \hline 39a + 14b - 13 \end{array}$$

Practice -2

(i) Add $3x + 2y$ and $4x - 7y$.

(ii) Find the sum of $3a + 2b - 5c$ and $4a - b + 3c$

Example 10 Find the sum of the following algebraic expressions using horizontal method of addition.

$(ab + 3pq + 5rs)$, $(-4ab - 6pq + 7rs)$ and $(4ab + 2pq)$

Solution Horizontal method of addition

$(ab + 3pq + 5rs)$, $(-4ab - 6pq + 7rs)$ and $(4ab + 2pq)$

$(ab + 3pq + 5rs) + (-4ab - 6pq + 7rs) + (4ab + 2pq)$

Arrange the terms having same variables.

$= ab - 4ab + 4ab + 3pq - 6pq + 2pq + 5rs + 7rs$

$= (1 - 4 + 4)\,ab + (3 - 6 + 2)\,pq + (5 + 7)\,rs$

$= ab - pq + 12rs$

Subtraction

As we know that subtraction is the reverse process of addition. In the given algebraic expressions the subtraction can be performed by changing the sign of each term of the expression to be subtracted and use the same procedure which we did in addition of algebraic expression. Now look at the following examples.

Example 11 Subtract: $17a$ from $30a$.

Solution

Vertical method of subtraction	Horizontal method of subtraction
$30\,a$ $\pm 17\,a$ $13\,a$	$(30\,a) - (+17\,a)$ $= 30\,a - 17\,a$ $= (30 - 17)\,a$ $= 13\,a$

Example 12 Find the difference of $6a - 5b + c$ and $2a + 2b - 8c$ using vertical method of subtraction.

Solution Vertical method of subtraction.

$$\begin{array}{r} 6a - 5b + c \\ \pm 2a \pm 2b \mp 8c \\ \hline 4a - 7b + 9c \end{array}$$ (by changing the signs)

Remember

- Always add the terms having same signs.
- Always subtract the terms having different signs.

Example 13 Subtract $4xy - 3yz + 4xz$ from $30xy + 5yz - 8xz$ using horizontal method of subtraction.

Solution Horizontal method of subtraction

$$(30xy + 5yz - 8xz) - (4xy - 3yz + 4xz)$$
$$= 30xy + 5yz - 8xz - 4xy + 3yz - 4xz$$

Arrange the terms having same variables $= 30xy - 4xy + 5yz + 3yz - 8xz - 4xz$

$$= (30 - 4)xy + (5 + 3)yz - (8 + 4)xz$$
$$= 26xy + 8yz - 12xz$$

Practice -3

(i) $5a - 3b$ from $8b - 4c$.
(ii) $17x + 4y$ from $-37x - 13y$.

Exercise - 6.4

1. Add the following terms:

(i) x, x, x, x, x (ii) $3p, 4q, 8p, 9q$ (iii) $4a, 5a, 6a$ (iv) $4xy, 23xy, 3xy$

(v) $98pq, 2qr, 23rs$ (vi) $xy, 14yx, 3pq, 3pq, 54$ (vii) $8x, 2y, 5x, 6y, 3z, 9z, 2y$

2. Sum of the following expressions:

(i) $3p + 4q, 8p - 3q$

(ii) $\frac{5}{7}a + \frac{2}{3}b, \frac{1}{7}a - \frac{1}{3}b$

(iii) $5xy + 9yz, xz - 2yz, 9xy + 4yz$

(iv) $31x + 3y - 4z, 6x + 7y - 5z, x + y + z$

(v) $9p + 8q + 1, 6q - 3r + 2, 4p + 2r + 7$

(vi) $6p, 2q, 3q + 9r, 4r, -6p$

3. Subtract:

(i) $3a + 2b$ from $15a + 25b$

(ii) $35xy + 3z$ from $48xy - 4z$

(iii) $16x + 2y - 3z$ from $25x - 3y + z$

(iv) $\frac{1}{3}\ell + \frac{3}{5}m - 8$ from $-\frac{1}{3}\ell + \frac{1}{5}m + 6$

(v) $27\ell + 3m - 4n$ from $-22\ell + 14m + 4n$

4. Solve:

(i) $(4x + 4y) + (5y - 4z) - (5x + 4y + 8z)$

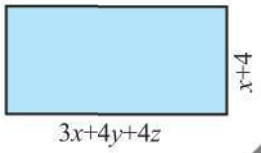
(ii) $(7xy + 3yz) + (8xy - 6yz) - (9xy + 3yz + 2)$

(iii) $(4m + 5m - 2) - (3m + 2n)$

(iv) $(13p + 2q) - (6q - 2r) + 5r$

5. Kinza, Mahak and Rabia have p, $2q$ and $3r$ books respectively. How many books they have altogether?

6. Find perimeter of rectangle?



7. If the perimeter of a triangle is $5x + 6y + 8z$ and the lengths of its two sides are $x + y + z$ and $x - 2y + 3z$ respectively. Find the length of third side of triangle.

