Chapter 9
Linear Equations and Inequalities

Exercise 9.1

Question 1.
(i) 2 (3 – 2x) = 13
(ii) 3/5 y – 2 = 7/10
Solution:

(i) 2 (3 – 2x) = 13 (Remove group symbol)

6 – 4x = 13 (Transposing 6 to R.H.S.)

-4x = 13 – 6

-4x = 7

$x = \frac{7}{-4}$

(ii) $\frac{3}{5}y - 2 = \frac{7}{10}$

Multiplying both sides by 5, we get

$$3y - 10 = \frac{7}{10} \times 5$$

$$3y - 10 = \frac{7}{2}$$

$$3y = \frac{7}{2} + 10$$

(Transposing – 10 to R.H.S.)

$$3y = \frac{7 + 20}{2}$$

$$3y = \frac{27}{2}$$

$$y = \frac{27^{9}}{2 \times 3} = \frac{9}{2} = 4\frac{1}{2}$$

Question 2.

(*i*) $\frac{x}{2} = 5 + \frac{x}{3}$

(*ii*) $2\left(x - \frac{3}{2}\right) = 11$

Solution:

(*i*) $\frac{x}{2} = 5 + \frac{x}{3}$

Multiplying both sides by 6, we get

$$6 \times \frac{x}{2} = 6\left(5 + \frac{x}{3}\right)$$

$$3x = 30 + 2x$$

$3x - 2x = 30$ (Transposing $2x$ to L.H.S.)

$$x = 30$$

(*ii*) $2\left(x - \frac{3}{2}\right) = 11$

Removing group symbols,

$$2x - 3 = 11$$

$$\Rightarrow \quad 2x = 11 + 3$$

(Transposing – 3 to R.H.S)

$$\Rightarrow 2x = 14$$

$$x = \frac{14}{2} = 7$$

Question 3.

(i) $7(x - 2) = 2(2x - 4)$

(ii) $21 - 3(x - 7) = x + 20$

Solution:

(i) $7(x - 2) = 2(2x - 4)$

Removing group symbols,

$7x - 14 = 4x - 8$

$7x - 4x = -8 + 14$

(Transposing 4x to L.H.S. and -14 to R.H.S.)

$3x = 6$

$x = 2.$

(ii) $21 - 3(x - 7) = x + 20$

Removing group symbols,

$21 - 3x + 21 = x + 20$

$\Rightarrow 42 - 3x = x + 20$

$\Rightarrow -3x - x = 20 - 42$

(Transposing x to L.H.S. and 42 to R.H.S.)

$\Rightarrow -4x = -22$

$\Rightarrow x = \frac{22}{4} = \frac{11}{2} = 5\frac{1}{2}$

Question 4.

$$(i)\ 3x - \frac{1}{3} = 2\left(x - \frac{1}{2}\right) + 5$$

$$(ii)\ \frac{2m}{3} - \frac{m}{5} = 7$$

Solution:

$$3x - \frac{1}{3} = 2\left(x - \frac{1}{2}\right) + 5$$

Removing group symbols,

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

Multiplying both sides by 3, we get

$$9x - 1 = 6x - 3 + 15$$

$$9x - 1 = 6x + 12$$

$$9x - 6x = 12 + 1$$

(Transposing $6x$ to L.H.S and -1 to R.H.S)

$$3x = 13$$

$$x = \frac{13}{3} = 4\frac{1}{3}$$

(*ii*) $\frac{2m}{3} - \frac{m}{5} = 7$

Multiplying both sides by 15, LCM of 3 and 5,

$$15 \times \frac{2m}{3} - 15 \times \frac{m}{5} = 7 \times 15$$

$$10m - 3m = 105$$

$$7m = 105$$

$$m = \frac{105^{15}}{7} = 15$$

Question 5.

(*i*) $\frac{x+1}{5} - \frac{x-7}{2} = 1$

(*ii*) $\frac{3p-2}{7} - \frac{p-2}{4} = 2$

Solution:

(*i*) $\frac{x+1}{5} - \frac{x-7}{2} = 1$

Multiplying both sides by 10, we get

$$10 \times \frac{(x+1)}{5} - 10\frac{(x-7)}{2} = 1 \times 10$$

$$2x + 2 - 5x + 35 = 10$$

$$2x - 5x + 37 = 10$$

$$-3x = 10 - 37$$

$$-3x = -27$$

$$x = \frac{27}{3} = 9$$

(ii) $\frac{3p-2}{7} - \frac{p-2}{4} = 2$

Multiplying both sides by 28, we get

$$\frac{28(3p-2)}{7} - \frac{28(p-2)}{4} = 2 \times 28$$

$$4(3p-2) - 7(p-2) = 56$$

Removing group symbols,

$$12p - 8 - 7p + 14 = 56$$

$$5p + 6 = 56$$

$$5p = 56 - 6$$

$$5p = 50$$

$$p = \frac{50}{5} = 10$$

Question 6.

