



- Linear Equation and its solution.
- Solution of linear equations $ax + b = cx + d$ ($a \neq c$) type.
- Solution of linear equations by cross-multiplication method.
- Numerical Problem based on linear equations.

6.1 Introduction

You have obtained knowledge related to algebraic expression and equation, in the previous class. You have read that equation is that condition on variables of the expression in which for specific value of expressions on both sides is equal. If power of variable used in the equation is one (1). Such equation is called linear equation.

Here, we will learn, the method of solving a such type of linear equation, whose variable (e.g. $ax + b = cx + d$) are in both sides, and $a \neq c$ besides this we will learn to solve some

linear equation/e.g. $\frac{ax+b}{cx+d} = k$, where $(cx + d \neq 0)$ by cross-multiplication method.

6.2 Linear equation

Come, we form equation taking some examples.

Example 1 : Mathematics teacher of class 7 Neelam said Dipti, “Suppose you have some money (amount). If Rs. 10 is added to 5 times of the amount. How much amount will you have? Dipti answered it will become Rs. 60.00 The teacher said, “show it in the form of an equation.”

Solution : Dipti said, “Suppose I have Rs. x ”

5 times of Rs. $x = \text{Rs. } 5x$

Therefore, the equation will be

$$5x + 10 = 60$$

Example 2 : The teacher said Ashish, “Ashish, whatever money you have do it ten (10) times and given me Rs. 20, what amount will be remained with you, Ashish answered. “I have Rs. 50 write it in the form of equations.

Solution : Let Ashish have Rs. x

10 times of $x = 10x$

On giving Rs. 20 to the teacher, the remaining amount is equal to Rs. 50

Therefore, the required equation will be $10x - 20 = 50$

Look, there is only one (1) power of the variable in the equation formed in these two examples and there is only one variable in these equations. Therefore, it is linear equation in one variable.

Try it:

Form linear equations from the following statements :

- (i) Sum of three times of a number and 11 is 32.
- (ii) There is 7 years less than 5 times of age of David that David's father. The age of father of David is 48 years.
- (iii) Sum of number x and 4 is 11.
- (iv) On subtracting 4 from one-fourth of a number x , 5 is obtained.
- (v) If 3 is added to one third of x , you get 25.

6.2.1 Solving linear equations, where in one side is expression and in other side is number.

Consider the equation $x + 3 = 7$

(Proper Method : On subtracting, adding multiplying or dividing equal number or term in both sides of the equation).

Here, we will subtract 3 from both sides to separate variable.

Example 1 :

$$x + 3 = 7$$

$$x + 3 - 3 = 7 - 3$$

$$x = 7 - 3$$

$$x = 4$$

This is the solution of the equation. Thus give attention on the following equation

$$x - 5 = 9.$$

in this equation 5 is to be added in both sides of the equation to separate the variable :

$$x - 5 + 5 = 9 + 5$$

$$x = 9 + 5$$

$$x = 14$$

In this way you will see in the next pages. How will you get the solution of the equation by multiplying or dividing by a non-zero number.

Try it :

Solve the following equations :

(i) $x + 2 = 4$

(ii) $5x = 20$

(iii) $\frac{x}{4} = 4$

6.2.2 Solving linear equations by transposition :

Transposition is called the method of taking number or letter number from one side of the equation to other side. Pay attention 3 is subtracted from both sides of the equation in example (1) and 5 is added in both sides in example (2). You have seen that the number which is added or subtracted, the number comes in another side with opposite sign.

So, far speeding the number of one side of the equation may be placed conveniently with opposite sign in another side of the equation. This operation is called as transposition.

Example 3 : Solve the equation $x + 5 = 3$.

Solution :

$$x + 5 = 3$$

On subtracting 5 from both sides

$$x + 5 - 5 = 3 - 5$$

or $x = 3 - 5$

Pay attention here, 5 of left hand side becomes as -5 in right hand side. This is called transposition.

or $x = -2$

To determine the value of x on solving any equation, same number is added or subtracted from both sides of the equation, there is change in side of number in the process.

It is clear from the above examples that in transposition sign $(+, -)$ of a term/number is changed into $(-, +)$ respectively.

Try it :

Solve the following equation by transposition :

(i) $x + 7 = 12$

(ii) $x - 5 = 8$

(iii) $x - 3 = -6$

**Any positive term becomes negative taking from one side to another.
Any negative term becomes positive taking from one side to another.**

Again, remember the equation formed by Dipti and Ashish.

Equation formed by Dipti is

$$5x + 10 = 60$$

...(i)

Equation formed by Ashish is

$$10x - 20 = 50$$

...(ii)

Solution (i) :

$$5x + 10 = 60$$

$$5x = 60 - 10 \text{ (by transposition)}$$

$$5x = 50$$

$$\frac{5x}{5} = \frac{50}{5} \quad (\text{Dividing by 5})$$

$$x = 10$$

Thus, Dipiti has Rs. 10

Solution (ii) :

$$10x - 20 = 50$$

$$10x = 50 + 20$$

$$10x = 70$$

$$x = \frac{70}{10} \quad (\text{Dividing by 10})$$

$$x = 7, \text{ Ashish had Rs. 7}$$

Example 4 : Solve the equation $\frac{x}{3} + \frac{5}{2} = -\frac{3}{2}$.

Solution : By transposing $\frac{5}{2}$ in right hand side

$$\frac{x}{3} = -\frac{3}{2} - \frac{5}{2}$$

$$\frac{x}{3} = -\frac{8}{2}$$

On multiplying by 3 in both sides

$$\frac{x}{3} \times 3 = -4 \times 3$$

$$x = -12$$

Verification :

$$\text{Left hand side} = \frac{x}{3} + \frac{5}{2}$$

$$= \frac{-12}{3} + \frac{5}{2}$$

$$= -4 + \frac{5}{2} = \frac{-8+5}{2}$$

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

= Right hand side

Try it :

Solve $\frac{15}{4} - 7x = 9$ and verify the answer.