Project - 4 Make a booklet for the rules of addition and subtraction of algebraic expression.

6.5 SIMPLIFICATION OF ALGEBRAIC EXPRESSIONS GROUPED WITH BRACKETS

In an algebraic expression, when more than one operations are performed with several terms. Before evaluation of it we need to simplify. To simplify an algebraic expression we will use the same rule which we used in arithmetic expressions. We are familiar that brackets are used to indicate the order for performing the operations. We have learnt four kinds of brackets in unit – 5. These are the four basic grouping symbols or brackets. The operation involving these symbols are performed in the order shown below.

- $\overline{\quad}$ Vinculum — 1st
- ( ) Parentheses or curved brackets or round brackets. — 2nd
- { } Braces or curly brackets. — 3rd
- [ ] Square brackets. — 4th

We will use the following algebraic expressions by grouping like terms:

Example 14 Simplify the following algebraic expressions by grouping like terms:

$2a + 4b + 5a - 8b - 3a + 8c + 9$

Solution

$2a + 4b + 5a - 8b - 3a + 8c + 9$

$= 2a + 5a - 3a + 4b - 8b + 8c + 9$ (combine the like terms)

$= (2 + 5 - 3)a + (4 - 8)b + 8c + 9$

$= 4a - 4b + 8c + 9$

Example 15 Simplify the following algebraic expressions:

(i) $5x + 3\ (8x + 4y)$ **(ii)** $3a + [3b - \{5c + (2b + 4c)\}]$

Solution

(i)
$5x + 3\ (8x + 4y)$
$= 5x + 24\ x + 12y$
$= 29\ x + 12y$

(ii)
$3a + [3b - \{5c + (2b + 4c)\}]$
$= 3a + [3b - \{5c + 2b + 4c\}]$
$= 3a + [3b - \{2b + 9c\}]$
$= 3a + [3b - 2b - 9c]$
$= 3a + [b - 9c]$
$= 3a + b - 9c$

Note

The sign before the brackets is very important if it is plus (+) then remove the brackets without changing the signs of the each term inside the brackets. If it is minus (–) then change the signs of each term inside the bracket, while removing it.

6.5.1 Evaluation and Simplification of an Algebraic Expression

"The process of finding the value of an algebraic expression by substituting the numeric value in place of variable in each term of the expression, is known as evaluation".

Look the following examples. To evaluate an algebraic expression.

Example 16 If $a = 2$, $b = 4$, $c = 3$, and $d = 5$ then evaluate the following expressions.

(i) $a + bc + 3d$ **(ii)** $4a + 2bc + d - ab$ **(iii)** $2ab + 3cd - (5ba - 4cd)$

Solution

(i) $a + bc + 3d$
Substitute the values $= (2) + (4)(3) + 3(5)$
$= 2 + 12 + 15 = 29$

(ii) $4a + 2bc + d - ab$
Substitute the values $= 4(2) + 2(4)(3) + (5) - (2)(4)$
$= 8 + 24 + 5 - 8 = 29$

(iii) $2ab + 3cd - (5ab - 4cd)$
Substitute the values $= 2ab + 3cd - (5ab - 4cd)$
$= 2ab - 5ab + 3cd + 4cd$
$= -3ab + 7cd$

Now, Substitute the values $= -3(2)(4) + 7(3)(5)$
$= -24 + 105$
$= 81$

Exercise - 6.5

1. Simplify the following:

(i) $x + y + 3x + 2y + 4x$

(ii) $a + a - (3a \div 3)$

(iii) $3a + \frac{1}{3}b + 3\{a + (2b - a + 4b \times 3)\}$

(iv) $4x + \{5a + (2a + (3a - 9a \div 3)\}$

(v) $a + [b + \{a - (b + \overline{a - b})\}]$

(vi) $[\{(2x + 4y) + 2z\} - 3y] + 2x - 12y$

2. Waqas, Waqar and Saif are selling bags of sweets. Waqas is selling 8 bags of sweets, Waqar is selling 12 bags of sweet and Saif is selling 20 bags of sweets. However Waqar decided to eat three of his bags of sweets as he was hungry. Saif decided to give 2 bags of sweets to his brother. Create an algebraic expression that represents the total amount of bags of sweets that they were selling altogether. Then simplify the expression.

3. Evaluate the following when $x = 2, y = -5$ and $z = 8$

(i) $4x + y - z$ **(ii)** $2xy + yz - zx$ **(iii)** $4x + \left(\frac{1}{2}y + \frac{1}{14}z\right)$

(iv) $y(3x - z + 2y) + 2$ **(v)** $\frac{x(2y+3z)}{3zx}$ **(vi)** $\frac{x+y}{z} + \frac{y+z}{x}$

4. If $a = 5$, $b = 8$ and $c = 20$ then evaluate: $b^2 - 4ac$.

5. Express the following into the simplest form and then evaluate it when $x = 8$, $y = 10$

$3x - 2 + [y + x - \{4 - x + (5 + y)\}]$

Review Exercise 6

1. Each of the questions below is followed by four suggested options. In each case choose the correct option.

(i) 28 + 6 is:

a. a geometric figure **b.** an algebraic expression
c. an arithematic expression **d.** three dimensional figure

