# CHAPTER-9
# LINEAR EQUATIONS

## Students Learning Outcomes

**After studying this chapter, students will be able to:**

- Define a linear equation in one variable.
- Demonstrate different techniques to solve linear equations.
- Solve linear equations of the type:
  - $ax + b = c$,
  - $\frac{ax+b}{cx+d} = \frac{m}{n}$
- Solve real life problems involving linear equations.

## SOLVED EXERCISE 9.1

**1. Solve the following equations.**

**Solution:**

**(i)** $\frac{1}{8}x = 4$

$x = 4 \times 8 \Rightarrow \boxed{x = 32}$

**(ii)** $x - 7 = -15$

$x = -15 + 7$

$\boxed{x = -8}$

**(iii)** $x + 1 = 5$

$x = 5 - 1$

$\boxed{x = 4}$

**(iv)** $2x - 6 = 0$

$2x = 6$

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

$\boxed{x = 3}$

**(v)** $11x - 2 = 20$

$11x = 20 + 2$

$11x = 22$

$x = \frac{22}{11}$

**(ix)**

$2x = 8 \times 5$

$x = 20$

**(x)** $- 7 = 2$

$= 2 + 7 \Rightarrow = 9$

$x = 9 \times 3 \Rightarrow$

**(xi)** $= 10$

$5x = 2 \times 10 \quad \Rightarrow 5x = 20$

$x = \quad \Rightarrow$

**(xii)** $9x + 11 = 83$

$9x = 83 - 11 \quad \Rightarrow 9x = 72$

$x = \quad \Rightarrow$

**(xiii)** $= 7$

$x - 5 = 7 \times 4 \quad \Rightarrow x - 5 = 28$

$x = 28 + 5 \quad \Rightarrow$

**(xiv)** $- 2 = 5$

$= 5 + 2$

$x = 7 \times 4 \quad \Rightarrow$

**(vi)** $17x = 255$

$x = \frac{255}{17} \Rightarrow \boxed{x = 15}$

**(vii)** $5x - 3 = 12$

$5x = 12 + 3 \Rightarrow 5x = 15$

$\Rightarrow x=3$

**(viii)** $11 - x = 6$

$11 - 6 = x$

$X=5$

**(xv)** $= 19$

$7x + 3 = 19 \times 2$

$7x = 38 - 3 \quad \Rightarrow 7x = 35$

$x = \quad \Rightarrow$

**2. Find the solution of the following equations.**

**Solution:**

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

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

$2x = -2$

$X=1$

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

$8 - 2 = 5x - 3x$

$6 = 2x$

$3=x$

**(iii)** $12x - 3 = 5(2x + 1)$

$12x - 3 = 10x + 5$

$12x - 10x = 5 + 3$

$2x = 8$

$x = 4$

**(iv)** $10(2 - x) = 4(x - 9)$

$20 - 10x = 4x - 36$

$20 + 36 = 4x + 10x$

$56 = 14x \Rightarrow x = 4$

**(v)** $=$

$5(x - 3) = 3(x + 1)$

$5x - 15 = 3x + 3$

$5x - 3x = 3 + 15$

$2x = 18$

$x = 9$

**(vi)** $=$

$4(x - 2) = 3(x - 1)$

$4x - 8 = 3x - 3$

$4x - 3x = 8 - 3$

$X=5$

**(vii)**

$7(x - 2) = 1(3x + 4)$

$7x - 14 = 3x + 4$

$7x - 3x = 14 + 4$

$4x = 18$

$x = 9/2$

**(viii)** $= 1$

$5x - 2 = 3x - 8$

$5x - 3x = -8 + 2$

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

**(ix)**

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

$5x + 10 = 4x - 10$

$5x - 4x = -10 - 10$

$X=-20$

**(x)**

$(X)3(x + 3) = 2(x + 6)$

$3x + 9 = 2x + 12$

$3x - 2x = 12 - 9$

$X=3$

**(xi)**

$7x - 6 = x - 18$

$7x - x = -18 + 6$

$6x = -12$

$x = -2$

**(xii)**

$2(4x + 3) = 3(x + 7)$

$8x + 6 = 3x + 21$

$8x - 3x = 21 - 6$

$5x = 15$

$X=3$

## SOLVED EXERCISE 9.2

**1. Hussain bought 10 ice creams. He gave Rs. 1000 to the shopkeeper. The shop keeper returned him Rs. 250. For how much he buy one ice cream.**

**Solution:**

No of ice cream = 10

Total Amount = 1000 Rs.

