

MATHEMATICS

Chapter 4: Simple Equations



Simple Equations

Introduction to Simple Equations

Variables and Expressions

Variable is a quantity that can take any value, its value is not fixed. It is a symbol for a number whose value is unknown yet.

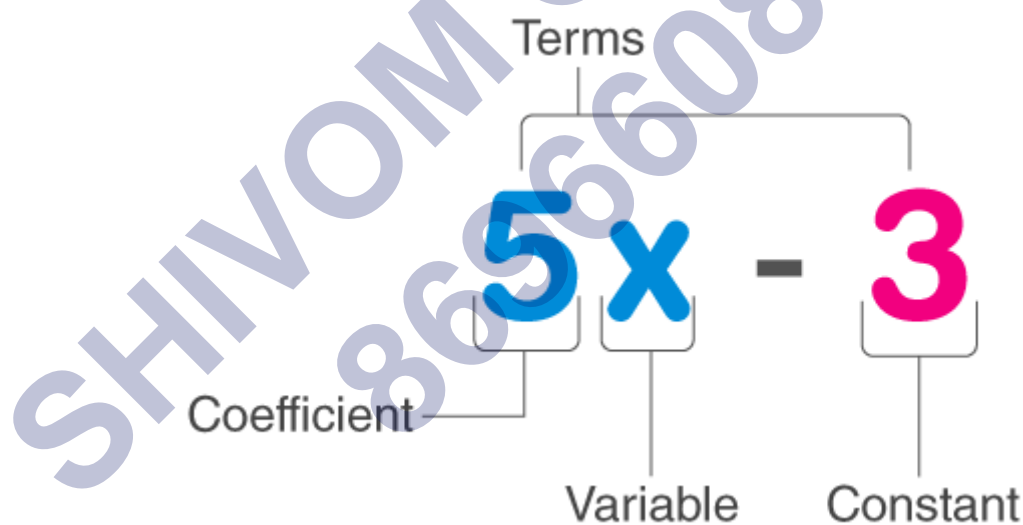
Expressions are formed by performing operations like addition, subtraction, multiplication and division on the variables.

Example: $6x - 3$ is an expression in variable x .

Algebraic expressions are the idea of expressing numbers using letters or alphabets without specifying their actual values. The basics of algebra taught us how to express an unknown value using letters such as x , y , z , etc. These letters are called here as variables. An algebraic expression can be a combination of both variables and constants. Any value that is placed before and multiplied by a variable is a coefficient.

Variables, Coefficient & Constant in Algebraic Expressions

In Algebra we work with Variable, Symbols or Letters whose value is unknown to us.



In the above expression (i.e. $5x - 3$),

- x is a variable, whose value is unknown to us which can take any value.
- 5 is known as the coefficient of x , as it is a constant value used with the variable term and is well defined.
- 3 is the constant value term that has a definite value.

The whole expression is known to be the Binomial term, as it has two unlikely terms.

Types of Algebraic expression

There are 3 main types of algebraic expressions which include:

Monomial Expression

Binomial Expression

Polynomial Expression

Monomial Expression

An algebraic expression which is having only one term is known as a monomial.

Examples of monomial expressions include $3x^4$, $3xy$, $3x$, $8y$, etc.

Binomial Expression

A binomial expression is an algebraic expression which is having two terms, which are unlike.

Examples of binomial include $5xy + 8$, $xyz + x^3$, etc.

Polynomial Expression

In general, an expression with more than one term with non-negative integral exponents of a variable is known as a polynomial.

Examples of polynomial expression include $ax + by + ca$, $x^3 + 2x + 3$, etc.

Other Types of Expression

Apart from monomial, binomial and polynomial types of expressions, an algebraic expression can also be classified into two additional types which are:

Numeric Expression

Variable Expression

Numeric Expression

A numeric expression consists of numbers and operations, but never include any variable. Some of the examples of numeric expressions are $10 + 5$, $15 \div 2$, etc.

Variable Expression

A variable expression is an expression that contains variables along with numbers and operation to define an expression. A few examples of a variable expression include $4x + y$, $5ab + 33$, etc.

Formulas

The general algebraic formulas we use to solve the expressions or equations are:

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

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

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

$$(a + b)^3 = a^3 + b^3 + 3ab(a + b)$$

$$(a - b)^3 = a^3 - b^3 - 3ab(a - b)$$

$$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$$

$$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$$

Algebraic Equation

In simple words, equations mean equality i.e. the equal sign. That's what equations are all about- "equating one quantity with another".

$$Ax^2 + bx + c = 0$$

Example:

$$5x^2 + 7x - 9 = 4x^2 + x - 18$$

$$5x^2 + 7x - 9 - 4x^2 - x + 18 = 0$$

$$X^2 + 6x + 9 = 0$$

Equations are like a balance scale. If you've seen a balance scale, you would know that an equal amount of weight has to be placed on either side for the scale to be considered "balanced". If we add some weight to just one side, the scale will tip on one side and the two sides are no longer in balance. Equations follow the same logic. Whatever is on one side of the equal sign must have exactly the same value on the other side else it becomes an inequality.