(ii) p + 2q is:

a. a geometric figure **b.** an algebraic expression
c. an arithematic expression **d.** three dimensional figure

(iii) In algebra a value that can be changed is called:

a. constant **b.** variable **c.** literal **d.** coefficient

(iv) In algebra a fixed value that can never be changed is called: .

a. constant **b.** variable **c.** literal **d.** coefficient

(v) In algebraic expression we can add or subtract only:

a. like terms **b.** unlike terms **c.** literal **d.** constant terms

(vi) The only operations that connect the algebraic terms are:

a. +, − **b.** ×, ÷ **c.** +, −, × **d.** ×

(vii) To simplify the algebraic expression we use:

a. exponent rule **b.** BODMAS rule **c.** DMAS rule **d.** chain rule

(viii) In expression $4x + 5,4$ is:

a. exponent **b.** variable **c.** constant **d.** coefficient

(ix) Each number in the pattern is called:

a. term **b.** expression **c.** equation **d.** constant

(x) The next term in the sequence 1, 1, 2, 3, 5, 8, ...

a. 10 **b.** 12 **c.** 13 **d.** 15

2. Define the following in a short way:

(i) Variable **(ii)** Constant **(iii)** Coefficient **(iv)** Pattern

3. Find the sum of:

(i) $2x+3y-4z$ and $5x+16x-9y$ **(ii)** $13xy+2yz, 5yx-2xz$ and $4xy+3zx$

4. Subtract the second expression from the first:

(i) $3x+1, x-y$ **(ii)** $5x-3y-2z, 7x+y-3$

5. Write the coefficients, variables and constants in each term of the following expression:

(i) $ap + bq + c$ **(ii)** $2.5x + \frac{1}{3}y + 14$ **(iii)** $13p + 2q + 5$

6. Solve: **(i)** $(13p + 2q) + (12p - q) - (8p + 3q)$

(ii) $(2xy + 3yz + 4zx) - (6xy - 2yz - 5) + (8xy + 2yz - 35)$

7. Find the perimeter of square field if length of its each side is $3x - y + 2z$.

8. Simplify the following expressions:

(i) $(p + q) - (2r - 3s) + (p + 5s)$ **(ii)** $(x + y) - (5x + \overline{3x-4})$

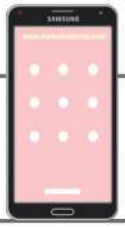
(iii) $6x-[3x + \{2x-4(\overline{x-2}) + y\}]$

9. If $x = 5$ and $y = 7$ then evaluate $6x - [2x + \{2x - 4(\overline{x-2}) + y\}]$

10. Write the missing numbers in the sequence below.
1, 4, 9, 16, 25, _____, _____, 64, 81. Also, state the rule.

Challenge

Use pattern of four straight lines to join all 9 dots given on the mobile screen.
Do not lift your pen or pencil while performing task.



Summary

- Algebra is a system of symbols and letters of alphabet to replace numbers and find the secret.
- A pattern is some phenomenon that repeats regularly based on a set rule or condition.
- Pattern can be ascending, descending or multiples of a certain numbers.
- Each term in the sequence/pattern is called term.
- A variable is a symbol or letter of alphabet that represents a quantity, the value of which is not known.
- A constant is a fixed value that can never be changed. i.e, all numerals are constants.
- Algebraic expression is an expression built up by the combination of integers and constants, variables are connected with the basic algebraic operational signs (+, –, ×, ÷).
- Each separated part of an algebraic expression is known as term.
- The terms having the same variables and exponents are known as like terms.
- The terms having the different variables and exponents are known as unlike terms.
- The process of finding the values of an algebraic expression by substituting the numeric value in place of variable in each term of expression is known as evaluation.

