4

Linear Equations in Two Variables

Checkpoint (Page 48)

1. The value of x which satisfies the equation $4x - 8 = 0$ is

(*a*) $x = -2$ (*b*) $x = 2$

(*c*) $x = 4$ (*d*) $x = -8$

Sol. (*b*) $x = 2$

We have $4x - 8 = 0$

$\Rightarrow \quad x = \frac{8}{2} = 2$

which is the required value of x.

2. Three-fourth of a certain number is 27. The number is

(*a*) 36 (*b*) 54

(*c*) 18 (*d*) 20

Sol. (*a*) 36

Let the number be x. Then according to the problem, we have

$$\frac{3}{4}x = 27$$

$\Rightarrow \quad 3x = 4 \times 27$

$\Rightarrow \quad x = \frac{4 \times 27}{3} = 36$

3. The sum of two consecutive multiples of 6 is 78. One of them is

(*a*) 18 (*b*) 24

(*c*) 36 (*d*) 54

Sol. (*c*) 36

Let the lower multiple be x. Then the next higher multiple is $x + 6$. According to the problem,

$$x + (x + 6) = 78$$

$\Rightarrow \quad 2x = 78 - 6 = 72$

$\Rightarrow \quad x = \frac{72}{2} = 36$

4. If $3(x - 4) = 9$, then the value of x is

(*a*) 6 (*b*) 8

(*c*) 7 (*d*) 9

Sol. (*c*) 7

We have $3(x - 4) = 9$

$\Rightarrow \quad x - 4 = \frac{9}{3} = 3$

$\Rightarrow \quad x = 3 + 4 = 7$

5. The value of y for which $\frac{3y+2}{y+3} = 1$ is

(*a*) $y = 1$ (*b*) $y = \frac{1}{2}$

(*c*) $y = 2$ (*d*) $y = 3$

Sol. (*b*) $y = \frac{1}{2}$

We have $\frac{3y+2}{y+3} = 1$

$\Rightarrow \quad 3y + 2 = y + 3$

$\Rightarrow \quad 3y - y = 3 - 2$

$\Rightarrow \quad 2y = 1$

$\Rightarrow \quad y = \frac{1}{2}$

6. Solve the following equation

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

Sol. We have

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

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

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

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

which is the required solution.

7. The sum of the digits of two-digit number is 15. If 9 is added to the number, the digits are interchanged. Find the number.

Sol. Let the digit in the unit's place be x. Then the digit in the ten's place is $15 - x$.

$\therefore$ According to the problem, we have

$$9 + x + 10(15 - x) = 15 - x + 10x$$
$$\Rightarrow \quad 9 + x + 150 - 10x = 15 + 9x$$
$$\Rightarrow \quad 10x + 9x - x = 159 - 15$$
$$\Rightarrow \quad 18x = 144$$
$$\Rightarrow \quad x = \frac{144}{18} = 8$$

The digit in the unit's place is 8 and that in the ten's place is $15 - 8 = 7$.

$\therefore$ The required number is 78.

8. If $x = \frac{-3}{2}$ and $y = \frac{-5}{7}$ is a solution of the equations $2x + 3k_1 = 0$ and $7y - 5k_2 = 0$, find the values of k_1 and k_2.

Sol. Since $x = \frac{-3}{2}$ and $y = \frac{-5}{7}$ is the solution of the equations $2x + 3k_1 = 0$ and $7y - 5k_2 = 0$ respectively, hence, we have

$$2 \times \left(\frac{-3}{2}\right) + 3k_1 = 0$$
$$\Rightarrow \quad -3 + 3k_1 = 0$$
$$\Rightarrow \quad k_1 = 1$$
$$\text{and} \quad 7 \times \left(\frac{-5}{7}\right) - 5k_2 = 0$$
$$\Rightarrow \quad -5 - 5k_2 = 0$$
$$\Rightarrow \quad k_2 = -1$$

Hence, the required values of k_1 and k_2 are 1 and –1 respectively.

9. The width of a rectangle is $\frac{2}{3}$ of its length. If the perimeter is 100 units, find the dimensions of the rectangle.

Sol. Let the length of the rectangle be l units. Then its width is $\frac{2l}{3}$ units.

$\therefore$ Perimeter of the rectangle $= 2\left(l + \frac{2l}{3}\right)$ units

$$= 2 \times \frac{5l}{3} \text{ units.}$$

$\therefore$ According to the problem,

$$2 \times \frac{5l}{3} = 100 \text{ units}$$
$$l = \frac{100 \times 3}{10} \text{ units} = 30 \text{ units}$$
$$\therefore \quad b = \frac{2l}{3}$$
$$= \frac{2 \times 30}{3} \text{ units} = 20 \text{ units}$$

$\therefore$ The required length is 30 units and width is 20 units

10. I have collected coins in a piggy bank. The day I opened it, I found I had 3 times as many 50 paise coins as one rupee coins. The total amount in the piggy bank is ₹ 150. How many coins of each kind are there?