An equation is a condition on a variable such that two expressions in the variable should have equal value.

Example: $8x - 8 = 16$ is an equation.

Algebraic Equations

An algebraic equation is an equation in the form:

$$P = 0$$

Where P is a polynomial.

For example, $x + 8 = 0$ is an algebraic equation, where $x + 8$ is a polynomial. Hence, it is also called a polynomial equation.

An algebraic equation is always a balanced equation that includes variables, coefficients, and constants.

Consider an equation $1 + 1 = 2$.

It is balanced as both sides have the same value. To avoid committing an error that tips the equation out of balance, make sure that any change on one side of the equation is reciprocated on the other side. For example, if you want to add a number 5 to one side of the equation you will have to add the same 5 to the other side of the equation i.e.

$$1 + 1 = 2$$

$$1 + 1 + 5 = 2 + 5$$

The same goes for subtraction, multiplication, and division. As long as you do the same thing to both sides of the equation it will remain balanced.

Equation

An equation is simply defined as mathematical statements that express the relationship between two values. Usually, the two values are equated by an equal sign in an equation.

For example, $2x + 3 = 7$ is an equation, where $2x + 3$ and 7 are equated by equal to “=” sign.

$2x + 3$ is at the Left-hand side of the equation and 7 is at the right-hand side. In this example,

- $2x$, 3 and 7 are terms
- x is the variable
- 3 and 7 are the constants
- ‘+’ is the operator

If we write $x = 3$, then it is also an equation, where we are denoting the value of variable x equal to 3.

Types of Algebraic Equations

Algebraic equations are of various types. A few of the equations in algebra are:

- Polynomial Equations
- Quadratic Equations
- Cubic Equations
- Rational polynomial Equations
- Trigonometric Equations

Polynomial Equations

All the polynomial equations are a part of algebraic equations like the linear equations. To recall, a polynomial equation is an equation consisting of variables, exponents and

coefficients.

Linear equations: $ax + b = c$ (a not equal to 0)

Quadratic Equations

A quadratic equation is a polynomial equation of degree 2 in one variable of type $f(x) = ax^2 + bx + c$.

Quadratic Equations: $ax^2 + bx + c = 0$ (a not equal to 0)

Cubic Equations

The cubic polynomials are polynomials with degree 3. All the cubic polynomials are also algebraic equations.

Cubic Polynomials: $ax^3 + bx^2 + cx + d = 0$

Rational Polynomial Equations

$$\frac{P(x)}{Q(x)} = 0$$

Trigonometric Equations

All the trigonometric equations are all considered as algebraic functions. For a trigonometry equation, the expression includes the trigonometric functions of a variable.

Trigonometric Equations: $\cos 2x = 1 + 4\sin x$

Difference Between Expression and Equations

Many times, students are confused between expressions and equation. Here is the difference between them

<u>Expression</u>	<u>Equation</u>
<ul style="list-style-type: none"> □ True for <u>all</u> values of x. □ Common key terms: <ul style="list-style-type: none"> ▪ Simplify ▪ Expand ▪ Factorise □ Example: <ul style="list-style-type: none"> ▪ $8x + 5y - 3x - 5$ 	<ul style="list-style-type: none"> □ True for <u>some</u> values of x. □ Common key terms: <ul style="list-style-type: none"> ▪ Solve □ Example: <ul style="list-style-type: none"> ▪ $5x - 4 = x$

The value of the variable in an equation for which the equation is satisfied is called the solution of the equation.

Example: The solution for the equation $2x - 3 = 5$ is $x = 4$.

How to Solve Algebraic Equations

Consider the following situation. I am going on a trip. In one bag I carry some t-shirts, shorts, and towels. A total of 8 items can fit in the bag. So I pack 4 shirts and 2 shorts. How many towels can I now carry?

Consider the number of towels to be 'x'. Let's form the equation now.

$$4 \text{ shirts} + 2 \text{ shorts} + 'x' \text{ towels} = 8 \text{ clothes}$$

The left-hand side (LHS) of our equation is being compared to the right-hand side (RHS) of the equation.

Now, let's solve this equation:

$$4 + 2 + x = 8$$

$$6 + x = 8$$

$$6 + x - 6 = 8 - 6$$

$$x = 2$$

I can carry 2 towels for my trip.