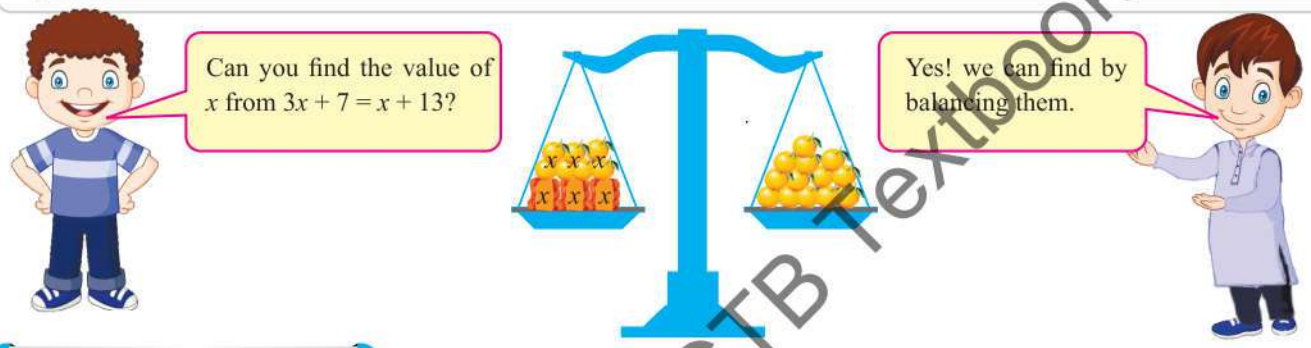
Sub-Domain 7

LINEAR EQUATIONS

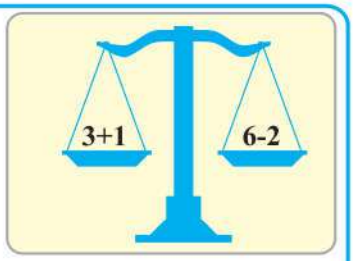
Students' Learning Outcomes:

By the end of this sub-domain, students will be able to:

- Recognize algebraic equations.
- Differentiate between linear algebraic equations and linear algebraic expressions in one variable.
- Solve linear equations and apply them in real life situations.



INTRODUCTION



An equation means that two things are equal and it is always denoted by an equal (=) sign. It can be compared to the pans of common balance in an equilibrium. The two sides of an equation are same as the two pans of scale and the equality sign shows that the two pans are equal. Take a look on the picture given on the right side where in arithmetics.

$$3 + 1 = 6 - 2$$

The equation says what is on the left side $(3 + 1)$ is equal to what is on the right $(6 - 2)$. The above weighing balance is an excellent example of an equation that we can observe in our daily life, in which.

(i) The two pans of the balance can be considered as two sides of an equation.

(ii) Equal sign "=" indicates that the two pans are in balance.

(iii) When we multiply, divide, add, or subtract on both sides the equation remains in balance.

So, we can say that an equation is like a statement "this is equal to that" so,

"An equation is a statement that shows two mathematical expressions are equal".

7.1 ALGEBRAIC EQUATION

We know that an equation is a statement which shows that two mathematical expressions are equal. Now, consider the following:

Aslam and Neelam write the algebraic sentences as equation. i.e.

Aslam's equation: Six times three increased by seven is twenty five $6(3) + 7 = 25$

Aslam's equation is a closed sentence, because it contains no variables. A closed sentence is either true or false. To determine whether an equation is true or false:

- Simplify each side of the equation by using BODMAS rule.
- Compare each side of the equation.

$$6(3) + 7 = 25$$
$$18 + 7 = 25$$
$$25 = 25 \text{ true}$$

The equation, $6(3)+7= 25$ is a true statement.

Neelam's equation: Twice a number n plus seven equals twenty seven $2n + 7 = 27$

Neelam's equation is an open sentence because it contains a variable n. An open sentence is neither true nor false. To determine wheather a value is a solution of an equation:

- Replace the variables with the given values.
- Simplify using the BODMAS rule and determine the value of variable which makes the statement true.

$2n + 7 = 27$ when $n = 10$	When $n = 11$
$2(10) + 7 = 27$	$2(11) + 7 = 27$
$20 + 7 = 27$	$22 + 7 = 27$
$27 = 27$ true	$29 = 27$ false
$2n + 7 = 27$	

It is the solution of the equation $2n + 7 = 27$ which makes a true statement.

So, Aslam's equation is an arithmetic equation and Neelam's equation is an Algebraic equation. Thus, *"An algebraic equation is an open mathematical sentence which contains an equal sign '='.*

Some other examples of an algebraic equation are $n + 25 = 27$, $3n - 28 = 19$, etc.

Practice -1

Find the solution of each equation by observation.

(i) $4p - 3 = 5$ **(ii)** $6x + 1 = 13$

Example 1 What is the value of x if

(i) $x + 7 = 10$ **(ii)** $x - 18 = 2$ **(iii)** $4x = 24$ **(iv)** $\frac{x}{3} = 3$

Solution

(i) The value of x is 3 because $3 + 7 = 10$.

(ii) The value of x is 20 because $20 - 18 = 2$.

(iii) The value of x is 6 because $4 \times 6 = 24$.

(iv) The value of x is 9 because $\frac{9}{3} = 3$

Example 2 Write an algebraic expression for the following statements. Use x as variable.

(i) One third of a number increased by sixteen.

(ii) Twice times the cost of a pen decreased by Rs. 7.

(iii) Two added to a number, multiplied by 15.

(iv) Three times a number decreased by 4.

Remember

a, b, c and x, y, z are written in alphabetical order.

Solution **(i)** $\frac{1}{3}x + 16$ **(ii)** $2x - 7$ **(iii)** $2 + 15x$ **(iv)** $3x - 4$

Thinking Time To multiply a given number by 99. Simply multiply the given number by 100 and subtract the given number from the product.

7.1.1 Difference between Algebraic Equations and Algebraic Expressions in One Variable

We have learnt in sub-domain 6 about algebraic expressions that an algebraic expression is a mathematical phrase, it is a combination of numbers, variables and mathematical operations. For example,

$$4x, 2a + 6, \ 3a + 2b - 7 \text{ and } \frac{1}{2}x + 5 \text{ etc.}$$

But an algebraic equation is formed by two algebraic expressions which are connected by the sign of equality '='.