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

(ii) $\frac{2x-3}{6} - \frac{x-5}{2} = \frac{x}{6}$

Solution:

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

Removing group symbols,

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

Multiplying both sides by 6, L.C.M. of 2 and 3,

$$\frac{6}{2}x + \frac{30}{2} - \frac{6}{3}x + \frac{12}{3} = 4 \times 6$$

$$3x + 15 - 2x + 4 = 4 \times 6$$

$$x + 19 = 24$$

$$x = 24 - 19 = 5$$

(*ii*) $\frac{2x-3}{6} - \frac{x-5}{2} = \frac{x}{6}$

Multiplying both sides by 6, LCM of 6 and 2,

$$\frac{6(2x-3}{6} - \frac{6(x-5)}{2} = \frac{x}{6} \times 6$$

$$2x - 3 - 3x + 15 = x$$

$$2x - 3x + 12 = x$$

$$-x - x = -12$$

$$-2x = -12$$

x = 6

Question 7.

(*i*) $\frac{x-4}{7} - \frac{x+4}{5} = \frac{x+3}{7}$

(*ii*) $\frac{x-1}{5} + \frac{x-2}{2} = \frac{x}{3} + 1$

Solution:

(*i*) $\frac{x-4}{7} - \frac{x+4}{5} = \frac{x+3}{7}$

Multiplying both sides by 35, the L.C.M. of 7 and 5,

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

$$5x - 20 - 7x - 28 = 5x + 15$$

$$-2x - 48 = 5x + 15$$

$$-2x - 5x = 15 + 48$$

$$-7x = 63$$

$$x = \frac{63}{-7} = -9.$$

(*ii*) $\frac{x-1}{5}+\frac{x-2}{2}=\frac{x}{3}+1$

Multiplying both sides by 30, the L.C.M. of 5, 2 and 3,

$$\frac{30(x-1)}{5}+\frac{30(x-2)}{2}=\frac{30x}{3}+30$$

$$6x-6+15x-30=10x+30$$

$$21x-36=10x+30$$

$$21x-10x=30+36$$

$$11x=66$$

$$x=\frac{66}{11}=6$$

Question 8.
(i) y + 1.2y = 4.4
(ii) 15% of x = 21
Solution:

(*i*) $y+1.2y=4.4$

$$2.2y=4.4$$

$$y=\frac{4.4}{2.2}=\frac{44\times10}{10\times22}=2$$

(*ii*) 15% of $x=21$

$$\Rightarrow \quad \frac{15x}{100}=21 \Rightarrow \frac{3x}{20}=21$$

By cross multiplication, we have

$$3x=21\times20$$

$$3x=420$$

$$x=\frac{420}{3}=140.$$

Question 9.
(i) 2p + 20% of (2p – 1) = 7
(ii) 3 (2x – 1) + 25% of x = 97

Solution:

(*i*) $2p$ + 20% of $(2p - 1) = 7$

$$\Rightarrow 2p + \frac{20}{100} \times (2p - 1) = 7$$

$$\Rightarrow 2p + \frac{1}{5}(2p - 1) = 7$$

Multiplying both sides by 5, we get

$$5 \times 2p + \frac{5 \times 1(2p - 1)}{5} = 7 \times 5$$

$$10p + 2p - 1 = 35$$

$$12p = 35 + 1$$

$$12p = 36$$

$$p = \frac{36}{12} = 3$$

(*i*) $2p$ + 20% of $(2p - 1) = 7$

$$\Rightarrow 2p + \frac{20}{100} \times (2p - 1) = 7$$

$$\Rightarrow 2p + \frac{1}{5}(2p - 1) = 7$$

Multiplying both sides by 5, we get

$$5 \times 2p + \frac{5 \times 1(2p - 1)}{5} = 7 \times 5$$

$$10p + 2p - 1 = 35$$

$$12p = 35 + 1$$

$$12p = 36$$

$$p = \frac{36}{12} = 3$$

(*ii*) 3 (2x – 1) + 25% of x = 97

$$\Rightarrow \quad 6x - 3 + \frac{25}{100} \times x = 97$$

$$\Rightarrow 6x - 3 + \frac{1}{4}x = 97$$

Multiplying both sides by 4, we get

$24x - 12 + x = 97 \times 4$

$25x - 12 = 388$

$25x = 388 + 12$

$25x = 400$

$$x = \frac{400}{25} = 16$$

Question 10.
Find the value of p if the value of $x^4 - 3x^3 - px - 5$ is equal to 23 when x = -2.
Solution:

$x = -2$

$x^4 - 3x^3 - px - 5 = 23$

$\Rightarrow (-2)^4 - 3(-2)^3 - p(-2) - 5 = 23$

$\Rightarrow 16 + 24 + 2p - 5 = 23$

$\Rightarrow 35 + 2p = 23$

$\Rightarrow 2p = 23 - 35 = -12$

$\Rightarrow p = -6$

Exercise 9.2

Question 1.
If 7 is added to five times a number, the result is 57. Find the number.
Solution:

Let the number be x

Five times a number is = 5x

If 7 is added, it becomes 7 + 5x

According to given condition,

$7 + 5x = 57$

$\Rightarrow 5x = 57 - 7$

$\Rightarrow 5x = 50$

$\Rightarrow x = 10$

Question 2.
Find a number, such that one-fourth of the number is 3 more than 7.
Solution:

Let number = x

According to the condition,

$\frac{1}{4}x - 3 = 7$

$\frac{1}{4}x = 7 + 3 = 10$

$x = 10 \times 4 = 40$

Number = 40

Question 3.
A number is as much greater than 15 as it is less than 51. Find the number.
Solution:

Let the number be x

If it is greater than 15, it becomes x – 15.