In the same way, what would depict an inequality? Obviously, when the left-hand side is not equal to the right-hand side. How would this happen?

Let's take the same $6 + x = 8$ and change that equal to into a greater than or a lesser than sign. These aren't equations! Consider some examples to clarify this concept.

$x + 2 = 21$, $xy + 9 = z$ are equations but $6p > 77$ is not.

How to Solve Linear Equations?

There are six main methods to solve linear equations. These methods for finding the solution of linear equations are:

Graphical Method

Elimination Method

Substitution Method

Cross Multiplication Method

Matrix Method

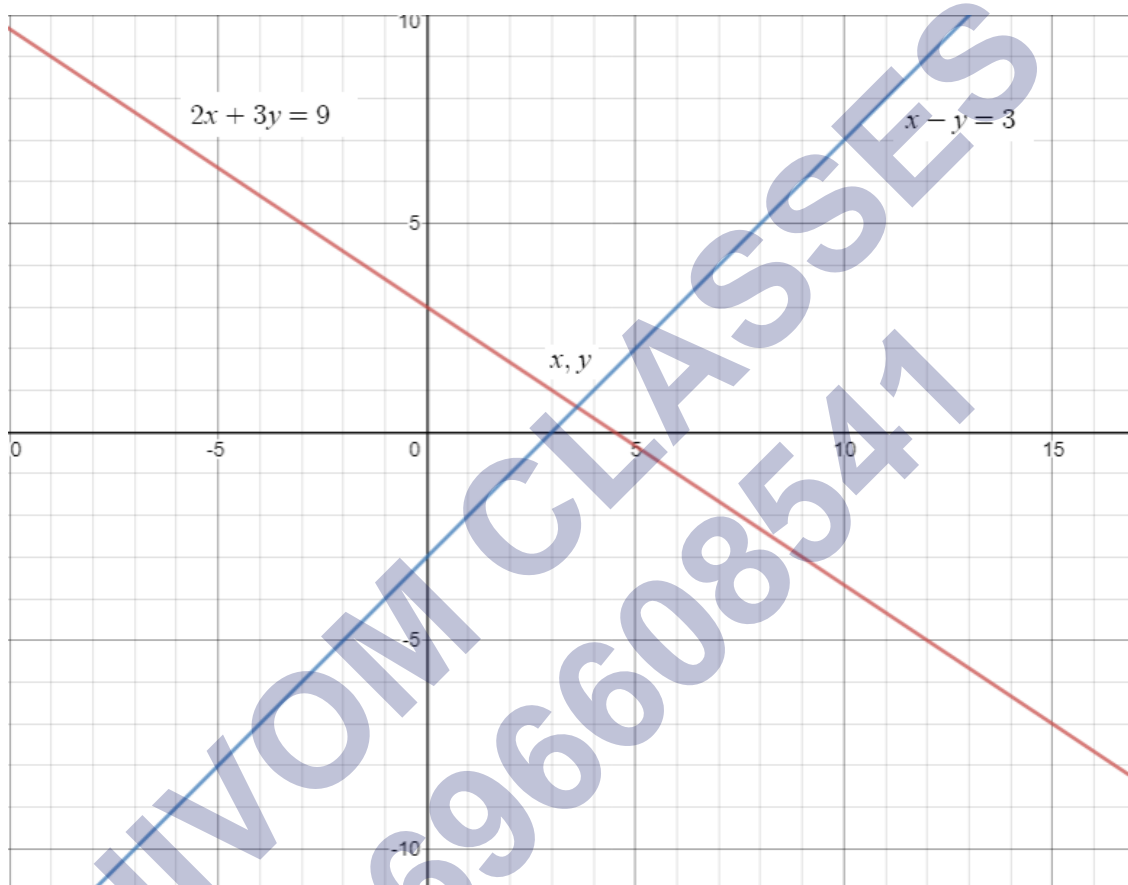
Determinants Method

Graphical Method of Solving Linear Equations

To solve linear equations graphically, first graph both equations in the same coordinate system and check for the intersection point in the graph. For example, take two equations as $2x + 3y = 9$ and $x - y = 3$.

Now, to plot the graph, consider $x = \{0, 1, 2, 3, 4\}$ and solve for y . Once (x, y) is obtained, plot the points on the graph. It should be noted that by having more values of x and y will make the graph more accurate.

The graph of $2x + 3y = 9$ and $x - y = 3$ will be as follows:



In the graph, check for the intersection point of both the lines. Here, it is mentioned as (x, y) . Check the value of that point and that will be the solution of both the given equations. Here, the value of $(x, y) = (3.6, 0.6)$.

Elimination Method of Solving Linear Equations

In the elimination method, any of the coefficients is first equated and eliminated. After elimination, the equations are solved to obtain the other equation. Below is an example of solving linear equations using the elimination method for better understanding.