For example, $2a = 8$, $3x + 5 = 17$ and $5a + 2b - 2 = 2x + 4$ etc.

Exercise - 7.1

1. Read and write the following sentences as an arithmetic or algebraic equation:

(i) Four times a number nine increased by four is forty.

(ii) Twice a number four decreased by two is six.

(iii) Twice a number n minus three equals twenty.

(iv) Half of a number x increased by six equals twenty two.

(v) Three times six divided by three is six.

(vi) A number increased by 7 is 14.

2. Write the following equations into words form:

(i) $3(6) - 4 = 14$ **(ii)** $3n + 4 = 10$ **(iii)** $4(6) \div 6 = 4$ **(iv)** $6x - 3 = 15$

3. Identify the following as an equation or expression:

(i) $4x + 2$ **(ii)** $2m + 5 + 3n$ **(iii)** $3p + 2 = 8$ **(iv)** $7s - 5$

(v) $26x + 2 = 54$ **(vi)** $\frac{2}{5}p + \frac{1}{3} = q + 6$ **(vii)** $3x + 2y + 7$ **(viii)** $4x + 5y = 5x - 3y + 3$

(ix) $4x - 1 = 7$ **(x)** $\frac{3}{4}x - 5 = 4x$ **(xi)** $4x + \frac{1}{3}y + 1$

Practice -2 Think and create at leat 5 linear algebraic equations and 5 linear expressions.

7.2 LINEAR EQUATIONS

7.2.1 Linear Equation in One Variable

Linear equation in one variable is

"The equation where the variable has an exponent or power of 1*".*

Usually '1' is not shown on the variable (it is understood).

For example, $4x + 3 = 0$, $3x = x - 3$

Generally we write linear equation as $ax + b = 0$

Remember

In an algebraic expression or an equation if a variable showing no power of exponent it means the variable contains exponent or power '1'.

7.2.2 Construction of Linear Expression and Linear Equation in One Variable

We know that an algebraic expression is a combination of variables, numbers and basic arithmetic operations. An open sentence can be written as algebraic expression or as an equation. Now consider the following examples:

Example 3 Write an algebraic equation for the following statements:

(i) Five less than twice a number is ten.

(ii) A number x decreased by 8 equals 18.

(iii) Divide a number x by thirteen is 10.

(iv) One sixth of a number x added to six is 10.

Solution

(i) $2x - 5 = 10$ **(ii)** $x - 8 = 18$ **(iii)** $\frac{x}{13} = 10$ **(iv)** $\frac{1}{6}x + 6 = 10$

7.2.3 Solution of Linear Equations

In section 7.1 consider the Neelam's equation. Which is $2n + 7 = 27$

The above equation is true for $n = 10$ and false for any other value of n. The number 10 only makes the equation true.

So, *"The value of variable which makes an equation true is known as the solution of linear equation".*

With the balance method we can solve equation by doing the same operations on both sides of the equal sign. As we discussed in section 7.1 that the two sides of an equation are same as the two pans of the weight balance.

Now, look at the following example,

Where we start removing (or adding) things from (or to) the weight balance until we are left with the equal scales.

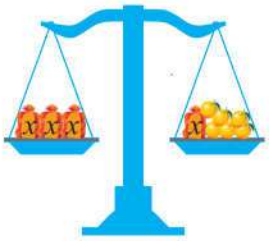
Example 4 Consider the equation and solve it for x.

$$3x + 7 = x + 13$$

Solution To make the balance and find the value of x. Take a bag x of oranges and separate oranges for the numbers.

Step I On both sides we have separated oranges.

So, we can remove 7 oranges from both pans without loosing the equilibrium of weight balance.

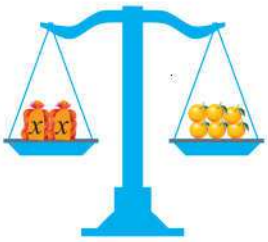


So, from equation $3x + 7 = x + 13$

Subtract 7 from both sides. $3x + 7 - 7 = x + 13 - 7$

$$3x = x + 6$$

Step II We also have the x bags of oranges, so, we can remove one x bag of oranges from both pans without loosing the equilibrum of the weight balance.



So, subtract x from both sides of the equation $3x = x + 6$

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

Step III Two orange bags are equal to 6 oranges. It means $6 \div 2 = 3$

So, divide both sides of the equation by 2.

$$\frac{2x}{2} = \frac{6}{2}$$
$$x = 3$$

So, the example and explanation will help to solve any type of linear equation.

Note To maintain the equilibrium, add, subtract, multiply or divide by the same number to both the weight balance.

Example 5 Solve the following linear equations:

(i) $n + 6 = 8$ **(ii)** $x - 9 = 35$

Remember

Do, the same operation on both sides of '=' sign in such a way you are left with the unknown variable.