Solve $\frac{3}{7} + x = \frac{17}{7}$ and verify the answer.

Solution of Linear equation $ax + b = cx + d$ ($a \neq c$) type :

Uptil now you have solved such equation in which there is a number in right hand side. But it is not necessary to be so always. There may be variable in both sides. For example in equation $3x - 5 = x + 3$, the variables are in both sides.

Now we will learn to solve such equations.

Example 5 : Solve $3x - 5 = x + 3$.

Solution : $3x - 5 = x + 3$

or $3x = x + 3 + 5$ (by transposition of -5)

or $3x - x = 8$ (by transposition of x)

or $2x = 8$

or $x = \frac{8}{2}$ (Dividing both sides by 2)

or $x = 4$.

Example 6 : Solve the equation $5x - 7 = x + 5$.

Solution : $5x - 7 = x + 5$

or $5x = x + 5 + 7$ (by transposing -7)

or $5x = x + 12$

or $5x - x = 12$ (by transposing x)

or $4x = 12$

or $\frac{4x}{4} = \frac{12}{4}$ (Dividing both sides by 4)

or $x = 3$

Verification : $5x - 7 = x + 5$

Right Hand Side (RHS) $= x + 5 = 3 + 5 = 8$

$$\begin{aligned}
 \text{Left Hand Side (LHS)} &= 5x - 7 &= 5 \times 3 - 7 \\
 &= 15 - 7 \\
 &= 8 \\
 &8 = 8
 \end{aligned}$$

or $LHS = RHS$

Therefore, solution obtained is correct.

Example 7 : Solve the equation $2(x - 1) = 10 - x$

Solution :

$$\begin{aligned}
 2(x - 1) &= 10 - x \\
 \text{or } 2x - 2 &= 10 - x && \text{(opening the bracket)} \\
 \text{or } 2x &= 10 - x + 2 && \text{(by transposing } -2) \\
 \text{or } 2x + x &= 10 + 2 && \text{(by transposing } -x) \\
 \text{or } 3x &= 12 \\
 \text{or } \frac{3x}{3} &= \frac{12}{3} && \text{(Dividing both sides by 3)} \\
 \text{or } x &= 4
 \end{aligned}$$

Verification : $2(x - 1) = 10 - x$

$$\begin{aligned}
 \text{LHS} &= 2(x - 1) & \text{RHS} &= 10 - x = 10 - 4 \\
 &= 2(4 - 1) = 2 \times 3 & &= 6 \\
 &= 6
 \end{aligned}$$

$\therefore LHS = RHS$

$\therefore$ Solution obtained is correct.

To solve linear equations : $ax + b = cx + d$ ($a \neq c$) type, variables are set on one side and constants are set on another side.

To solve the equation transforming into simplest form :

Example 8 : Solve the equation.

$$\frac{x-1}{4} + 2 = 1 + \frac{2x+3}{6}$$

Solution :

$$\frac{x-1}{4} + 2 = 1 + \frac{2x+3}{6}$$

$$\text{or } \frac{(x-1) \times 12}{4} + 2 \times 12 = 1 \times 12 + \frac{(2x+3) \times 12}{6} \quad \text{(multiplying both sides by LCM 12 of denominator 4, 6)}$$

by LCM 12 of denominator 4, 6)

$$\text{or } (x-1) \times 3 + 24 = 12 + (2x+3) \times 2$$

$$\text{or } 3x - 3 + 24 = 12 + 4x + 6$$

$$\text{or } 3x = 12 + 4x + 6 + 3 - 24 \quad \text{(by transposing } -3 \text{ and } 24)$$

$$\text{or } 3x = 4x - 3$$

$$\text{or } 3x - 4x = -3 \quad (\text{by transposing } 4x)$$

$$\text{or } -x = -3$$

$$\text{or } x = 3 \quad (\text{dividing both sides by } -1)$$

Verification :

$$\frac{x-1}{4} + 2 = 1 + \frac{2x+3}{6}$$

$$\text{or } \frac{3-1}{4} + 2 = 1 + \frac{2 \times 3 + 3}{6} \quad (\text{substituting } x = 3)$$

$$\text{or } \frac{2}{4} + 2 = 1 + \frac{9}{6}$$

$$\text{or } \frac{10}{4} = \frac{15}{6}$$

$$\text{or } \frac{5}{2} = \frac{5}{2}$$

LHS = RHS

Therefore solution obtained is correct.

Try it : Solve the following equations and verify the answer

$$(i) 4y + \frac{4}{5} = 21 \quad (ii) \frac{6y+1}{3} + 1 = \frac{7y-3}{3}$$

$$(iii) 0.6x + \frac{4}{5} = 0.28x + 1.16$$

Exercise – 6(a)