Sol. Let the number of ₹1 coins be x. Then the number of 50 paisa coins be $3x$.

$\therefore$ According to the problem

$$x + 3x \times \frac{50}{100} = 150$$
$$\Rightarrow \quad x + \frac{3x}{2} = 150$$
$$\Rightarrow \quad \frac{5x}{2} = 150$$
$$\Rightarrow \quad x = 150 \times \frac{2}{5} = 60$$

The required number of ₹ 1 coins is 60 and that of 50 paisa coins is 60×3, i.e. 180.

Check Your Progress

(Page 51)

Multiple-Choice Questions

1. The linear equation $3x - 7y = 11$ has

(*a*) a unique solution.
(*b*) two solutions.
(*c*) infinitely many solutions.
(*d*) no solution.

Sol. (*c*) infinitely many solutions.

2. The condition that the equation $ax + by + c = 0$ represents the linear equation in two variables is

(*a*) $a \neq 0, b = 0$ (*b*) $b \neq 0, a = 0$
(*c*) $a = 0, b = 0$ (*d*) $a \neq 0, b \neq 0$

[CBSE SP 2011]

Sol. (*d*) $a \neq 0, b \neq 0$

We know that a linear equation in two variables contain both x and y.

Hence, in $ax + by + c = 0$, we must have $a \neq 0$ and $b \neq 0$.

3. If the line $2x + 3y = 2k$ where k is a constant, passes through the point $(-1, 2)$, then the value of k is

(*a*) 4 (*b*) 2

(*c*) 1 (*d*) $\frac{1}{2}$

Sol. (*b*) 2

If the line $2x + 3y = 2k$ passes through the point $(-1, 2)$, then $x = -1$ and $y = 2$ must satisfy this equation.

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

$\Rightarrow \qquad k = 2$

4. The cost of entry ticket to a show for an adult is ₹ 7 more than the twice the cost of the ticket for a child. The cost of adult ticket is y while that of a child is x. Which of the following equations relate the cost y in terms of cost x?

(*a*) $y = 7 + 2x$ (*b*) $y + 7 = 2x$

(*c*) $y = 2 + 7x$ (*d*) $y + 2 = 7x$

Sol. (*a*) $y = 7 + 2x$

5. Any solution of the linear equation $3x + 0y + 7 = 0$ in two variables is of the form

(*a*) $\left(\frac{-7}{2}, a\right)$ (*b*) $\left(b, \frac{-7}{2}\right)$

(*c*) $\left(0, \frac{-7}{2}\right)$ (*d*) $\left(\frac{-7}{3}, 0\right)$

Sol. (*d*) $\left(\frac{-7}{3}, 0\right)$

Very Short Answer Type Questions

6. Show that $(3, -1)$ is not a solution of $3x - 5y = 9$.

Sol. Putting $x = 3$ any $y = -1$ in the equation $3x - 5y = 9$. We see that LHS $= 3 \times 3 - 5 \times (-1) = 14 \neq$ RHS

$\therefore$ $(3, -1)$ is not a solution of $3x - 5y = 9$.

7. Write any two different solutions of the equation $2x + 3y = 0$.

Sol. We see that $x = 0$ and $y = 0$ or $x = 3$, $y = -2$ satisfy the given equation. Hence, any two solutions of the given equation are $x = 0$, $y = 0$ and $x = 3$, $y = -2$.

(Note that there may be many other solutions also).

8. Verify that $x = \frac{22}{7}$, $y = \frac{127}{35}$ is a solution of the equation $-8x + 5y + 7 = 0$.

Sol. LHS $= -8x + 5y + 7 = -8 \times \frac{22}{7} + 5 \times \frac{127}{35} + 7$

$$= -\frac{176}{7} + \frac{127}{7} + 7$$

$$= \frac{-176 + 127 + 49}{7}$$

$$= \frac{-176 + 176}{7}$$

$$= 0$$

$$= \text{RHS}$$

$\therefore\ x = \frac{22}{7}$ and $y = \frac{127}{35}$ is a solution of the given equation.

9. Express $5y - 8x = 7(x + y) - 9$ in the form of $ax + by + c = 0$.

Sol. $5y - 8x = 7(x + y) - 9$

$\Rightarrow \qquad 5y - 8x = 7x + 7y - 9$

$\Rightarrow \qquad 7x + 7y - 5y + 8x - 9 = 0$

$\Rightarrow \qquad 15x + 2y - 9 = 0$

10. A person deposits a particular sum of money in his savings account in a Bank. He earns an interest of ₹ 200 every month. Let the interest earned by ₹ y after x months be ₹ 5000. Express the above statement in the form of linear equation in two variables.