Consider the same equations as

$$2x + 3y = 9 \text{ ---(i)}$$

And,

$$x - y = 3 \text{ ---(ii)}$$

Here, if equation (ii) is multiplied by 2, the coefficient of "x" will become the same and can be subtracted.

So, multiply equation (ii) $\times 2$ and then subtract equation (i)

$$\begin{array}{r} 2x + 3y = 9 \\ (-)2x - 2y = 6 \\ \hline -5y = -3 \end{array}$$

Or, $y = \frac{3}{5} = 0.6$

Now, put the value of $y = 0.6$ in equation (ii).

So, $x - 0.6 = 3$

Thus, $x = 3.6$

In this way, the value of x, y is found to be 3.6 and 0.6.

Substitution Method of Solving Linear Equations

To solve a linear equation using the substitution method, first, isolate the value of one variable from any of the equations. Then, substitute the value of the isolated variable in the second equation and solve it. Take the same equations again for example.

Consider,

$$2x + 3y = 9 \text{ -----(i)}$$

And,

$$x - y = 3 \text{ -----(ii)}$$

Now, consider equation (ii) and isolate the variable "x".

So, equation (ii) becomes,

$$x = 3 + y.$$

Now, substitute the value of x in equation (i). So, equation (i) will be-

$$2x + 3y = 9$$

$$\Rightarrow 2(3 + y) + 3y = 9$$

$$\Rightarrow 6 + 2y + 3y = 9$$

Or, $y = \frac{3}{5} = 0.6$

Now, substitute "y" value in equation (ii).

$$x - y = 3$$

$$\Rightarrow x = 3 + 0.6$$

$$\text{Or, } x = 3.6$$

$$\text{Thus, } (x, y) = (3.6, 0.6).$$

Cross Multiplication Method of Solving Linear Equations

Linear equations can be easily solved using the cross multiplication method. In this method, the cross-multiplication technique is used to simplify the solution. For the cross-multiplication method for solving 2 variable equation, the formula used is:

$$\frac{x}{(b_1c_2 - b_2c_1)} = \frac{y}{(c_1a_2 - c_2a_1)} = \frac{1}{(b_2a_1 - b_1a_2)}$$

For example, consider the equations

$$2x + 3y = 9 \text{ --- (i)}$$

And,

$$x - y = 3 \text{ --- (ii)}$$

Here,

$$a_1 = 2, b_1 = 3, c_1 = -9$$

$$a_2 = 1, b_2 = -1, c_2 = -3$$

Now, solve using the aforementioned formula.

$$x = \frac{(b_1c_2 - b_2c_1)}{(b_2a_1 - b_1a_2)}$$

Putting the respective value we get,

$$x = \frac{18}{5} = 3.6$$

Similarly, solve for y.

$$y = \frac{(c_1a_2 - c_2a_1)}{(b_2a_1 - b_1a_2)}$$

$$\text{So, } y = \frac{3}{5} = 0.6$$

Matrix Method of Solving Linear Equations

Linear equations can also be solved using matrix method. This method is extremely helpful for solving linear equations in two or three variables. Consider three equations as:

$$a_1x + a_2y + a_3z = d_1$$

$$b_1x + b_2y + b_3z = d_2$$

$$c_1x + c_2y + c_3z = d_3$$

These equations can be written as:

$$\begin{bmatrix} a_1x + a_2y + a_3z \\ b_1x + b_2y + b_3z \\ c_1x + c_2y + c_3z \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix} \Rightarrow \begin{bmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{bmatrix} \begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

$$\Rightarrow AX = B \text{ --- (i)}$$

Here, the A matrix, B matrix and X matrix are:

$$A = \begin{bmatrix} a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \\ c_1 & c_2 & c_3 \end{bmatrix}, X = \begin{bmatrix} x \\ y \\ z \end{bmatrix}, B = \begin{bmatrix} d_1 \\ d_2 \\ d_3 \end{bmatrix}$$

Now, multiply (i) by A^{-1} to get:

$$A^{-1}AX = A^{-1}B \Rightarrow I.X = A^{-1}B$$

$$\Rightarrow X = A^{-1}B$$

Mathematical Operations on Expressions

Addition of variables: $(3x + 4z) + (5y + 6)$

Subtraction of variables: $(4x - 7y) - (6y + 5)$

Multiplication of variables: $(5xy + 6) \times 7x$

Division of variables: $\frac{(8xz + 5z)}{(5x - 6y)}$

Solving an Equation

Solving an equation involves performing the same operations on the expressions on either side of the "=" sign so that the value of the variable is found without disturbing the balance.