1. Solve the following equations and check your answer :

$$(i) 3x - 5 = 4$$

$$(ii) 5y + 2 = 3y + 8$$

$$(iii) 3x + 12 = 24$$

$$(iv) 6y - 9 = 2y + 15$$

$$(iv) 18 - 5y = 3y - 6$$

2. Solve the following equations and check the answer :

$$(i) \frac{x}{3} - 7 = 4$$

$$(ii) \frac{x}{3} + 2x = 14$$

$$(iii) \frac{x}{2} + \frac{x}{3} = 10$$

$$(iv) \frac{3x}{4} + \frac{x}{6} = 22$$

3. Solve the following equations and check the answer :

(i) $\frac{x-3}{5} + \frac{x-4}{7} = 6 - \frac{2x-1}{35}$

(ii) $\frac{x+3}{7} - \frac{2x-5}{3} = \frac{3x-5}{5} - 25$

(iii) $\frac{3y-2}{7} - \frac{5y-8}{4} = \frac{1}{14}$

(iv) $\frac{x+3}{2} - \frac{3x+1}{4} = \frac{2(x-2)}{3} - 2$

4. Solve the following equations :

(i) $1.5y - 7 = 0.5y$

(ii) $2.8x = 5.4 + x$

(iii) $0.5y + 0.2y = 0.3y + 2$

(iv) $0.16(5x - 2) = 0.4x + 7$

5. Solve the following equations and check the answer :

(i) $x + 2(x - 2) + 3x = 35$

(ii) $3x - 2(x - 5) = 2(x + 3) - 8$

(iii) $15(y - 4) - 2(y - 9) + 5(y + 6) = 0$

(iv) $7(3 - 2x) + 3(5 - 4x) = 45$

(v) $3(15 - 4x) + 5(3x - 7) = 15$

To solve the equation of the type

$\frac{ax+b}{cx+d} = k$, where $cx + d \neq 0$ by cross multiplication method.

Example : Solve $\frac{20x+6}{3x+2} = 6$.

Solution : Multiply by $(3x + 2)$ in both sides $\frac{20x+6}{3x+2} \times (3x+2) = 6(3x+2)$

or $20x + 6 = 18x + 12$

or $20x - 18x = 12 - 6$ (by transposition)

or $2x = 6$

or $\frac{2x}{2} = \frac{6}{2}$ (dividing both sides by 2)

or $x = 3$

Also solve this question in the following way :

$$\frac{20x+6}{3x+2} = 6$$

or $\frac{20x+6}{3x+2} \times \frac{6}{1} \quad \left(6 \text{ may be written as } \frac{6}{1} \right)$

Here as arrow shown in the equation numerator $(20x + 6)$ of LHS is multiplied by denominator 1 of RHS is to be done. Similarly, denominator of LHS is multiplied by numerator of RHS and the sign of equality $(=)$ is placed in between both multiplications. See

$$(20x+6) \times 1 = (3x+2) \times 6 \text{ (by cross-multiplication)}$$

$$20x+6 = 18x+12$$

or $20x - 18x = 12 - 6$ (by transposition on $18x$ and 6)

or $2x = 6$

or $\frac{2x}{2} = \frac{6}{2} \quad \text{(Dividing both sides by 2)}$

or $x = 3$

Check :

Putting the value of $x = 3$ in LHS

$$\begin{aligned} \text{LHS} &= \frac{20 \times 3 + 6}{3 \times 3 + 2} \\ &= \frac{60 + 6}{9 + 2} \\ &= \frac{66}{11} \\ &= 6 \\ &= \text{RHS} \end{aligned}$$

This method is called as cross multiplication method.

Example 9. Difference between two number is 44. When greater number is divided by smaller number, quotient is 5. Form the equation by this statement and solve the equation by cross-multiplication method.

Solution : Suppose small number is x .

Therefore, large number will be $x + 44$.

So according to the given condition.

$$\frac{x+44}{x} = 5$$

$$x + 44 = 5x \quad (\text{by cross multiplication})$$

$$x - 5x = -44 \quad (\text{by transposing } 44 \text{ and } 5x)$$

$$-4x = -44$$

$$x = 11$$

So, small number is 11 and large number

$$= 11 + 44 = 55$$

Check :

$$\text{Here } 55 - 11 = 44$$

$\therefore$ Difference between numbers is 44.

$$\frac{\text{Large number}}{\text{Small number}} = \frac{55}{11} = 5$$

Note it :

$$\frac{ax+b}{cx+d} = k \text{ is only possible, when } \frac{a}{c} \neq \frac{b}{d} \text{ and } cx+d \neq 0.$$

If $\frac{a}{c} = \frac{b}{d}$ and $cx + d \neq 0$ rational expression $\frac{ax+b}{cx+d}$ becomes constant and equation is not formed. See the following example for its verification.

For example :

$$\text{See } \frac{x-2}{3x-6} = \frac{2}{1}, \quad 3x-6 \neq 0 \text{ or } x \neq 2$$

$$\text{Here } \frac{x-2}{3x-6} = \frac{x-2}{3(x-2)} = \frac{1}{3}, \text{ because } x \neq 2$$

Try it :

Following equation is formed or not. If the equation is formed, solve them :

$$(i) \frac{3x+4}{6x+8} = 12$$

$$(ii) \frac{x+7}{2x-6} = 7$$

Exercise – 6(b)

1. If the numerator of a rational number is 3 less than its denominator. If 5 is added its numerator and denominator. The value of new number becomes $\frac{3}{4}$. Find out the number.
2. Solve by cross-multiplication method.
 - (i) $\frac{11x+7}{22x+13} = \frac{6}{7}$
 - (ii) $\frac{4+7x}{6x+2} = \frac{11}{12}$
 - (iii) $\frac{3}{4} = \frac{9+8x}{2x+6}$
3. The denominator of a fraction is 3 greater than its numerator. If 5 is added to both numerator and denominator, its value become $\frac{4}{5}$. Find the fraction.

Language problems based on linear equation

Fill in blanks on your exercise book in the following table.

Serial No.	Statement	Equation	Required Number
1.	Remainder is 13, subtracting 7 from a number.	$x - 7 = 13$	20
2.	Multiplication of a number and 9 is 36.		4
3.	Quotient is 3 on a number divided by 4.	$\frac{y}{4} = 3$	12
4.	Sum of a number and 12 is 20.		
5.	Dividing a number by 5, the quotient is obtained 6		
6.	Twice of a number is 20.	$2x = 20$	10
7.	One third of a number is 5.		
8.	7 less than thrice of a number is 6.		