Solution

(i) $n + 6 = 8$

Subtract 6 from both sides of the equation.

$$n + 6 - 6 = 8 - 6$$
$$n = 2$$

Check

$$n + 6 = 8$$
$$(2) + 6 = 8$$
$$8 = 8$$ which is a true sentence.

(ii) $x - 9 = 35$

Add 9 on both sides of the equation.

$$x - 9 + 9 = 35 + 9$$
$$x = 44$$

Check

$$x - 9 = 35$$
$$43 - 9 = 35$$
$$35 = 35$$ which is a true sentence.

Example 6 Solve the following linear equations:

(i) $3a + 7 = 19$ **(ii)** $7x + 12 = 4x + 27$

Solution

(i) $3a + 7 = 19$

Subtract 7 from both sides of the equation.

$$3a + 7 - 7 = 19 - 7$$
$$3a = 12$$

Divide both sides of the equation by 3, $\frac{3a}{3} = \frac{12}{3}$

$$a = 4$$

Check

$$3a + 7 = 19$$
$$3(4) + 7 = 19$$
$$12 + 7 = 19$$
$$19 = 19$$

Which is a true sentence.

Teaching Point

Bring the original balance in the classroom to perform the math activity as shown above.

(ii) $7x + 12 = 4x + 27$

Subtract 12 from both sides of the equation.

$$7x + 12 - 12 = 4x + 27 - 12$$
$$7x = 4x + 15$$

Now, subtract $4x$ from both sides of the equation.

$$7x - 4x = 4x + 15 - 4x$$
$$3x = 15$$

Divide both sides by 3

$$\frac{3x}{3} = \frac{15}{3}$$
$$x = 5$$

Check

$7x + 12 = 4x + 27$
$7(5) + 12 = 4(5) + 27$
$35 + 12 = 20 + 27$
$47 = 47$
Which is a true sentence.

Go Online

Visit the following online game links to practice algebraic equations.
https://www.mathgames.com/skill/3.75-solve-for-the-variable-with-addition-and-subtraction

Example 7 Solve: **(i)** $\frac{1}{4}x + 6 = x - \frac{1}{3}$ **(ii)** $3.5x + 11 = 1.5x + 21$

Solution

(i) $\frac{1}{4}x + 6 = x - \frac{1}{3}$ (L.C.M of denominators $= 3 \times 4$)

Multiply the equation on both sides by L.C.M = 12

$$12\left(\frac{1}{4}x + 6\right) = 12\left(x - \frac{1}{3}\right)$$
$$3x + 72 = 12x - 4$$

Add 4 on both sides of the equation

$$3x + 72 + 4 = 12x - 4 + 4$$
$$3x + 76 = 12x$$

Subtract $3x$ from both sides

$$3x + 76 - 3x = 12x - 3x$$
$$76 = 9x$$

Divide both sides of equation by 9

$$\frac{76}{9} = \frac{9x}{9}$$
$$x = \frac{76}{9}$$
$$x = 8\frac{4}{9}$$

Check

$$\frac{1}{4}x + 6 = x - \frac{1}{3}$$
$$\frac{1}{4}\left(\frac{76}{9}\right) + 6 = \frac{76}{9} - \frac{1}{3}$$
$$\frac{19}{9} + 6 = \frac{76}{9} - \frac{3}{9}$$
$$\frac{19}{9} + \frac{54}{9} = \frac{76}{9} - \frac{3}{9}$$
$$\frac{73}{9} = \frac{73}{9}$$

Which is true sentence.

(ii) $3.5x + 11 = 1.5x + 21$

Subtract 11 from both sides of the equation.

$$3.5x + 11 - 11 = 1.5x + 21 - 11$$
$$3.5x = 1.5x + 10$$

Subtract $1.5x$ from both sides of the equation.

$$3.5x - 1.5x = 1.5x + 10 - 1.5x$$
$$2x = 10$$

Divide both sides of the equation by 2

$$\frac{2x}{2} = \frac{10}{2}$$
$$x = 5$$

Check

$3.5x + 11 = 1.5x + 21$
$3.5(5) + 11 = 1.5(5) + 21$
$17.5 + 11 = 7.5 + 21$
$28.5 = 28.5$

Go Online

Visit the following online game links to practice algebraic equations.
https://www.mathgames.com/skill/3.76-solve-for-the-variable-with-muliplication-and-division

7.1.4 Real Life Problems Involving Linear Equation

In Mathematics real life problems or word problems are representing situations. A real world problem is represented as text rather than in mathematical notation. In our daily life we face many word problems. To solve these problems we must know:

(i) Which information is given in the problem? (ii) Which information is required?

Example 8 Arslan and Waqas bought 30 books together . Waqas bought 8 books. How many books did Arslan buy?

Solution Let Arslan bought = x books

Waqas bought = 8 books

So, $x + 8 = 30$

Subtract 8 from both sides of the equation.

$$x + 8 - 8 = 30 - 8$$
$$x = 22$$

Hence, Arslan bought 22 books.