Sol. Interest = ₹ 200 per month

No. of months = x

$\Rightarrow \qquad y + 200x = 5000$

Short Answer Type Questions

11. For what value of k, the linear equation $2x + ky = 8$ has equal values of x and y for its solution.

Sol. $2x + ky = 8$

For equal values of x and y, the above equation reduces to

$$2x + kx = 8$$

$\Rightarrow \qquad k = \frac{8 - 2x}{x}$

12. Find the value of 'p' if $(-p, 3)$ is a solution of equation $4x + 9y - 3 = 0$.

Sol. $(-p, 3)$ is a solution of the equation $4x + 9y - 3 = 0$

$\Rightarrow \qquad 4 \times -p + 9 \times 3 - 3 = 0$

$\Rightarrow \qquad -4p + 27 - 3 = 0$

$\Rightarrow \qquad -4p + 24 = 0$

$\Rightarrow \qquad -4p = -24$

$\Rightarrow \qquad p = 6$

13. Ankita took a taxi to go the market. The taxi fare is as follows:

For the first kilometre, the fare is ₹ 100. For the subsequent distance, the rate is ₹ 20 per kilometre. Form a linear equation in two variables by taking distance covered as x km and total fare as ₹ y. If the total distance covered was 20 km, then find the total fare Ankita has to pay.

Sol. $y = 100 + (x - 1) \times 20$

$\Rightarrow \quad y = 100 + 20\,(x - 1)$

When distance covered is 20 km, Ankita has to pay

$$= 100 + 20\,(20 - 1)$$
$$= 100 + 380$$
$$= ₹\ 480$$

14. Let y varies directly as x. If $y = 15$ when $x = 3$, then write a linear equation. What is the value of y, when $x = 4$?

Sol. $y \propto x$

$\Rightarrow \quad y = kx,$

when k is constant of proportionality $y = 15$, then $x = 3$

$\Rightarrow \quad 15 = k \cdot 3$

$\Rightarrow \quad k = \frac{15}{3} = 5$

Value of y when $x = 4$

The equation is $y = 5x$

Putting the value of $x = 4$

$\therefore \quad y = 5 \times 4 = 20$

$\Rightarrow \quad y = 20$

Long Answer Type Questions

15. In an election 60% of the voters cast their votes. Form an equation with this data. From the equation, find

(*a*) the total number of voters if 2,100 voters cast their votes and

(*b*) the number of votes cast if the total number of voters are 10,000.

Sol. Let x be the total number of voters. According to the problem, $\frac{60x}{100}$ voters $= \frac{3x}{5}$ voters cast their votes. Let y be the number of voters who cast their votes.

$\therefore$ We have $\quad y = \frac{3x}{5}$

(*a*) If $y = 2100$, then $\quad x = \frac{5y}{3}$

$$= \frac{5}{3} \times 2100 = 3500$$

Total number of voters = 3500

(*b*) If $\quad x = 10000$

then $\quad y = \frac{3}{5} \times 10000 = 6000$

Out of 10000 voters, only 6000 cast their votes in this case.

16. The population of a small city is 12,000. The ratio of the female and male is 5 : 7. Set up an equation between the population and females. From the equation, find the number of females in the city.

Sol. Let x be the total population of the city and y be the number of females. Then the number of males $= x - y$.

$\therefore$ According to the problem,

$$y : x - y = 5 : 7$$

$\Rightarrow \quad \frac{y}{x - y} = \frac{5}{7}$

$\Rightarrow \quad 7y = 5x - 5y$

$\Rightarrow \quad 12y = 5x$

$\Rightarrow \quad y = \frac{5x}{12} \qquad \ldots(1)$

(1) is the equation between the number of population and the number of females.

Now, when $x = 12000$, then from (1), we see that

$$y = \frac{5}{12} \times 12000 = 5000$$

Hence, the required number of females = 5000.

17. To convert Celsius to Fahrenheit, we use the following linear equation.

$$F = \frac{9}{5}C + 32$$

(*a*) If the temperature is 0°C, what is the temperature in Fahrenheit?

(*b*) What is the numerical value of temperature which is same in both the scales?

(*c*) If the temperature is 40°C, what is the temperature in Fahrenheit.