Write following equations in the form of mathematical statements in your exercise book and find the number to satisfy it.

Serial No.	Equation	Statement	Proper Value (Required Number)
1.	$x + 5 = 9$	Sum becomes 9 after adding 5 in a number	
2.	$x - 1 = 9$		
3.	$5x = 30$		
4.	$\frac{x}{5} = 4$		

Application of simple equations in practical situations :

You have seen such examples in which statements in language of daily life is transferred in simple equations and to solve these equations. Thus corresponding equations are formed to obtain the solution of the problems related to practical situations. On solving the equation, solution of the problem is obtained.

Example 8 : The sum of thrice of a number and 12 is 72. Find the number.

Solution : Let the unknown number is x . Its three times will be $3x$. It is known from the question, sum of $3x$ and 12 is 72.

Implies that,

$$3x + 12 = 72$$

$$\text{or } 3x = 72 - 12$$

$$\text{or } 3x = 60$$

$$\text{or } \frac{3x}{3} = \frac{60}{3} \quad (\text{Dividing both sides by 3})$$

$$\text{or } x = 20$$

L.H.S.

$$\text{Check : } = 3 \times 20 + 12$$

$$= 60 + 12$$

$$= 72$$

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

$\therefore$ the required number is 20.

Now we will consider on some practical problems, which arises in relation of known and unknown quantities and it is expressed by verbal statements oftenly.

Example 10 : The remainder is 1 after subtracting 1 from one fourth of a number. Find that number.

Solution : Let that number be x .

$$\text{One-fourth of the number} = \frac{1}{4} \text{ of } x = \frac{x}{4}$$

According to question,

$$\frac{x}{4} - 1 = 1$$

$$\text{or } \frac{x}{4} = 1 + 1$$

$$\text{or } \frac{x}{4} = 2$$

$$\text{or } x = 2 \times 4$$

$$\text{or } x = 8$$

Check : Number is 8

$$\frac{1}{4} \text{ of the number} = \frac{1}{4} \times 8 = 2$$

$$1 \text{ subtracted from } \frac{1}{4} \text{ of the number} = 2 - 1 \\ = 1 = \text{given remainder.}$$

So, it is right solution.

Example 11 : Internal angles of a triangle are $3x^\circ$, $(2x + 20)^\circ$ and $(5x - 40)^\circ$. Prove that this an equilateral triangle.

Solution : The sum of the internal angles of a triangle is 180° , so

$$3x^\circ + (2x + 20)^\circ + (5x - 40)^\circ = 180^\circ$$

$$\text{or } 3x^\circ + 2x^\circ + 5x^\circ + 20^\circ - 40^\circ = 180^\circ$$

$$\text{or } 10x^\circ - 20^\circ = 180^\circ$$

$$\text{or } 10x^\circ = 180^\circ + 20^\circ$$

$$\text{or } 10x^\circ = 200^\circ$$

$$\text{or } x^\circ = 20^\circ$$

So, the three internal angles of a triangle will be respectively

$$3x^\circ = 3 \times 20^\circ = 60^\circ$$

$$(2x + 20)^\circ = 2 \times 20^\circ + 20^\circ = 40^\circ + 20^\circ = 60^\circ$$

$$(5x - 40)^\circ = 5 \times 20^\circ - 40^\circ = 100^\circ - 40^\circ \\ = 60^\circ$$

$\therefore$ All the three angles of the triangle are equal.

$\therefore$ This is an equilateral triangle.

Example 12 : A goods train started from a station at 9 AM with speed of 40 km per hour. An express train started from the same station at 10 AM, which catches that goods train at 12 noon on the day at another station. Find the speed of the express train.

Solution : Speed of goods train = 40 km per hour

Therefore during 9 AM to 12 noon *i.e.* in 3 hours, distance travelled by the goods train = 3×40 km = 120 km.

Suppose the speed of express train = x km/hr.

Therefore during 10 AM to 12 noon *i.e.* 2 hrs. distance covered by express train = $2x$ km.

According to question,

$$2x = 120$$

$$\text{or } \frac{2x}{2} = \frac{120}{2} \text{ (dividing by 2 in both sides)}$$

$$\text{or } x = 60$$

$\therefore$ Speed of express train = 60 km per hour.

Check :

Distance covered by goods train during 9 AM to 12 noon = 3×40 km = 120 km

Distance covered by express train during 10 AM to 12 noon = 2×60 km. = 120 km

So, the express train, catches goods train at 12 O'clock because distance covered by the both train is equal. From above mentioned examples, it is clear that solution of following type of problems related to daily life may be easily done with the help of simple equations.

1. Related to number

2. Related to age

3. Related to Geometry.
4. Related to time distance and speed.
5. Other question.

The following procedure is used to solve the equations.

- We recognize the problem reading carefully that what is to be found and what is known.
- Unknown quantity is expressed by x , y , z or any letter number.
- As possible every given verbal statement is changed into mathematical statement.
- We seek those quantities, who are like terms and again in place of quantities, we form equation writing proper expression.
- Finally equation is solved for unknown quantity.

In last answer is checked that solution satisfy the given condition or not.

In short, firstly we express problems in euqation. Them problem is solved with the help of equation.

Some problems related to daily life are solved by the equation in following examples.

Verbal question related to number.

Example 13. If the sum of two consecutive numbers is 7. Find those numbers.