Example: Solve $2x + 4 = 10$

Consider $2x + 4 = 10$

$$\Rightarrow 2x + 4 - 4 = 10 - 4 \text{ [Subtracting 4 from both LHS and RHS]} \Rightarrow 2x = 6$$

$$\Rightarrow 2x/2 = 6/2 \text{ [Dividing both LHS and RHS by 2]} \Rightarrow x = 3$$

Methods of Solving an Equation

Method 1: performing the same operations on the expressions on either side of the “=” sign so that the value of the variable is found without disturbing the balance.

Operations involve Adding, subtracting, multiplying or dividing on both sides.

Example: $x + 2 = 6$

Subtract 2 from LHS and RHS

$$\Rightarrow \text{LHS: } x + 2 - 2 = x$$

$$\Rightarrow \text{RHS: } 6 - 2 = 4$$

But LHS = RHS

$$\Rightarrow x = 4$$

Method 2: Transposing

It involves moving the terms to one side of the equation to find out the value of the variable.

When terms move from one side to another they change their sign.

Example: $x + 2 = 6$

Transpose (+2) from LHS to RHS

$$\Rightarrow x = 6 - 2$$

$$\Rightarrow x = 4$$

Applying Equations

Forming Equation from Solution

Given a solution, many equations can be constructed.

Example: Given solution: $x = 3$

Multiply both sides by 4,

$$\Rightarrow 4x = 4 \times 3$$

Add -5 to both sides,

$$\Rightarrow 4x - 5 = 12 - 5$$

$$\Rightarrow 4x - 5 = 7$$

Similarly, more equations can be constructed.

Applications (Word problem)

Example: Ram's father is 3 times as old as his son Ram. After 15 years, he will be twice the age of his son. Form an equation and solve it.

Solution: Let Ram's age be x .

\Rightarrow His father's age is $3x$.

After 15 years:

$$3x + 15 = 2(x + 15)$$

On solving,

$$3x + 15 = 2x + 30$$

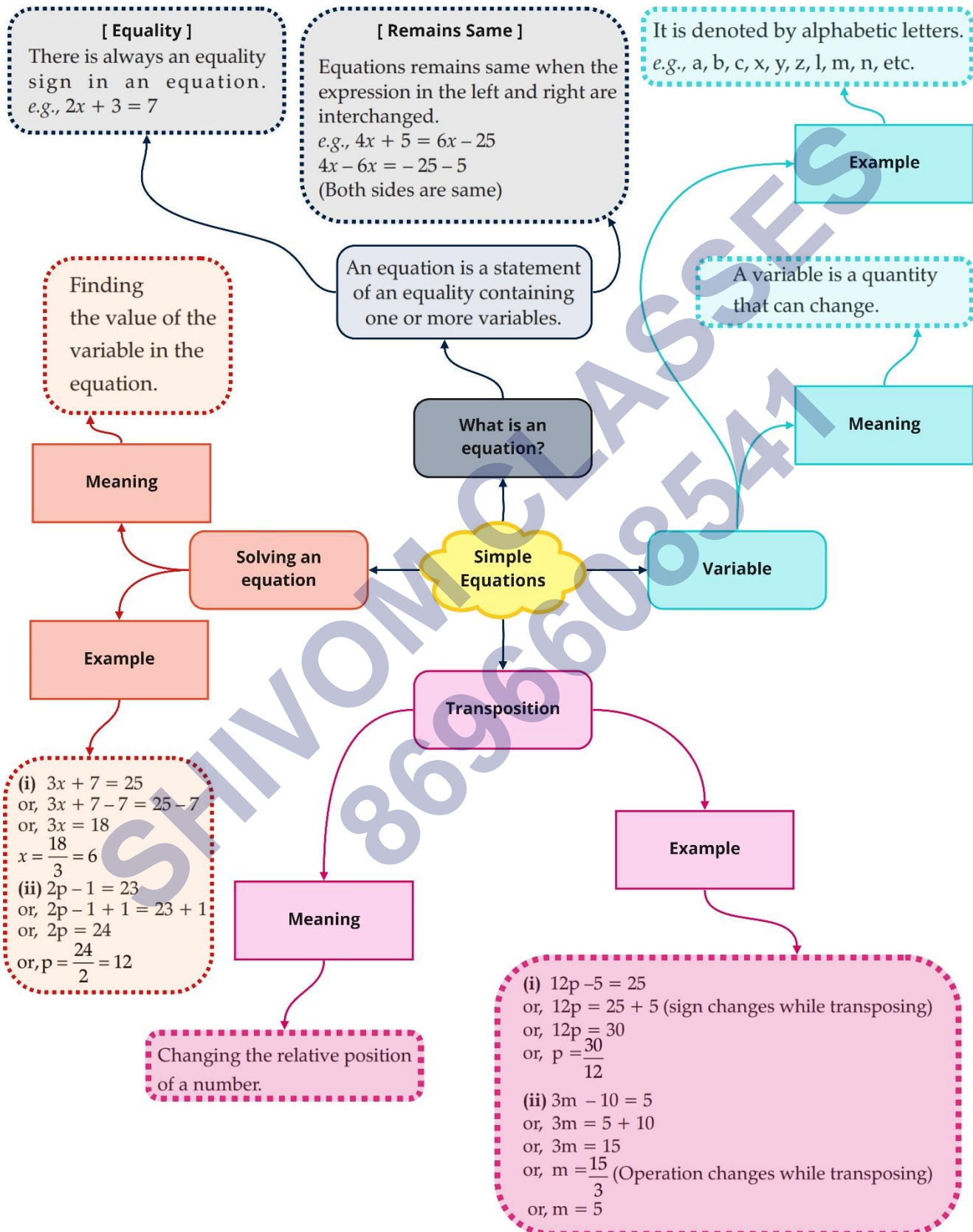
$$3x - 2x = 30 - 15$$

$$x = 15$$

\therefore Ram's age is 15 and his dad's age is 45.

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Class : 7th mathematics
Chapter-4 : Simple Equations



Important Questions

Multiple Choice Questions:

Question 1. Write the statements "Seven times a number plus 7 gets you 77" in the form of equations:

- (a) $7x + 7 = 77$
- (b) $7x - 7 = 77$
- (c) $7x + 6 = 66$
- (d) None of these

Question 2. Solve the given equation: $3n - 2 = 46$.

- (a) 16
- (b) 12
- (c) 14
- (d) None of these

Question 3. Which is a solution of the equation $4x - 3 = 13$?

- (a) $x = 5$
- (b) $x = 3$
- (c) $x = 4$
- (d) None of these

Question 4. Write an equation for If you take away 6 from 6 times y you get 60.

- (a) $6y - 6 = 60$
- (b) $6y + 6 = 60$
- (c) $6y \div 6 = 60$
- (d) None of these

Question 5. The solution of the equation $m - 7 = 3$ is $m =$

- (a) 15
- (b) 12
- (c) 10
- (d) None of these

Question 6. Solve the given equation: $x + 6 = 2$.

- (a) 4
- (b) 6
- (c) -4

(d) None of these

Question 7. By solving the equation $2a - 2 = 20$, the value of 'a' will be

(a) 12

(b) 14

(c) 11

(d) 13

Question 8. Write an equation for three fourth of t is 15.

(a) $\frac{3}{4}t = 15$

(b) $\frac{3}{4} + t = 15$

(c) $\frac{3}{4} - t = 15$

(d) None of these

Question 9. The solution of the equation $4m - 2 = 18$ is $m =$

(a) 4

(b) 6

(c) 5

(d) none of these

Question 10. Write an equation in statement form: $2m = 7$.

(a) Two times of a number m is 7.

(b) Two added to m becomes 7.

(c) Two subtracted from m becomes 7.

(d) None of these.

Question 11. Which is a solution of the equation $2x = 12$?

(a) $x = 4$

(b) $x = 6$

(c) $x = 5$

(d) $x = 7$

Question 12. Write an equation for 2 subtracted from y is 8.

(a) $y - 2 = 8$

(b) $2y = 8$

(c) $y + 2 = 8$

(d) None of these

Question 13. Write the statements "If you take away 6 from 6 time a number, you

get 60" in the form of equations:

(a) $6x + 6 = 60$

(b) $6x - 5 = 60$

(c) $6x - 6 = 60$

(d) None of these

Question 14. Solve the given equation: $\frac{b}{2} = 6$.

(a) 6

(b) 3

(c) 12

(d) None of these

Question 15. The solution of the equation $\frac{20m}{3} = 40$ is $m =$

(a) 5

(b) 6

(c) 7

(d) none of these

Very Short Questions:

- Write the following statements in the form of equations.
 - The sum of four times a number and 5 gives a number five times of it.
 - One-fourth of a number is 2 more than 5.
- Convert the following equations in statement form:
 - $5x = 20$
 - $3y + 7 = 1$
- If $k + 7 = 10$, find the value of $9k - 50$.
- Solve the following equations and check the answers.

(a) $\frac{5z + 1}{3} = 7$ (b) $\frac{5x}{3} + 3 = x + 7$
- Solve the following equations:

$$3(y - 2) = 2(y - 1) - 3$$

Short Questions:

- If 5 is added to twice a number, the result is 29. Find the number.
- If one-third of a number exceeds its one-fourth by 1, find the number.
- The length of a rectangle is twice its breadth. If its perimeter is 60 cm, find the

length and the breadth of the rectangle.