If it is less than 51, it becomes 51 – x

According to statement,

$x - 15 = 51 - x$

$\Rightarrow x + x = 51 + 15$

$\Rightarrow 2x = 66$

$\Rightarrow x = 33$

Question 4.
If 12 is subtracted from a number and the difference is multiplied by 4, the result is 5. What is the number?
Solution:

Let the number = x

According to the condition,

$(x - \frac{1}{2}) \times 4 = 5$

$\Rightarrow 4x - 2 = 5$

$\Rightarrow 4x = 5 + 2$

$\Rightarrow 4x = 7$

$\Rightarrow x = \frac{7}{4}$

Number = $\frac{7}{4}$

Question 5.
The sum of two numbers is 80 and the greater number exceeds twice the smaller by 11. Find the numbers.
Solution:

Let the numbers be x and y

Smaller number = x

Greater number = y

If greater number exceeds twice the smaller by 11,

It becomes y = 2x + 11

According to statement,

$x + 2x + 11 = 80$

$\Rightarrow 3x + 11 = 80$

$\Rightarrow 3x = 80 - 11$

$\Rightarrow 3x = 69$

$\Rightarrow x = 23$

Smaller number = 23

Greater number = $2x + 11 = 2 \times 23 + 11 = 46 + 11 = 57$

Question 6.
Find three consecutive odd natural numbers whose sum is 87.

Solution:

Let the three consecutive odd natural numbers be

x, x + 2, x + 4.

According to statement,

x + x + 2 + x + 4 = 87

⇒ 3x + 6 = 87

⇒ 3x = 81

⇒ x = 27

x + 2 = 27 + 2 = 29 and x + 4 = 27 + 4 = 31

Three consecutive odd natural numbers are 27, 29 and 31.

Question 7.

In a class of 35 students, the number of girls is two-fifths of the number of boys. Find the number of girls in the class.

Solution:

Let the number of boys = x

The number of girls = $\frac{2x}{5}$

According to statement,

$$x + \frac{2x}{5} = 35 \Rightarrow \frac{5x + 2x}{5} = 35 \Rightarrow \frac{7x}{5} = 35$$

$$7x = 35 \times 5 \Rightarrow x = \frac{35 \times 5}{7} = 25.$$

$\therefore$ Number of boys $= x = 25$

$$\text{Number of girls} = \frac{2}{5}x = \frac{2}{5} \times 25 = 10$$

Question 8.

A chair costs ₹ 250 and the table costs ₹ 400. If a housewife purchased a certain number of chairs and two tables for ₹ 2800, find the number of chairs she purchased.

Solution:

Cost of a chair = ₹ 250

and cost of a table = ₹ 400

Let number of chairs = x

and number of tables = 2

Total cost = ₹ 2800

$x \times 250 + 2 \times 400 = 2800$

$\Rightarrow 250x + 800 = 2800$

$\Rightarrow 250\ x = ₹\ 2800 - ₹\ 800 = ₹\ 2000$

$\Rightarrow x = 8$

Number of chairs = 8

Question 9.

Aparna got ₹ 27840 as her monthly salary and over-time. Her salary exceeds the overtime by ₹ 16560. What is her monthly salary?

Solution:

Let Apama's monthly salary = ₹ x

Then over-time payment = ₹ (27840 − x)

According to the condition,

$x - (27840 - x) = 16560$

$\Rightarrow x - 27840 + x = 16560$

$\Rightarrow 2x = 16560 + 27840 = ₹\ 44400$

$\Rightarrow x = 22200$

Monthly salary = ₹ 22200

Question 10.

Heena has only ₹ 2 and ₹ 5 coins in her purse. If in all she has 80 coins in her purse amounting to ₹ 232, find the number of ₹ 5 coins.

Solution:

Total number of coins = 80

Let the number of ₹ 2 coins = x

The number of ₹ 5 coins = 80 − x

According to given statement,

$2x + 5 (80 - x) = 232$

$\Rightarrow 2x + 400 - 5x = 232$

$\Rightarrow -3x = 232 - 400$

$\Rightarrow -3x = -168$

$\Rightarrow x = 56$

Number of ₹ 5 coins = 80 − x = 80 − 56 = 24

Number of ₹ 5 coins = 24

Question 11.

A purse contains ₹ 550 in notes of denominations of ₹ 10 and ₹ 50. If the number of ₹ 50 notes is one less than that of ₹ 10 notes, then find the number of ₹ 50 notes.

Solution:

Total amount in a purse = ₹ 550

Let number of notes of ₹ 10 = x

The number of notes of ₹ 50 = x − 1

According to the condition,

$x \times 10 + (x - 1) \times 50 = 550$

$\Rightarrow 10x + 50x - 50 = 550$

$\Rightarrow 10x = 550 + 50 = 600$

$\Rightarrow x = 10$

50 rupees notes = 10 − 1 = 9

Question 12.

After 12 years, 1 shall be 3 times as old as I was 4 years ago. Find my present age.

Solution:

Let my present age = x years

After 12 years, I will be = (x + 12) years

and 4 years ago, I was = (x − 4) years

According to the condition,

$(x - 4) \times 3 = x + 12$

$\Rightarrow 3x - 12 = x + 12$

$\Rightarrow 3x - x = 12 + 12$

$\Rightarrow 2x = 24$

$\Rightarrow x = 12$

My present age = 12 years

Question 13.