Solution : Let first number be x

$$\therefore \text{Consecutive other number} = x + 1$$

$$\begin{aligned} \text{Sum of the consecutive numbers} &= x + x + 1 \\ &= 2x + 1 \end{aligned}$$

$$2x + 1 = 7$$

$$\text{or } 2x = 7 - 1$$

$$\text{or } x = \frac{6}{2}$$

$$\text{or } x = 3$$

$$\therefore \text{first number} = 3$$

$$\text{second number} = 3 + 1 = 4$$

BHASKARACHARYA FIRST

He was a resident of Sourashtra and a precious gem of disciple family of Aryabhat. He wrote comment on Aryabhat's Arybhattiya (499 A.D.) book/granth in 629 A.D. There are his two granths Mahabhaskariya and Laghubhaskariya. He has solved some linear eqautions related to Astrological question in the Mahabhaskariya granth.

Check :

$$\begin{aligned}\text{Sum of two consecutive numbers} &= 3 + 4 = 7 \\ &= \text{given sum.}\end{aligned}$$

$\therefore$ It is right solution.

Example 14. Sum of two consecutive even numbers is 10. Find numbers.

Solution :

$\therefore$ Let first number be $2x$

$\therefore$ Second consecutive even number $= 2x + 2$

$\therefore$ Sum of these two consecutive even numbers $= 2x + 2x + 2$

$\therefore$ According to question

$$2x + 2x + 2 = 10$$

$$\text{or } 4x = 10 - 2 \quad (\text{by transposition of } 2)$$

$$\text{or } x = \frac{8}{4} \quad (\text{dividing both sides by } 4)$$

$$\text{or } x = 2$$

$\therefore$ First even number $= 2x = 2 \times 2 = 4$

and Second even number $= 2x + 2 = 2 \times 2 + 2 = 6$

Check :

$$\text{Sum of these numbers} = 4 + 6 = 10$$

$\therefore$ **Solution is correct.**

Note that:

- (i) $2x - 3, 2x - 1, 2x + 1, 2x + 3$ consecutive odd numbers.
- (ii) $2x - 4, 2x - 2, 2x, 2x + 2, 2x + 4$, consecutive even numbers.

Example 15. Neha, Adarsh and Raziya have Rs. $2y$, $(2y + 1)$ and $(3y - 2)$ respectively. If all the three have total Rs. 27. What is amount of Adarsh ?

Solution :

Number of rupee of Neha $= 2y$

Number of rupee of Adarsh $= (2y + 1)$

Number of rupee of Raziya $= (3y - 2)$

Total number of rupees of all three $= 2y + 2y + 1 + 3y - 2$

So, according to question,

$$7y - 1 = 27$$

$$\text{or } 7y = 27 + 1 \quad (\text{by transposition of } -1)$$

$$\text{or } y = \frac{28}{7} \quad (\text{dividing both sides by } 7)$$

$$\text{or } y = 4$$

$$\begin{aligned} \therefore \text{Rupee of Adarsh} &= \text{Rs. } (2y + 1) \\ &= \text{Rs. } (2 \times 4 + 1) \end{aligned}$$

$$\therefore \text{Adarsh has Rs. 9.00}$$

Example 16. Prabodh Kumar gave $\frac{1}{3}$ part to his son, $\frac{1}{5}$ part to his daughter and remaining part to his wife. If the value of wife's part is Rs. 42,000, what was amount of Prabodh?

Solution : Let Prabodh Kumar's wealth be Rs. x .

$$\text{Son's part} = \frac{1}{3} \text{ of } x = \frac{x}{3}$$

$$\text{Daughter's part} = \frac{1}{5} \text{ of } x = \frac{x}{5}$$

$$\begin{aligned} \text{Wife's part} &= x - \left(\frac{x}{3} + \frac{x}{5} \right) \\ &= x - \frac{x}{3} - \frac{x}{5} \end{aligned}$$

$\therefore$ According to question

$$x - \left(\frac{x}{3} + \frac{x}{5} \right) = 42000$$

$$\text{or } \frac{15x - 5x - 3x}{15} = 42000$$

$$\text{or } \frac{7x}{15} = 42000$$

$$\text{or } x = 42000 \times \frac{15}{7} \quad \left(\text{Multiply both sides by } \frac{15}{7} \right)$$

$$\text{or } x = 90,000$$

So, **Prabodh Kumar** had wealth of **Rs. 90,000**

Exercise – 6(c)

1. Select right option :

(a) Product of a number and 7 is 28, the number is :

- (i) 5 (ii) - 4 (iii) 4 (iv) 7

(b) A number divided by 5, quotient is 7, the number is:

- (i) 5 (ii) 2 (iii) 35 (iv) 7

(c) If one odd number is $2x + 1$, another consecutive add number will be:

- (i) $2x + 2$ (ii) $2x + 3$ (iii) $2x$ (iv) $x + 1$

2. Some mathematical statements are expressed in the form of linear equations choose the correct equations.

(a) The difference between two third and one third of a positive number is 7:

$$\frac{1}{3}x - \frac{2}{3}x = 7$$

(b) Sum of any two consecutive numbers is 27 : $x + (x + 1) = 27$

(c) Sum of twice of a number and 8 is 27 : $2y + 8 = 50$

(d) 17 is added two third of a number sum is 19 : $\frac{2x}{3} + 17 = 19$

3. $\frac{1}{2}$ of a number is greater than $\frac{1}{4}$ of that number by 15. Find the number.

4. If a number is 4 greater than 7. Find the number.

5. There are 45 students in a class. If the number of students is $\frac{2}{3}$ of girl students. Find the number of girl students.