Returned Amount = 250

Amount of Ice-creams = 1000 – 250

= 750 Rs.

Amount of one Ice-cream = 750 /10

= 75 Rs.

**2. The length of a rectangle is 2cm more than twice its breadth. If the perimeter of the rectangle is 28cm, find its length and breadth.**

**Solution:**

Let the breadth of rectangle = x

Length of rectangle = 2x + 2

Perimeter of rectangle = 28cm

2[Length + breadth] = perimeter

$2[2x + 2 + x] = 28$

$2(3x + 2) = 28$

$3x + 2 =$

$3x + 2 = 14$

$3x = 14 - 2$

$3x = 12$

$x =$

$x = 4cm$ => Breadth = 4 cm

Length of rectangle = 2x + 2

= 2(4) + 2

= 8 + 2 = 10cm

**3. The price of pen is Rs.42 and of notebook is Rs. 18. Calculate how many pens and notebooks you can buy for Rs. 480 if you want to buy an equal quantity of both.**

**Solution:**

Price of a pen = Rs. 42

Price of a notebook = Rs. 18

Total price of pen and notebook = 42 + 18 = 60Rs.

Total Amount = 480 Rs.

No of pens and notebook = = 8

Notebooks 8, pens = 8

**4. A father's age is twice his daughter's age but 16 years ago the father's age was 4 times his daughter's age. Calculate their ages.**

**Solution:**

Let the current age of father = x

Let the current age of daughter = y

16 years ago father's age was = x – 16

16 years ago daughter's age was = y – 16

Now by the given condition

16 years ago $x - 16 = 4(y - 16)$ ⟶ (i)

Present $x = 2y$ ⟶ (ii)

Put the values of x in eq (i)

$2y - 16 = 4(y - 16)$

$2y - 16 = 4y - 64$

$2y - 4y = 16 - 64$

$-2y = -48$

$y = 24$

years Age of daughter's

Put the value of y in eq (ii)

$x = 2(24)$

years Age of father

**5. Distribute an amount of Rs. 200 between Raheem and Usman such that Raheem gets Rs. 50 more than twice as much as Usman gets.**

**Solution:**

Suppose Amount of Raheem = R

Amount of Usman = U

$R + U = 200$ → (1)

$R = 50 + 2U$ → (2)

Put value of R in equal (1)

$50 + 2U + U = 200$

$50 + 3U = 200$

$3U = 150$

$U =$ = Rs. 50 => Usman gets = Rs. 50

$R = 50 + 2U = 50 + (2 \times 50) = 150$ => Raheem gets = Rs. 150

**6. The length of a marriage hall is 4 times as much as its breadth. If the perimeter of the hall is 240m, find the length and the breadth of the marriage hall.**

**Solution:**

Let the breadth of hall = x

Length of hall = 4x

Perimeter of hall = 240m

2(length + breadth) = perimeter

$2(4x + x) = 240$

$5x =$

$5x = 120$

$x = 24$

Breadth = 24m

Length = 4x = 4(24)

= 96m

**7. Aslam's age is half of his father's age but 15 years ago his age was just rd of father's age. Find his present age now.**

**Solution:**

Age of father = (x)

Age of Aslam = y

15 years ago

Acc. to first condition,

$x-15 = 3(y-15)$ _____ (1)

Present

Acc. to condition,

$X = 2y$ _____ (2)

Substitute in (1)

$2y - 15 = 3(y - 15)$

$2y - 15 = 3y - 45$

$45 - 15 = 3y - 2y$

$30 = y$ in (2)