Two equal sides of an isosceles triangle are 3x – 1 and 2x + 2. The third side is 2x units. Find x and the perimeter of the triangle.

Solution:

Two equal sides of an isosceles Δ are 3x − 1 and 2x + 2

$3x - 1 = 2x + 2$

$3x - 2x = 2 + 1$

$x = 3$

We know that

Perimeter of a $\Delta = (3x - 1) + (2x + 2) + (2x)$

$= (3 \times 3 - 1) + (2 \times 3 + 2) + (2 \times 3)$

$= (9 - 1) + (6 + 2) + (6)$

$= 8 + 8 + 6$

= 22 units

Question 14.

The length of a rectangle plot is 6 m less than thrice its breadth. Find the dimensions of the plot if its perimeter is 148 m.

Solution:

Let the breadth of a rectangle = x m.

Thrice its breadth = 3x m

Length of a rectangle = 3x − 6 m

Perimeter of a rectangle = 2 (l + b)

= 2 (3x − 6 + x)

= 2 (4x − 6)

= 8x − 12

But we are given, perimeter = 148 m

8x − 12= 148

8x = 148 + 12

8x = 160

x = 20 metres

Breadth = x = 20 metres

and Length = 3x − 6 = 3 × 20 − 6 = 60 − 6 = 54 metres.

Question 15.

Two complementary angles differ by 20°. Find the measure of each angle.

Solution:

We know that

Sum of measures of two complementary angles = 90°

⇒ x + y = 90° ..... (i)

But we are given x − y = 20° ..... (ii)

2x = 110° [On comparing (i) and (ii)]

⇒ x = 55°

Now, x + y = 90°

⇒ y = 90° − x

⇒ y = 90° − 55° = 35°

Exercise 9.3

Question 1.
If the replacement set is (- 5, – 3, – 1, 0, 1, 3, 4), find the solution set of:
(i) $x < -2$
(ii) $x > 1$
(iii) $x \geq -1$
(iv) $-5 < x < 3$
(v) $-3 \leq x < 4$
(vi) $0 \leq x < 7$.
Solution:

Replacement set = {-5, -3, -1, 0, 1, 3, 4}

(i) Solution set of $x < -2$ = {-5, -3}

(ii) Solution set of $x > 1$ = {3, 4}

(iii) Solution set of $x \geq -1$ = {- 1, 0, 1, 3, 4}

(iv) Solution set of $-5 < x < 3$ = {-3, -1, 0, 1}

(v) Solution set of $-3 \leq x < 4$ = {-3, -1,0, 1, 3}

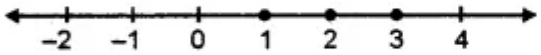
(vi) Solution set of $0 \leq x < 7$ = {0, 1, 3, 4}

Question 2.
Represent the following inequations graphically:
(i) $x \leq 3, x \in N$
(ii) $x < 4, x \in W$
(iii) $-2 \leq x < 4, x \in I$
(iv) $-3 \leq x \leq 2, x \in I$
Solution:

(i) Given $x \leq 3, x \in N$

The solution set = {1, 2, 3}

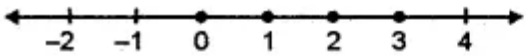
The solution set is shown by thick dots on the number line.



(ii) $x < 4, x \in W$

The solution set = {0, 1, 2, 3}

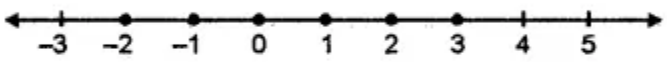
The Solution set is shown by thick dots on the number line.



(iii) $-2 \leq x < 4, x \in I$

The solution set = {-2, -1, 0, 1, 2, 3}

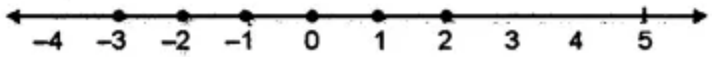
The graph of the solution set is shown by thick dots on the number line.



(iv) $-3 \leq x \leq 2, x \in I$

The solution set = {-3, -2, -1, 0, 1, 2}

The graph of the solution set is shown by thick dots on the number line.



Question 3.
Solve the following inequations.
(i) $4 - x > -2, x \in N$
(ii) $3x + 1 \leq 8, x \in W$
Also represent their solutions on the number line.
Solution:

(i) Given, $4 - x > -2$

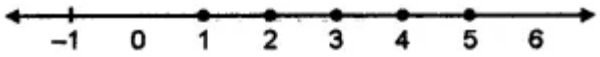
Subtract 4 from both sides

$\Rightarrow -4 + 4 - x > -2 - 4 - x > -6$

$\Rightarrow x < 6$ (Reverse the symbols)

As $x \in N$, the solution set = {1, 2, 3, 4, 5}

The graph of the solution set



(ii) Given $3x + 1 \leq 8$.