6. If remainder is 4 after subtracting $\frac{1}{4}$ part from $\frac{1}{3}$ part of the number. Find number.

7. The total weight of Adarsh David and Hameed is 44 kilogram. If weight of Davit is 1.3 kg more than weight of Adarsh and 2.1 kg more than Hameed. find their weight separately.
8. Sum of digits of a number having two digits is 4. If digit of unit is subtracted from digit of tens, remainder is 2. Find the number.
9. Sum of two consecutive numbers is 21. Find those numbers.
10. Sum of two consecutive even numbers is 30. Find those numbers.
11. Sum of two consecutive odd numbers is 40. Find those numbers.
12. Denominator of a fractional number is 7. If 3 is added to its numerator and denominator value of fraction becomes $\frac{4}{5}$. Find that fraction.

Question related to age

Example 17. Age of Suneel is 10 years more than his sister Asha. If 5 years ago, age of Suneel has been twice of age of Asha. Determine their present age separately.

Solution :

Let the present age of Suneel be x years

Age of Asha = $(x - 10)$ years

5 years before Suneel age = $(x - 5)$ years

5 years before Asha's age = $(x - 10 - 5)$ years
 $= (x - 15)$ years

$\therefore$ According to question

$$(x - 5) = (x - 15) \times 2$$

$$\text{or } x - 5 = 2x - 30$$

$$\text{or } x - 2x = -30 + 5$$

$$\text{or } -x = -25$$

$$\text{or } x = 25$$

$\therefore$ Suneel's present age = 25 years

and Asha's present age = $25 - 10 = 15$ years.

Check :

For first condition

$$\begin{aligned}\text{Suneel's age} - \text{Asha age} \\ &= (25 - 15) \text{ years} \\ &= 10 \text{ years.}\end{aligned}$$

For second condition

$$\begin{aligned}&5 \text{ years before ages of both} \\ &= (25 - 5) \text{ years and } (15 - 5) \text{ years respectively} \\ &= 20 \text{ years and } 10 \text{ years respectively}\end{aligned}$$

$$\text{Suneel's age of Asha's age } \frac{20}{10} = 2 \text{ times}$$

Solution obtained satisfy both conditions. So, solution is right.

Example 18. Salma is 10 years older than his sister Reshma. 4 years ago Salma's age was twice of Reshma. Find Salma's and Reshma's present ages.

Solution : Suppose Reshma's present age = x years

$$\therefore \text{Salma's present age} = (x + 10) \text{ years}$$

$$4 \text{ years ago Reshma's age} = (x - 4) \text{ years}$$

$$4 \text{ years ago Salma's age} = (x + 10 - 4) \text{ years} = (x + 6) \text{ years}$$

So, accordingly to question

$$(x + 6) = 2(x - 4)$$

$$\text{or } x + 6 = 2x - 8$$

$$\text{or } x - 2x = -8 - 6$$

$$\text{or } -x = -14$$

$$\text{or } x = 14$$

Reshma's age = 14 years

and Salma's age = $14 + 10 = 24$ years

Check :

For first condition

$$\begin{aligned}\text{Salma's age} - \text{Reshama's age} \\ &= (24 - 14) \text{ years} \\ &= 10 \text{ years}\end{aligned}$$

For second condition

$$\begin{aligned}&4 \text{ years before ages of both} \\ &= (24 - 4) \text{ years and } (14 - 4) \text{ years} \\ &= 20 \text{ years and } 10 \text{ years}\end{aligned}$$

$$\text{Salma's age was } \frac{20}{10} \text{ or } 2 \text{ times that of Reshma's age.}$$

Solution obtained satisfy both conditions. **So, solution is right.**

Exercise – 6(d)

1. The age of mother is five (5) times of his son. 8 years latter the age of mother will be 3 times of the age of son. Determine both's present age.
2. Abdul is 25 years smaller than his father. It 10 years before the age of father had been six times that of age of Abdul. What is present age of Abdul?
3. The age of mother is 5 years less than age of father. 10 years before ratio of ages of both was 5 : 6. Find present age of the mother.
4. Maya is 20 years older than his 5 years child. How many years later her age will be 3 times the age of child from now?

Questions Related to Geometry

Example 19. Equal sides of an isosceles triangle are $(2x + 3)$ cm and $(4x - 1)$ cm. If third side is $(3x - 2)$ cm. Find the value of x and perimeter of the triangle.

Solution : According to question

$$2x + 3 = 4x - 1$$

$$\text{or } 2x - 4x = -1 - 3$$

$$\text{or } -2x = -4$$

$$\text{or } \frac{-2x}{-2} = \frac{-4}{-2}$$

$$\text{or } x = 2$$

$$\therefore \text{First side of triangle} = (2x + 3) \text{ cm}$$

$$= (2 \times 2 + 3) \text{ cm} = 7 \text{ cm} = \text{Second equal side.}$$

$$\text{Third side} = (3x - 2) \text{ cm} = (3 \times 2 - 2) \text{ cm} = 4 \text{ cm}$$

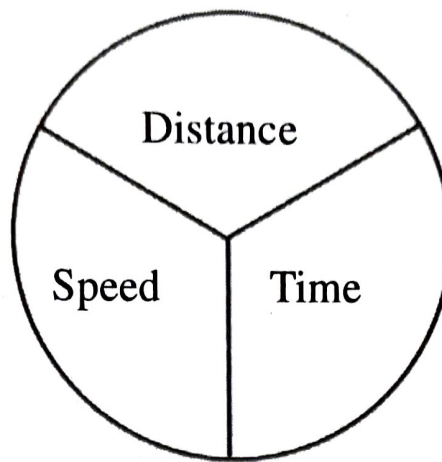
$$\therefore \text{Perimeter of triangle} = (7 + 7 + 4) \text{ cm.}$$
$$= 18 \text{ cm}$$

Exercise – 6(e)

1. The ratio of two acute angles is 7 : 11 of a right angled triangle. Find the values of angles.
2. Difference between two complementary angles is 20° . Find measure of such angles.
3. Difference between two supplementary angles is 40° . What is the measure of angles?
4. A rectangular field is surrounded by 190m long wire. If the length of the field is $1\frac{1}{2}$ times of its breadth. Find the measure of length and breadth separately.