4. Seven times a number is 12 less than thirteen times the same number. Find the number.
5. The present age of a son is half the present age of his father. Ten years ago, the father was thrice as old as his son. What are their present age?

Long Questions:

1. The sum of three consecutive multiples of 2 is 18. Find the numbers.
2. Each of the 2 equal sides of an isosceles triangle is twice as large as the third side. If the perimeter of the triangle is 30 cm, find the length of each side of the triangle.
3. A man travelled two-fifth of his journey by train, one-third by bus, one-fourth by car and the remaining 3 km on foot. What is the length of his total journey?

Assertion and Reason Questions:

1.) Assertion: if $x = 2$, $y = 1$ is a solution of the equation $2x + 3y = k$, then the value of k is 7.

Reason: the solution of the line will satisfy the equation of the line.

- a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion
- b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.
- c.) assertion is true but the reason is false.
- d.) both assertion and reason are false.

2.) Assertion: Expressions are formed by performing operations like addition, subtraction, multiplication and division on the variables.

Reason: $6x - 3$ is an expression in variable x .

- a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion
- b.) Both Assertion and Reason are correct and Reason is not the correct explanation for Assertion.
- c.) assertion is true but the reason is false.
- d.) both assertion and reason are false.

ANSWER KEY -

Multiple Choice Questions:

1. (a) $7x + 7 = 77$
2. (a) 16
3. (c) $x = 4$
4. (a) $6y - 6 = 60$
5. (c) 10
6. (c) -4
7. (c) 11
8. (a) $\frac{3}{4}t = 15$
9. (c) 5
10. (a) Two times of a number m is 7.
11. (b) $x = 6$
12. (d) None of these
13. (c) $6x - 6 = 60$
14. (c) 12
15. (b) 6

Very Short Answer:

1. (a) Let the number be x .

$$\text{Sum of } 4x \text{ and } 5 = 4x + 5$$

The sum is $5x$.

The equation is $4x + 5 = 5x$ as required.

- (b) Let the number be x .

$$\frac{1}{4}x = 5 + 2$$

$$\Rightarrow \frac{1}{4}x = 7 \text{ as required.}$$

2. (a) Five times a number x gives 20.
(b) Add 7 to three times a number y gives 1.

3. $k + 7 = 10$

$$\Rightarrow k = 10 - 7 = 3$$

Put $k = 3$ in $9k - 50$, we get

$$9 \times 3 - 50 = 27 - 50 = -23$$

Thus the value of $k = -23$

4.

$$(a) \frac{5z + 1}{3} = 7$$

$$\Rightarrow \frac{5z + 1}{3} \times 3 = 7 \times 3$$

(Multiplying both sides by 3)

$$\Rightarrow 5z + 1 = 21$$

$$\Rightarrow 5z = 21 - 1 \quad (\text{Transposing 1 to RHS})$$

$$\Rightarrow 5z = 20$$

$$\Rightarrow \frac{5z}{5} = \frac{20}{5} \quad (\text{Dividing both sides by 5})$$

$$\Rightarrow z = 4$$

Check: Put $z = 4$ in LHS

$$\frac{5 \times 4 + 1}{3} = \frac{20 + 1}{3} = \frac{21}{3}$$

$= 7$ RHS as required.

$$(b) \frac{5x}{3} + 3 = x + 7$$

$$\Rightarrow \frac{5x}{3} - x = 7 - 3 \quad (\text{Transposing 3 to RHS and } x \text{ to LHS})$$

$$\Rightarrow \frac{5x - 3x}{3} = 4$$

$$\Rightarrow \frac{2x}{3} = 4$$

$$\Rightarrow \frac{2x}{3} \times 3 = 4 \times 3 \quad (\text{Multiplying both sides by 3})$$

$$\Rightarrow 2x = 12$$

$$\Rightarrow \frac{2x}{2} = \frac{12}{2} \quad (\text{Dividing both sides by 2})$$

$$\Rightarrow x = 6$$

Check: Put $x = 6$ in LHS

$$\frac{5 \times 6}{3} + 3 = 10 + 3 = 13$$

Put $x = 6$ in RHS

$$6 + 7 = 13$$

$$\text{LHS} = \text{RHS}$$

Hence verified.

$$5. \quad 3(y - 2) = 2(y - 1) - 3$$

$$\Rightarrow 3y - 6 = 2y - 2 - 3 \quad (\text{Removing the brackets})$$

$$\Rightarrow 3y - 6 = 2y - 5$$

$$\Rightarrow 3y - 2y = 6 - 5 \quad (\text{Transposing 6 to RHS and } 2y \text{ to LHS})$$

$$\Rightarrow y = 1$$

Thus $y = 1$

Short Answer:

1. Let the required number be x .

Step I: $2x + 5$

Step II: $2x + 5 = 29$

Solving the equation, we get

$$2x + 5 = 29$$

$$\Rightarrow 2x = 29 - 5 \text{ (Transposing 5 to RHS)}$$

$$\Rightarrow 2x = 24$$

$$\Rightarrow x = 12 \text{ (Dividing both sides by 2)}$$

$$\Rightarrow x = 12$$

Thus the required number is 12.