Subtracting -1 from both sides,

$3x + 1 - 1 \leq 8 - 1$

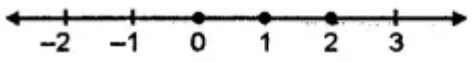
$3x \leq 7$

Dividing both sides by 3

$\Rightarrow x \leq \frac{7}{3}$

As x = W, the solution set = {0, 1, 2}

The graph of the solution set



Question 4.
Solve 3 – 4x < x – 12, x ∈ {-1, 0, 1, 2, 3, 4, 5, 6, 7}.
Solution:

Given 3 – 4x < x – 12

Subtracting 3 from both sides

⇒ -3 + 3 – 4x < x – 12 – 3

⇒ -4x < x – 15

Subtracting x from both sides

⇒ -4x – x < x – x – 15

⇒ -5x < -15 ⇒ x > 3

(Dividing by – 5 and reverse the symbols)

As x ∈ {-1, 0, 1, 2, 3, 4, 5, 6, 7}

The solution set = {4, 5, 6, 7}

Question 5.
Solve -7 < 4x + 1 ≤ 23, x ∈ I.
Solution:

Given, -7 < 4x + 1 ≤ 23.

We take -7 < 4x + 1 ≤ 23.

Subtracting -1 from all sides,

-7 – 1 < 4x + 1 – 1 ≤ 23 – 1

-8 < 4x ≤ 22

$\frac{-8}{4} < \frac{4x}{4} \leq \frac{22}{4}$ (Dividing by 4)

-2 < x ≤ 5.5

As x ∈ I, the solution set = {-1, 0, 1, 2, 3, 4, 5}.

Objective Type Questions

Question 1.
Fill in the blanks:
(i) A linear equation in one variable cannot have more than ..... solution.
(ii) If five times a number is 50, then the number is .....
(iii) The number 4 is the ..... of the equation $2y - 5 = 3$.
(iv) The equation for the statement '5 less than thrice a number x is 7' is .....
(v) ..... is a solution of the equation $4x + 9 = 5$.
(vi) If $3x + 7 = 1$, then the value of $5x + 13$ is .....
(vii) In natural numbers, $4x + 5 = -7$ has ..... solution.
(viii) In integers, $3x - 1 = 4$ has ..... solution.
(ix) $5x +$ ..... $= 13$ has the solution -3.
(x) If a number is increased by 15, it becomes 50. Then the number is .....
(xi) If 63 exceed another number by 21, then the other number is .....
(xii) If $x \in W$, then the solution set of $x < 2$ is .....
Solution:

(i) A linear equation in one variable

cannot have more than one solution.

(ii) If five times a number is 50, then the number is 10.

(iii) The number 4 is the solution of the equation $2y - 5 = 3$.

$\Rightarrow 2y = 3 + 5 = 8$

$\Rightarrow y = 4$

(iv) The equation for the statement '5

less than thrice a number x is 7' is $3x - 5 = 7$.

(v) -1 is a solution of the equation

$4x + 9 = 5$

$\Rightarrow 4x = 5 - 9 = -4$

$\Rightarrow x = -1$

(vi) If $3x + 7 = 1$

$\Rightarrow 3x = 1 - 2 - 6$

$\Rightarrow 3x = -6$

$\Rightarrow x = -2$

Then the value of $5x + 12$ is 3.

(vii) In natural numbers, 4x + 5 = -7 has no solution.

4x = -7 − 5

⇒ 4x = -12

⇒ x = -3

Which is not natural number.

(viii) In integers, 3x − 1 = 4

⇒ 3x = 4 + 1

⇒ 3x = 5 has no solution.

⇒ x = $\frac{5}{3}$ which is not an integer.

(ix) 5x + 28 = 13 has the solution -3.

5(-3) + ... = 13

-15 + ... = 13

Required number = 13 + 15 = 28

(x) If a number is increased by 15, it becomes 50.

Then the number is 35.

Let number = x, then number is 35

x + 15 = 50

⇒ x = 50 − 15 = 35

(xi) If 63 exceed another number by 21,

then the other number is 42.

Let number = x then other number = 63 − 21 = 42

(xii) If x ∈ W, then the solution set of x < 2 is x = {0, 1}.

Question 2.

State whether the following statements are true (T) or false (F):

(i) We can add (or subtract) the same number of expression to both sides of an equation.

(ii) We can divide both sides of an equation by the same non-zero number.

(iii) 3x – 5 = 2(x + 3) + 7 is a linear equation in one variable.

(iv) The solution of the equation 3(x – 4) = 30 is x = 6.

(v) The solution of the equation 3x – 5 = 2 is x = 73

(vi) The solution of a linear equation in one variable is always an integer.

(vii) 4x + 5 < 65 is not an equation.

(viii) 2x + 1 = 7 and 3x – 5 = 4 have the same solution.

(ix) 94 is a solution of the equation 5x – 1 = 8.

(x) If 5 is a solution of variable x in the equation 5x−72 = y, then the value of y is 18.

(xi) One-fourth of a number added to itself given 10, can be represented as x4 + 10 = x.
Solution:

(i) We can add (or subtract) the same number of expression to both sides of an equation. (True)

(ii) We can divide both sides of an equation by the same non-zero number. (True)

(iii) $3x - 5 = 2(x + 3) + 7$ is a linear equation in one variable. (True)

$3x - 5 = 2x + 6 + 7$

$\Rightarrow 3x - 2x = 6 + 7 + 5$

$\Rightarrow x = 18$

(iv) The solution of the equation $3(x - 4) = 30$ is $x = 6$. (False)

Correct:

$3(x - 4) = 30$

$\Rightarrow x - 4 = 10$

$\Rightarrow x = 10 + 4 = 14$

$x \neq 6$

(v) The solution of the equation $3x - 5 = 2$ is $\frac{7}{3}$ (True)

$3x - 5 = 2$

$\Rightarrow 3x = 2 + 5 = 7$

$\Rightarrow x = \frac{7}{3}$

(vi) The solution of a linear equation in one variable is always an integer. (False)

Correct:

It can be a rational number also.