Questions Related to Time, Distance and Speed :

To solve the problems related to time, distance and speed, following formulae are used :



1. **Distance = Speed $\times$ Time**

2. **Speed = $\frac{\text{Distance}}{\text{Time}}$**

3. **Time = $\frac{\text{Distance}}{\text{Speed}}$**

Questions are solved using units of distance, speed and time as km, km/hour and hour respectively or metre, m/sec and second respectively.

If it is not so, units are changed conveniently.

$$1 \text{ km} = 1000 \text{ m} \quad \text{or} \quad 1 \text{ m} = \frac{1}{1000} \text{ km}$$

$$1 \text{ km per hour} = \frac{5}{18} \text{ m per sec} \quad \text{or} \quad 1 \text{ m/s} = \frac{18}{5} \text{ km/hr.}$$

$$1 \text{ hour} = 3600 \text{ second} \quad \text{or} \quad 1 \text{ second} = \frac{1}{3600} \text{ hour.}$$

Example 20. A train, whose length is 270 metre. Crosses a pillar in 9 seconds. Determine its speed in km/hr.

Solution : Suppose its speed = x m/second

Train travels a distance equal to its length in 9 second

So, accordingly to question

$$x \times 9 = 270 \quad (\text{distance} = \text{speed} \times \text{time})$$

$$\text{or } x = \frac{270}{9}$$

$$\text{or } x = 30$$

$\therefore$ Speed of train = 30 m./sec.

$$= \frac{30 \times 18}{5} \text{ km/h.}$$

$$= 108 \text{ km/h.}$$

Example 21. A scooter traveller if drives with speed of 24 km/hr, he reaches the destination at 5 minutes late and if he drives with speed of 30 km/hr he reaches the destination 4 minutes before right time. Find distance of destination place.

Solution : Suppose, total distance of travelling = x km.

$$\text{Time 5 minute} = \frac{5}{60} \text{ hour} = \frac{1}{12} \text{ hour}$$

$$\text{and Time 4 minute} = \frac{4}{60} \text{ hour} = \frac{1}{15} \text{ hour}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

$$\text{Time taken to travel } x \text{ km distance with speed of 24 km/hr} = \frac{x}{24} \text{ hour.}$$

$$\text{According to question right time to reach destination place with equal speed} = \left(\frac{x}{24} - \frac{1}{12} \right) \text{ hour.}$$

$$\text{Similarly, time taken to reach the destination } x \text{ km with speed of 30 km/hr} = \frac{x}{30} \text{ hour.}$$

$$\text{Right time to reach the destination place with equal speed} = \left(\frac{x}{30} + \frac{1}{15} \right) \text{ hour.}$$

In above mentioned two circumstances on earvating right time obtained, we get

$$\frac{x}{24} - \frac{1}{12} = \frac{x}{30} + \frac{1}{15}$$

$$\text{or } \frac{x}{24} - \frac{x}{30} = \frac{1}{15} + \frac{1}{12}$$

$$\text{or } \frac{5x - 4x}{120} = \frac{4 + 5}{60}$$

$$\text{or } \frac{x}{120} = \frac{9}{60}$$

$$\text{or } 60x = 9 \times 120$$

$$\text{or } x = \frac{9 \times 120}{60}$$

$$\text{or } x = 18$$

So, distance of destination place = 18 km.

Exercise – 6(f)

1. A goods train, whose length is 450 m, crosses a pillar in 18 seconds. Determine speed of that goods train in km. per hour.
2. Adarsh, standing at distance of 1.3 km listens sound of explosion of the sphere 4 sec after the explosion. Find speed of sound in metre per second.
3. A person cover a distance of 15 km in 3 hours, in which some distance by walking and rest distance by running. If his speed in walking was 3 km per hour and in running 9 km per hour. What distance does he cover by running?
4. Nasreen goes to school from home with speed of 3 km per hour and returns with speed of 4 km/per hour. If she takes total 21 minute in going and coming. How far is the school from her home?
5. Sanjay reached the office 6 minutes late by cycle having speed 10 km per hour. If he increases his speed by 2 km per hour, he would have reached 6 minutes before. Find distance of the office from his home.
6. David's home is 19 km far from Hamid's home. He started their journey to reach their homes to 9 AM by cycle. If speed of Hamid 9 km per hour and that David's 10 km per hour. Where will they meet from Hamid's home and when?
7. The children of orphanage have been given healthy food at the rate 200 gm Dalia per child by the Government. If total 20 kg Dalia was distributed what was the number of children?

8. Total x kg apples has been distributed among children of the school on the occasion of fifteenth August. The cost of apple was Rs. m per kg. Fruit trader took less Rs. 10 per kg in honour of national festival. Show by equation of paid amount of Rs. 2000 of apple total cost.