2. Let the required number be x .

$$\therefore \frac{1}{3}x - \frac{1}{4}x = 1 \Rightarrow \frac{4x - 3x}{12} = 1$$

$$\Rightarrow \frac{x}{12} = 1 \Rightarrow \frac{x}{12} \times 12 = 1 \times 12$$

(Multiplying both sides by 12)

$$\Rightarrow x = 12$$

Thus, the required number is 12.

3. Let the breadth of the rectangle be x cm.

its length = $2x$

$$\text{Perimeter} = 2(\text{length} + \text{breadth}) = 2(2x + x) = 2 \times 3x = 6x$$

As per the condition of the question, we have

$$6x = 60 \Rightarrow x = 10$$

Thus the required breadth = 10 cm

and the length = $10 \times 2 = 20$ cm.

4. Let the required number be x .

$$7x = 13x - 12$$

$$\Rightarrow 7x - 13x = -12 \text{ (Transposing 13x to LHS)}$$

$$\Rightarrow -6x = -12$$

$$\Rightarrow x = 2$$

Thus, the required number is 2.

5. Let the present age of a father be x years.

Son's age = $\frac{1}{2}x$ years

10 years ago, father's age was $(x - 10)$ years

10 years ago, son's age was $\left(\frac{x}{2} - 10\right)$ years

As per the question, we have

$$x = 3\left(\frac{x}{2} - 10\right)$$

$$\Rightarrow x - 10 = \frac{3x}{2} - 30$$

Transposing 10 on RHS and $\frac{3x}{2}$ on LHS, we get

$$x - \frac{3x}{2} = 10 - 30$$

$$\frac{2x - 3x}{2} = -20$$

$$\frac{-x}{2} = -20$$

$$-x = -20 \times 2$$

$$-x = -40$$

$$x = 40$$

Thus, present age of father = 40 years

and age of son = $\frac{1}{2} \times 40 = 20$ years

Long Answer:

- Let the three consecutive multiples of 2 be $2x$, $2x + 2$ and $2x + 4$.

As per the conditions of the question, we have

$$2x + (2x + 2) + (2x + 4) = 18$$

$$\Rightarrow 2x + 2x + 2 + 2x + 4 = 18$$

$$\Rightarrow 6x + 6 = 18$$

$$\Rightarrow 6x = 18 - 6 \text{ (Transposing 6 to RHS)}$$

$$\Rightarrow 6x = 12$$

$$\Rightarrow x = 2$$

Thus, the required multiples are

$$2 \times 2 = 4, 4 + 2 = 6, 6 + 2 = 8 \text{ i.e., } 4, 6 \text{ and } 8.$$

- Let the length of the third side be x cm.

Each equal side = $2x$ cm.

As per the condition of the question, we have

$$\text{Perimeter} = x + 2x + 2x = 30$$

$$\Rightarrow 5x = 30$$

$$\Rightarrow x = 6$$

Thus, the third side of the triangle = 6 cm

and other two equal sides are $2 \times 6 = 12$ cm each

3. Let the total length of total journey be x km.

$$\text{Distance travelled by train} = \frac{2}{5}x \text{ km}$$

$$\text{Distance travelled by bus} = \frac{1}{3}x \text{ km}$$

$$\text{Distance travelled by car} = \frac{1}{4}x \text{ km}$$

Remaining distance = 3 km

As per the question, we have

$$x = \frac{2}{5}x + \frac{1}{3}x + \frac{1}{4}x + 3$$

$$\Rightarrow x - \frac{2}{5}x - \frac{1}{3}x - \frac{1}{4}x = 3$$

$$\Rightarrow \frac{60x - 24x - 20x - 15x}{60} = 3$$

[LCM of 5, 3 and 4 = 60]

$$\Rightarrow \frac{60x - 59x}{60} = 3$$

$$\Rightarrow \frac{x}{60} = 3$$

$$\Rightarrow x = 3 \times 60 = 180 \text{ km}$$

Thus, the required journey = 180 km.

Assertion and Reason Answers:

- 1) a) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion
- 2) a.) Both Assertion and Reason are correct and Reason is the correct explanation for Assertion