Check

$x + 8 = 30$
$22 + 8 = 30$
$30 = 30$

Remember

Always assume unknown/required value by a variable such as 'x' or n. Or any of the alphabet.

Example 9 What are the three consecutive numbers whose sum is 48?

Solution Let the first number = x

Second number = $x + 1$

Third number = $x + 2$

So, $x + (x + 1) + (x + 2) = 48$

$x + x + 1 + x + 2 = 48$

$3x + 3 = 48$

Subtract 3 from both sides of the equation.

$$3x + 3 - 3 = 48 - 3$$
$$3x = 45$$

Divide both sides by 3.

$$\frac{3x}{3} = \frac{45}{3}$$
$$x = 15$$

Hence, first number = 15

Second number = $x + 1$
$= 15 + 1$
$= 16$

Third number = $x + 2$
$= 15 + 2$
$= 17$

Remember

To solve any type of word problem simply follow these four steps.

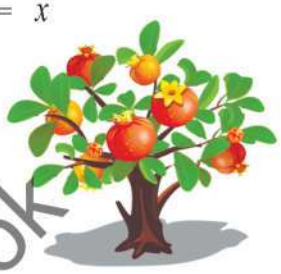
- Read the given statement again and again until you understand the problem.
- Plan to solve.
- Make solution.
- Recheck the problem.

Check

$x + (x + 1) + (x + 2) = 48$
$15 + (15 + 1) + (15 + 2) = 48$
$15 + 16 + 17 = 48$
$48 = 48$

Example 10 Neelam bought 70 pomegranate for Rs. 820. Some of them are Rs. 10 each and the rest are Rs. 20 each. How many each kind of pomegranate has she bought?

Solution Let the number of pomegranate Neelam bought at Rs. 10 each $= x$



Number of pomegranate she bought at Rs. 20 each $= 70 - x$

Cost of x pomegranate at Rs. 10 each $= 10x$

Cost of $(70 - x)$ pomegranate at Rs. 20 each $= 20 \times (70 - x)$

So, $10x + 20(70 - x) = 820$

$10x + 1400 - 20x = 820$

Subtracting 1400 from both sides of the equation.

$10x + 1400 - 20x - 1400 = 820 - 1400$

$10x - 20x = -580$

$-10x = -580$

Divide the equation both sides by -10.

$$\frac{-10x}{-10} = \frac{-580}{-10}$$

$x = 58$

Hence, Neelam bought 58 pomegranate at Rs. 10 each and 12 pomegranate at Rs. 12 each.

Check

$10x + 20(70 - x) = 820$

$10(58 + 20(70-58) = 820$

$10(58)+20(12) = 820$

$580+240 = 820$

$820 = 820$

Example 11 The present age of Saeed is 5 times as old as his daughter Rabia. After 20 years, the sum of their ages will be 100. How old was Saeed when Rabia was born?

Solution Let the present age of Rabia $= x$ year

The present age of Saeed $= 5x$

Rabia's age after 20 years $= x + 20$

Saeed's age after 20 years $= 5x + 20$

So, $(x + 20) + (5x + 20) = 100$

$x + 20 + 5x + 20 = 100$

$6x + 40 = 100$

Subtract 40 from both sides from the equation.

$6x + 40 - 40 = 100 - 40$

$6x = 60$

Divide the equation by 6

$$\frac{6x}{6} = \frac{60}{6}$$

$x = 10$

Hence, the present age of his daughter is 10 years and Saeed's age is 50 years.

So, Saeed's age when Rabia was born $= 50 - 10 = 40$ years.

Check

$(x + 20) + (5x + 20) = 100$

$(10+20)+(5(10)+20) = 100$

$30+(50+20) = 100$

$30+70 = 100$

$100 = 100$

Activity -2

1. Construct a linear equation in which the solution is the number of textbooks, work books and notebooks in your bag. The equation should comprise at least two operations.
   $2(16 - x) = 62$
2. Pass your paper to the student sitting to your right who will solve the equation and verify that answer.

Exercise - 7.2

1. Identify the linear equations:

(i) $4x + 5 = 8$ **(ii)** $12x + 5 = 15 + \frac{1}{x}$ **(iii)** $18x + 7 = 54$ **(iv)** $\frac{x}{2} + 3 = 25$

(v) $3x^2 = 80$ **(vi)** $ax + b = c$ **(vii)** $a\sqrt{x} + 6 = 9$ **(viii)** $\frac{3}{x} + \frac{1}{2} = \frac{2}{9}$

2. Construct the following linear equations:

(i) When a number n is increased by 8 the result is 18.
(ii) When a number y is decreased by 7 the result is 14.
(iii) The sum of two consecutive numbers is 29.
(iv) Four times of a number n is 23 more than twice the number:

3. Solve the following linear equations:

(i) $x + 6 = 18$ **(ii)** $x + 13 = 20$ **(iii)** $5a - 5 = 20$
(iv) $a - 15 = 20$ **(v)** $2x + 5 = 35$ **(vi)** $3n - 8 = 39$

4. The sum of a number x and its double is 12. Find the number.

5. The sum of a number x and its double is 15. Find the number.

6. Five times of a number x is 100. Find the number.

7. Find the length of each side of square of whose perimeter is 36 *cm*.

8. When Anoral opened a book there are two pages in front of her. The sum of the page numbers is 161. If one page number is 81, what is the other page number?