$X = 2(30) = 60$

$X = 60$

**8. Distribute an amount of Rs. 500 among 2 brothers and I sister such that,**

**a. sister gets twice as much as brothers do.**

**b. each brother gets twice as much as the sister does.**

**Solution:**

(a) Let brother get = x

Then according to condition

Sister get = 2x

Then $2x + x + x$ = 500

$4x$ = 500

$x$ = 125

Each Brother get = Rs. 125

Sister get = 2x = $2 \times 125$ = Rs. 250

(b) Let Sister get = x

Then according to condition

Brother get = 2x

Then $x + 2x + 2x$ = 500

$5x$ = 500

$x$ = 100

Sister get = x = Rs. 100

Each Brother get = 2x = $2 \times 100$ = Rs. 200

## SOLVED REVIEW EXERCISE 9

**1. Answer the following question.**

**(i) What is a linear equation?**

**Answer:** An equation consisting of a polynomial of degree one is called a linear equation.

**(ii) What is meant by the solution of an equation?**

**Answer:** The process of finding the value of the variable that makes the equation true is called it solution.

$$x=\frac{-25}{5}\Rightarrow$$

(iv) $3(3x-1)-8\left(x+\frac{3}{2}\right)=0$

$9x-3-8x-12=0$

$x-15=0\Rightarrow$

(v) $\frac{5}{2}\left(\frac{3}{2}-\frac{2x}{1}\right)+\frac{3}{2}\left(\frac{2x}{1}-\frac{5}{2}\right)=0$

$\frac{5}{2}\left(\frac{3-4x}{2}\right)+\frac{3}{2}\left(\frac{4x-5}{2}\right)=0$

$\frac{15-20x}{4}+\frac{12x-15}{4}=0$

$\frac{15-20x+12x-15}{4}=0$

$-8x=0$

(vi) $\frac{2}{3}-\frac{2}{3}x=\frac{3}{2}x-\frac{1}{3}$

$\frac{2-2x}{3}=\frac{9x-2}{6}$

$6(2-2x)=3(9x-2)$

$12-12x=27x-6$

$12+6=27x+12x$

$18=39x$

$\frac{18}{39}=x\Rightarrow x=\frac{6}{13}$ )

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

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

$4-3x=5-5x$

$-3x+5x=5-4$

$2x=1\Rightarrow x=\frac{1}{2}$ )

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

$\frac{6x-2}{5}=2x-1$

$6x-2=10x-5$

$-2+5=10x-6x$

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

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

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

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

$12x-9=6x-6$

$12x-6x=9-6$

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

$x=\frac{1}{2}$ )

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

$\frac{x}{3}-1+\frac{2}{3}=\frac{4}{3}x-1+\frac{7}{2}$

$\frac{x-3+2}{3}=\frac{8x-6+21}{6}$

$$\frac{x-1}{3}=\frac{8x+15}{6}$$
$$24x+45=6x-6$$
$$24x-6x=-45-6$$
$$18x=-51$$
$$x=\frac{-51}{18}$$
$$x=\frac{-17}{6})$$

**5. Find the number.**

**(i) -3 added to a number is equal to 10.**

**Solution:**

Let the number is x

$$x+(-3)=10$$
$$x-3=10$$
$$x=10+3$$

**(ii) Three times a number is 15.**

**Solution:**

Let the number is x

$$3x = 15$$

**(iii) 13 subtracted from three times a number is 8.**

**Solution:**

Let the number is x

$$3x - 13 = 8$$
$$3x = 13 + 8$$
$$3x = 21$$
$$x =$$
$$\boxed{x=7}$$

**(iv) A number divided by 5 given 9 less than twice the number.**

**Solution:**

Let the number is x

$$= 2x - 9$$
$$x = 10x - 45$$
$$-9x = -45$$
$$x = \frac{45}{9}$$
$$\boxed{x=5}$$

**(v) The sum of three consecutive number is 45.**

**Solution:**

Let three consecutive numbers are $x, x + 1, x + 2$

$x + x + 1 = x + 2 = 45$

$3x + 3 = 45$

$3x = 42$

so numbers are 14, 15, 16