(vii) $4x + 5 < 65$ is not an equation. (True)

It is an in eqaution.

(viii) $2x + 1 = 7$ and $3x - 5 = 4$
have the same solution. (True)
$2x + 1 = 7$
$\Rightarrow 2x = 6$
$\Rightarrow x = 3$
and $3x - 5 = 4$
$\Rightarrow 3x = 4 + 5 = 9$
$\Rightarrow x = 3$
(ix) $\frac{9}{4}$ is a solution of the equation $5x - 1 = 8$. (False)
Correct:
$5x - 1 = 8$
$\Rightarrow 5x = 8 + 1 = 9$
$\Rightarrow x = \frac{9}{5}$

(x) If 5 is a solution of variable x in the equation $\frac{5x-7}{2} = y$, then the value of y is 18. (False)

Correct :

If $x = 5$, then

$$\frac{5x-7}{2} = y \Rightarrow \frac{x \times 5 - 7}{2} = y \Rightarrow \frac{13}{2} = y$$

$\therefore y \neq 18$

(xi) One-fourth of a number added to itself given 10, can be represented as $\frac{x}{4} + 10 = x$. (False)

Correct :

Let number $= x$

$$x + \frac{1}{4}x = 10$$

$$\frac{5}{4}x = 10 \Rightarrow x = \frac{10 \times 4}{5} = 8$$

Multiple Choice Questions

Choose the correct answer from the given four options (3 to 17):
Question 3.

Which of the following is not a linear equation in one variable?
(a) $3x - 1 = 7$
(b) $5y - 2 = 3(y + 2)$
(c) $2x - 3 = 7/2$
(d) $7p + q = 3$
Solution:

$7p + q = 3$ is not a linear equation in one variable. (d)

Question 4.
The solution of the equation $13(2y - 1) = 3$ is
(a) 5
(b) 3
(c) 2
(d) 1
Solution:

Solution of $\frac{1}{3}(2y - 1) = 3$

$$\Rightarrow 2y - 1 = 3 \times \frac{3}{1} = 9$$

$$2y = 9 + 1 = 10$$

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

Question 5.
$x = -1$ is a solution of the equation
(a) $x - 5 = 6$
(b) $2x + 5 = 7$
(c) $2(x - 2) + 6 = 0$
(d) $3x + 5 = 4$
Solution:

$x = -1$

$2(x - 2) + 6 = 0$

$\Rightarrow 2(-1 - 2) + 6 = 0$

$\Rightarrow 2 \times (-3) + 6 = 0$

$\Rightarrow -6 + 6 = 0$ (c)

Question 6.
If $3(3n - 10) = 2n + 5$, then the value of n is
(a) 12
(b) 5

(c) 3
(d) -5
Solution:

$3(3n - 10) = 2n + 5$

$\Rightarrow 9n - 30 = 2n + 5$

$\Rightarrow 9n - 2n = 5 + 30$

$\Rightarrow 7n = 35$

$\Rightarrow n = 5$ (b)

Question 7.
-1 is not a solution of the equation
(a) $x + 1 = 0$
(b) $3x + 4 = 1$
(c) $5x + 7 = 2$
(d) $x - 1 = 2$
Solution:

$x - 1 = 2$

$\Rightarrow -1 - 1 \neq 2$

-1 is not solution of $x - 1 = 2$ (d)

Question 8.
The value of p for which the expressions $p - 13$ and $2p + 1$ become equal is
(a) 0
(b) 14
(c) -14
(d) 5
Solution:

$p - 13 = 2p + 1$

$\Rightarrow 2p - p = -13 - 1$

$\Rightarrow p = -14$ (c)

Question 9.
The equation which cannot be solved in integers is
(a) $5x - 3 = -18$
(b) $3y - 5 = y - 1$
(c) $3p + 8 = 3 + p$
(d) $9z + 8 = 4z - 7$

Solution:

$3p + 8 = 3 + p$

$\Rightarrow 3p - p = 3 - 8$

$\Rightarrow 2p = -5$

$\Rightarrow p = \frac{-5}{2}$

Which is not an integer. (c)

Question 10.
The solution of which of the following equations is neither an integer nor a fraction?
(a) $2x + 5 = 1$
(b) $3x - 7 = 0$
(c) $5x - 7 = x + 1$
(d) $4x + 7 = x + 2$
Solution:

$4x + 7 = x + 2$

$\Rightarrow 4x - x = 2 - 7$

$\Rightarrow 3x = -5$

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

Question 11.
If the sum of two consecutive even numbers is 54, then the smaller number is
(a) 25
(b) 26
(c) 27
(d) 28
Solution:

Let first even integer = 2x

Then second integer = 2x + 2

$2x + 2x + 2 = 54$

$\Rightarrow 4x = 54 - 2$

$\Rightarrow 4x = 52$

$\Rightarrow x = 13$

Smaller even integer = $2 \times 13 = 26$ (b)