Ability Exercise - 6

1. Solve the following equation :

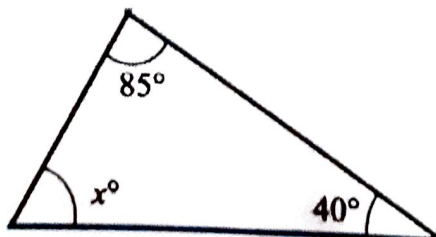
(a) $\frac{1}{3}x + 5 = 6$

(b) $0.6 - 1.2x + 3 = -3$

(c) $\frac{3}{7}x - 5 = 3 - \frac{x}{7}$

(d) $3(5x - 7) + 2(9x - 11) = 4(8x - 7) - 5$

2. The remainder is 18 on subtracting 3 times of a number from 5 times of the number. Find the number.
3. Sum of two consecutive odd number is 6 times of its difference. Find those numbers.
4. A person plucks some flowers from a garden. He distributes $\frac{1}{2}$ part of the flower to gardener, $\frac{1}{4}$ part to flower (vessel), $\frac{1}{6}$ part to his son $\frac{1}{18}$ part to his daughter and remaining 1 flower to his wife. How many flowers did he plucked?
5. Difference between the ages of Rabiya and Elvi is 2 years. If Rabiya's age is 6 years less than twice of Elvi's age. Find ages of both.
6. Father's age is 4 times of his son's age. 6 years later father's age will be 6 years more than $2\frac{1}{2}$ times of son's age. Find their present ages.
7. The length of a rectangle is 5 cm more than its breadth. If its perimeter is 26 cm., find its length.
8. One side of a parallelogram is $(2x - 1)$ cm and its opposite side is $(4x - 6)$ cm. Find the measurement of side.
9. Find the value of x in adjacent figure



10. A woman covers $(4x + 1)$ km distance in 5 hours by cycle. If her speed is $(x - 2)$ km per hour. Find distance travelled.
11. A girl covers 20 km distance in $2\frac{1}{2}$ hours. If she covers some distance by foot with speed of 5 km per hour and remaining distance by cycle with speed of 10 km per hour. Find distance covered by foot.
12. When Madhav goes to school with speed of 12 km per hour, he reaches 3 minutes late. But when he goes to school with speed of 16 km per hour, he reaches 2 minutes before. Find distance of the school from his house.

M.S.E.

13. Sum of two numbers is 710. When large number is divided by small number quotient is 12 and remainder 8. Large number will be : (2009)
- (a) 566 (b) 656
(c) 665 (d) 654
14. If $2y + z = 17$, $2z + x = 15$ and $2x + y = 10$, value of $x + y + z$ will be :
- (a) 42 (b) 39
(c) 41 (d) 14
15. On solving equation $\frac{x-b-c}{a} + \frac{x-c-a}{b} + \frac{x-a-b}{c} = 3$, value of x :
- (i) $(a - b + c)$ (ii) $(a + b + c)$
(iii) $(a + b - c)$ (iv) $(b + c - a)$

We learned in this unit :

- Equation is a condition on variable, in which value of expressions in both sides is always equal. There is no change in balance of the equation adding subtracting multiplying or dividing by same number in both sides.
- Process of representing any statement into equation is given.
- To solve any equation operation of addition, subtraction, multiplication and division is performed and find the value of variable conveniently.
- The solution of linear equation of type $ax + b = cx + d$ where $a \neq c$.
- To solve equation rapidly, one side or a part of the side of the equation is transferred to other side and solve the equation.

6. To solve the equation of type $\frac{ax+b}{cx+d} = k$, where $cx + d \neq 0$ by cross-multiplication method.
7. The relevant equation is formed to solve the practical problems relating to known and unknown quantities or variables. Solving these equations we get solution of the problems. These practical problems are mainly related to numbers, age, geometry, time, distance and speed.

Special BRAHMGUPTA

He was born in 598 AD in Bhilman Town of South Rajasthan. Duration of Brahmgupta was equivalent duration of ruling of king Harshvardhan. He wrote his famous books living in Ujjayini and worked related to Mathematics and Astrology (Jyotish). Brahmgupta is the first mathematician to use zero in Algebra. Many formulae have been given related to Arithmetic, Algebra and Geometry in his famous book (Granth) Brahmasphut Siddhant. Cube root, four methods of multiplication, square, cube, fraction, ratio, interest, zero infinity are expressed in Arithmetic part of the granth.

ANSWERS

Exercise – 6(a)

1. (i) 3, (ii) 3, (iii) 4, (iv) 6, (v) 3; 2. (i) 33, (ii) 6, (iii) 12, (iv) 24; 3. (i) 18, (ii) 25, (iii) 2, (iv) 5; 4. (i) - 7, (ii) 3, (iii) 5, (iv) 18.3; 5. (i) 6.5, (ii) 12, (iii) $\frac{2}{3}$, (iv) $-\frac{9}{26}$, (v) $\frac{5}{3}$.

Exercise – 6(b)

1. $\frac{4}{7}$, 2. (i) $-\frac{29}{25}$, (ii) $-\frac{13}{9}$, (iii) $-\frac{9}{13}$; 3. $\frac{7}{10}$

Exercise – 6(c)

1. (a) 4, (b) 35, (c) $2x + 3$; 2. (a) No, (b) Yes, (c) Yes, (d) Yes; 3. 60; 4. 11; 5. 27; 6. 48; 7. 14.5 kg, 15.8 kg, 13.7 kg; 8. 31; 9. 10, 11; 10. 14, 16; 11. 19, 21; 12. $\frac{5}{7}$

Exercise – 6(d)

1. 40, 8; 2. 15; 3. 35; 4. 5 years

Exercise – 6(e)

1. 35° , 55° ; 2. 35° , 55° ; 3. 70° , 110° ; 4. 57m, 38m

Exercise – 6(f)

1. 90 km per hr.; 2. 325 m/sec.; 3. 9 km; 4. 0.6 km; 5. 12 km; 6. 9 km, 10 o'clock;
7. 100 children; 8. $x(m - 10) = 2000$

Ability Exercise – 6

1. (a) 3, (b) 5.5, (c) 14, (d) 10; 2. 9; 3. 5, 7, 4. 36 flowers; 5. 10 year, 8 year; 6. 40 years, 10 years; 7. 9 cm; 10. 4 cm; 9. 55° ; 10. 45 km; 11. 5 km; 12. 4 km; 13. (b) 656;
14. (d) 14; 15. (ii) $(a + b + c)$