9. In a cricket match Ahmed Shahzad and Shahid Afridi enhanced the scored of Pakistan cricket team by 96 runs, if Shahid Afridi scored 22 more than Ahmed Shahzad. Find the score of Ahmed Shahzad.

10. Namra is senior to Shumaila by 18 years. After six years, Namra will be twice as old as Shumaila. Find Namra's present age.

11. A number is divided into two parts, such that one part is 40 more than the other. If the two parts are in the ratio 2 : 3, find the number.

12. A tractor trolly is loaded with sugar canes. The loaded weight of truck is 54,450 kg. If the sugar canes, weight is four times as heavy as the empty tractor trolly. Find the weight of the sugar canes.

Project - 2

Solve the following for x and write the corresponding letter in the space below that are matches your answer.

(i)	$8 + x = 16$	(A)	**(ii)**	$2x - 8 = 6$	(R)	**(iii)**	$x - 10 = 0$	(B)
(iv)	$4 + 3x = 7$	(P)	**(v)**	$2x + 5 = 9$	(C)	**(vi)**	$4x - 4 = 16$	(B)
(vii)	$9 + 2x = 17$	(E)	**(viii)**	$6 + 2x = 24$	(S)	**(ix)**	$3x - 6 = 3$	(B)
(x)	$3x + 5 = 23$	(Y)						

What do witches put on their hair? Find the secret.

9	2	8	7	4

9	1	5	7	6

Review Exercise 7

1. Each of the question below is followed by four suggested options. In each case choose the correct option.

(i) An equation shows that two mathematical expressions are:

a. unequal **b.** equal
c. less than equal to **d.** greater than equal to

(ii) In the expression $6x^4$ the number 4 is:

a. constant **b.** exponent **c.** coefficient **d.** base

(iii) The power of variable in a linear equation is always:

a. 1 **b.** 2 **c.** 3 **d.** 4

(iv) The exponent of variable in a linear equation is also known as:

a. degree **b.** base **c.** coefficient **d.** constant

(v) $4x + 5$ is an:

a. algebraic equation **b.** algebraic expression
c. arithmetic equation **d.** arithmetic expression

(vi) $ax + b = 0$ is an:

a. algebraic equation **b.** algebraic expression
c. arithmetic equation **d.** arithmetic expression

(vii) The value of variable which makes an equation true is known as:

a. Algebra **b.** arithmetics
c. solution of an equation **d.** solution of an expression

(viii) Mathematical word problems represent:

a. sentence **b.** situation **c.** variable **d.** constant

(ix) To write an equation we use the sign:

a. + **b.** − **c.** = **d.** /

(x) $x + 9 = 19$ is true for $x =$ _____:

a. 1 **b.** 10 **c.** 2 **d.** 20

2. Solve the following equations:

(i) $3x + 6 = 2x - 9$ **(ii)** $8x + 4 = 2x + 28$ **(iii)** $\frac{1}{2}x + 5 = 10$

(iv) $\frac{1}{2}x + 2 = 5 - \frac{1}{6}x$ **(v)** $3.5x + 2.5 = 1.5x - 4.5$ **(vi)** $9x + \frac{3}{10} = x - \frac{2}{7}$

3. Solve the following equations:

(i) $2x + 5 = \frac{1}{2}x - 10$ **(ii)** $4.3p - 2.5 = -8.85p + 10.5$ **(iii)** $\frac{3}{7}x + \frac{1}{14} = 2 - x$

(iv) $\frac{1}{x} + \frac{2}{x} = 3$ **(v)** $4(x - 5) - 8(3x - 5) = 4(x + 1) - 2$ **(vi)** $\frac{7}{9} = \frac{7}{x}$

4. When a number is added to 4 times of itself, the result is 65. Find the number.

5. Abdullah is two more than 3 times as old as Yaseen. If the sum of both of their ages is 60 years. How old is Abdullah?

6. A number is divided into two parts, such that one part is 20 more than the other. If the two parts are in the ratio 3 : 2, find the number.

Summary

- A relationship of equality between two algebraic expressions is known as equation.
- An algebraic equation is an open Mathematical sentence which contains an equal sign, '='
- The value of variable which makes an equation true is known as the solution of an algebraic equation.
- Do the same operation on both sides of '=' sign in such a way that you left with the value of unknown variable.
- In an algebraic expression or equation if a variable showing no power or exponent, it means the variable contains exponent or power '1'.

Teaching Point

The questions in the exercises, practices and different activities are given as examples (symbols) for learning. You can use self generated questions (test items) conceptual type MCQ's, fill in the blanks, column matching, constructed response questions and (simple computations) based on cognitive domain (e.g. knowing = 40%, applying = 40% and reasoning = 20%) to assess the understanding of learners.