Question 12.
If the sum of two consecutive odd numbers is 28, then the bigger number is
(a) 19

(b) 17
(c) 15
(d) 13
Solution:

Let first odd number = x

Then second = x + 2

x + x + 2 = 28

⇒ 2x = 28 − 2 = 26

⇒ x = 13

Bigger odd number = 13 + 2 = 15 (c)

Question 13.
If 5 added to thrice an integer is -7, then the integer is
(a) -6
(b) -5
(c) -4
(d) 4
Solution:

Let integer be x, then 3x + 5 = -7

⇒ 3x = -7 − 5

⇒ 3x = -12

⇒ 3x= -14

⇒ x = -4 (c)

Question 14.
If the length of a rectangle is twice its breadth and its perimeter is 120 m, then its length is
(a) 20 m
(b) 30 m
(c) 40 m
(d) 60 m
Solution:

Let breadth of a rectangle = x

Then length = 2x

Perimeter = 2(x + 2x) = 2 × 3x = 6x

6x = 120

⇒ x = 20

Length = 2x = 20 × 2 = 40 m (c)

Question 15.
If the difference of two complementary angles is 10°, then the smaller angle is
(a) 40°
(b) 50°
(c) 45°
(d) 35°
Solution:

Let first angle = x

Then its complementary angle = 90° − x

Now x − (90° − x) = 10°

⇒ x − 90° + x = 10°

⇒ 2x = 10° + 90° = 100°

⇒ x = 50°

Second angle = 90° − 50° = 40°

Smaller angle = 40° (a)

Question 16.
If the difference of two supplementary angles is 30°, then the larger angle is
(a) 60°
(b) 75°
(c) 90°
(d) 105°
Solution:

Let first supplementary angle = x

Then second = 180° − x

x − (180° − x) = 30°

⇒ x − 180° + x = 30°

⇒ 2x = 30° + 180° = 210°

⇒ x = 105°

Larger angle = 105° (d)

Question 17.
If $x \in W$, the solution set of the inequation $-2 \leq x < 3$ is
(a) {-2, -1,0, 1, 2}
(b) {-1, 0, 1, 2, 3}
(c) {0, 1, 2, 3}
(d) (0, 1, 2}

Solution:

$x \in W$

Solution set $-2 \leq x < 3 = \{-2, -1, 0, 1, 2\}$ (a)

Value Based Questions

Question 1.
On his 13th birthday, a boy decided to distribute blankets to the poor people instead of giving a party to his friends. Half of the blankets he distributed in an old age home, three fourths of the remaining in an orphanage and rest 20 were distributed to the roadside beggars. Find the number of blankets he had. What values are being promoted?
Solution:

Let the number of blankets = x

Blankets given to old age home = $\frac{x}{2}$

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

given orphanage = $\frac{3}{4}$ th of remaining $\frac{x}{2} = \frac{3x}{8}$

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

Rest to road side = $\frac{x}{8}$

$\frac{x}{8} = 20$

$\Rightarrow x = 20 \times 8 = 160$

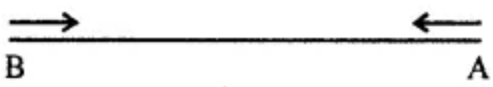
It is a noble cause to help the needy person instead of wasting in parties etc.

Higher Order Thinking Skills (HOTS)

Question 1.
Two persons start moving from two points A and B in opposite directions towards each other. One person start moving from A at a speed of 4 km/h and meets the other person coming from B after 6 hours. If the distance between A and B is 42 km, find the speed of the other person.

Solution:

Distance between A and B = 42 km



Speed of one person = 4 km/h

After 6 hours they meet together

Let speed of other person = x km/h

According to the condition,

$4 \times 6 + x \times 6 = 42$

$\Rightarrow 24 + 6x = 42$

$\Rightarrow 6x = 42 - 24 = 18$

$\Rightarrow x = 3$

Speed of other person = 3 km/h

Question 2.

There are some benches in the classroom. If 4 students sit on each bench then 3 benches remain empty and if 3 students sit on each bench then 3 students remain standing. Find the number of students in the class.

Solution:

Let number of benches in a classroom = x

Accorind to the condition,

No. of students = $(x - 3) \times 4$ and $x \times 3 + 3$

$(x - 3) \times 4 = x \times 3 + 3$

$\Rightarrow 4x - 12 = 3x + 3$

$\Rightarrow 4x - 3x = 3 + 12$

$\Rightarrow x = 15$

Number of benches = 15

and number of students = $15 \times 3 + 3 = 45 + 3 = 48$

Check Your Progress

Question 1.

Solve the following equations :

(i) $2(x - 5) + 3(x - 2) = 8 + 7(x - 4)$

(ii) $\frac{3(2x-5)}{4} - \frac{5(7-5x)}{6} = \frac{7x}{3}$.

Solution:

(i) 2 (x − 5) + 3 (x − 2) = 8 + 7 (x − 4)

Removing group symbols,

2x − 10 + 3x − 6 = 8 + 7x − 28

⇒ 5x- 16 = 7x − 20

⇒ 5x − 7x = − 20 + 16

(Transposing -16 to R.H.S and 7x to L.H.S)

⇒ -2x = -4

⇒ x = 2

(ii) $\frac{3(2x-5)}{4} - \frac{5(7-5x)}{6} = \frac{7x}{3}$

Multiplying both sides by 12, LCM of 4, 6 and 3

$$\frac{12\times3(2x-5)}{4} - \frac{5\times12(7-5x)}{6}$$

$$= \frac{12\times7x}{3}$$

$18x - 45 - 70 + 50x = 28x$

$68x - 115 = 28x$

$68x - 28x = 115$

$40x = 115$

$$x = \frac{115}{40} = \frac{23}{8} = 2\frac{7}{8}$$

Question 2.

A number exceeds its three-fifth by 22. Find the number.

Solution:

Let the number be x

Three-fifth of a number = $\frac{3}{5}$ x

According to statement,

$$x = \frac{3}{5}x + 22$$

$$x - \frac{3}{5}x = 22$$

$$\frac{5x - 3x}{5} = 22$$

$$\frac{2x}{5} = 22$$

$$x = \frac{22 \times 5}{2} = 55$$

Question 3.

When 9 is added to twice a number, the result is 3 more than thrice the number. Find the number.

Solution:

Let the number be x

Twice a number = 2x

Thrice a number = 3x

According to statement,

9 + 2x = 3 + 3x

⇒ 9 − 3 = 3x − 2x

⇒ 6 = x

⇒ x = 6

Question 4.

The ten's digit of a two digit number is twice the unit's digit. The sum of the number and its unit's digit is 66. Find the number.

Solution:

Let the unit's digit be x.

Ten's digit = 2x.

The number =10 × 2x + x = 20x + x

According to statement,

10 × 2x + x + x = 66

⇒ 20x + x + x = 66

⇒ 22x = 66

⇒ x = 3

The number = 20x + x = 20 × 3 + 3 = 60 + 3 = 63

Question 5.

A student bought some pens at ₹ 8 each and some pencils at ₹ 1.50 each. If the total number of pens and pencils purchased is 16 and their total cost is ₹ 50, how many pens did he buy?

Solution:

The total number of pens and pencils purchased = 16

Let the number of pens bought = x

The number of pencils bought = 16 − x

Cost of pens bought = 8x

Cost of pencils bought = 1.50 (16 − x)

According to given condition,

8x + 1.50 (16 − x) = ₹ 50

⇒ 8x + 24 − 1.50x = 50

⇒ 6.50x = 50 − 24

⇒ $x = \frac{26}{650} \times 100 = 4$

No. of pens bought = 4

Question 6.

Arvind is eight years older than his sister. In three years, he will be twice as old as his sister. How old are they now?

Solution:

Let the sister's age = x years

Arvind's age = (x + 8) years.

In three years, sister's age = (x + 3) years

In three years, Arvind's age = (x + 8 + 3) years

According to statement,

$x + 8 + 3 = 2(x + 3)$

$\Rightarrow x + 11 = 2x + 6$

$\Rightarrow x - 2x = 6 - 11$

$\Rightarrow -x = -5$

$\Rightarrow x = 5.$

Sister's age = 5 years

Arvind's age = 5 + 8 = 13 years.

Question 7.

The angles of a triangle are in the ratio 1 : 2 : 3. Find their measure in degrees.

Solution:

Let the angles of a Δ are x, 2x and 3x.

We know that

Sum of ∠s of a Δ is 180°

$x + 2x + 3x = 180°$

$\Rightarrow 6x = 180°$

$\Rightarrow x = 30°$

∠s of a Δ are

$1x = 1 \times 30° = 30°,$

$2x = 2 \times 30° = 60°,$

and $3x = 3 \times 30° = 90°$

Question 8.

Solve the following inequations and represent their solution on a number line:

(i) $\frac{2x-1}{3} \leq 2\frac{1}{2}, x \in \mathbf{W}$

(ii) $-1 < \frac{2x}{3} + 1 \leq 4, x \in \mathbf{I}$

Solution:

(*i*) Given $\frac{2x-1}{3} \le 2\frac{1}{2}$

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

Multiplying both sides by 6, we get

$\frac{6(2x-1)}{3} \le \frac{5\times 6}{2}$

$4x - 2 \le 15 \Rightarrow 4x \le 15 + 2$

$4x \le 17 \Rightarrow x \le \frac{17}{4}$

As $x \in \mathbf{W}$, the solution set = {0, 1, 2, 3, 4}

(*ii*) $-1 < \frac{2x}{3} + 1 \le 4,\ x \in \mathbf{I}$

Given $-1 < \frac{2x}{3} + 1 \le 4$

Multiplying by 3,

$-3 < 2x + 3 \le 12$

$-3 - 3 < 2x + 3 - 3 \le 12 - 3$ (Subtracting – 3)

$-6 < 2x \le 9$

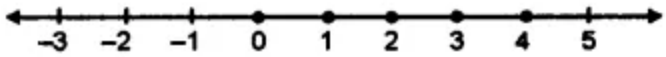
$\frac{-6}{2} < x \le \frac{9}{2}$ (Dividing by 2)

$-3 < x \leq \frac{9}{2}$

As $x \in \mathbf{I}$, the solution set

$= \{-2, -1, 0, 1, 2, 3, 4\}$

(*i*) The solution set is represented by thick dots on the number line.



(*ii*) The solution set is represented by thick dots on the number line.