Sol. (*a*) $F = \frac{9}{5}C + 32$

When temperature is 0°C,

$$F = \frac{9}{5} \times 0 + 32$$

$$F = 32°$$

(*b*) When F = C

$$F = \frac{9}{5}F + 32$$

$$\Rightarrow \quad F - \frac{9}{5}F = 32$$

$$\Rightarrow \quad \frac{5F - 9F}{5} = 32$$

$$\Rightarrow \quad -\frac{4}{5}F = 32$$

$$\Rightarrow \quad F = -\frac{5}{4} \times 32$$

$$\Rightarrow \quad F = -40°$$

At –40°, F = C

(*c*) When C = 40°

$$F = \frac{9}{5} \times 40 + 32$$

$$\Rightarrow \quad F = 72 + 32$$

$$\Rightarrow \quad F = 104°$$

Higher Order Thinking Skills (HOTS) Questions

(Page 52)

1. The ratio of the ages of a father and his son, 10 years ago, was 4 : 1 and that after 20 years was 7 : 4. Form two simultaneous linear equations and hence solve these two equations algebraically to find the present ages of the father and his son.

Sol. Let the present ages of the father and his son be x years and y years respectively. Then according to the problem,

$$(x - 10) : (y - 10) = 4 : 1$$

$$\Rightarrow \quad \frac{x - 10}{y - 10} = \frac{4}{1}$$

$$\Rightarrow \quad 4y - 40 = x - 10$$

$$\Rightarrow \quad x - 4y + 30 = 0 \quad \ldots(1)$$

and $(x + 20) : (y + 20) = 7 : 4$

$$\Rightarrow \quad \frac{x + 20}{y + 20} = \frac{7}{4}$$

$$\Rightarrow \quad 7y + 140 = 4x + 80$$

$$\Rightarrow \quad 4x - 7y - 60 = 0 \quad \ldots(2)$$

From (1), we have

$$x = 4y - 30 \quad \ldots(3)$$

$\therefore$ From (2) and (3), we get

$$4(4y - 30) - 7y - 60 = 0$$

$$\Rightarrow \quad 16y - 120 - 7y = 60$$

$$\Rightarrow \quad 9y = 60 + 120$$

$$= 180$$

$$\Rightarrow \quad y = \frac{180}{9}$$

$$= 20$$

$\therefore$ From (3), $x = 4 \times 20 - 30 = 80 - 30 = 50$

Hence, the present ages of the father and his son are 50 years and 20 years respectively.

2. A company gives a fixed salary per month plus a commission on monthly sales to every new joinee in the sales team. The monthly earning is given by the following linear equation,

$$y = 20{,}000 + 0.05x.$$

On good performance of an individual, the company gives a hike of 20% on the fixed salary and ₹ 150 on every ₹ 3000 worth of sales. What will be the new linear equation which gives the enhanced earning.

Sol. $y = 20{,}000 + 0.05x$

Where y = monthly earning

Fixed salary = 20,000

Monthly sales = x

Now, enhanced earning on good performance

$$\text{Fixed salary} = 20{,}000 + \frac{20}{100} \times 20{,}000$$

$$= 20{,}000 + 4000 = 24{,}000$$

$$\text{Earning on monthly sales} = \frac{150}{3000}\, x = 0.05x$$

Enhanced earning per month = 24,000 + 0.05x.

Self-Assessment

(Page 53)

Multiple-Choice Questions

1. The equation $3x + 7y = 9$ has a unique solution, if x and y are
(*a*) natural numbers.
(*b*) real numbers.
(*c*) positive real numbers.
(*d*) rational numbers.

Sol. (*a*) natural numbers.

2. If we multiply or divide both sides of a linear equation with a non-zero number, then the solution of the linear equation
(*a*) changes.
(*b*) remains the same.
(*c*) changes in case of multiplication only.
(*d*) changes in case of division only.

Sol. (*b*) remains the same.

3. If three times the abscissa of a point is subtracted from four times its ordinate and then the whole expression is divided by 12, then the result

becomes 3. When this statement is expressed in terms of an equation, it becomes

(*a*) $4y - 3x = 36$

(*b*) $3x - 4y = 36$

(*c*) $3x + 4y - 36 = 0$

(*d*) $4y + 3x + 36 = 0$

Sol. (*a*) $4y - 3x = 36$

According to the problem, we have

$$\frac{4y - 3x}{12} = 3$$

$$\Rightarrow \quad 4y - 3x = 3 \times 12 = 36$$

which is the same as (*a*).

4. Which of the following is a solution of the equation $x + 2y = 7$?

(*a*) $x = 3, y = -5$ (*b*) $x = 3, y = 5$

(*c*) $x = 0, y = 7$ (*d*) $x = 3, y = 2$

Sol. (*d*) $x = 3, y = 2$

We see that when $x = 3$ and $y = 2$, then LHS = $3 + 2 \times 2 = 7$ = RHS and the other values, in (*a*), (*b*) and (*c*) do not satisfy this equation.

5. The positive solutions of the equation $ax + by + c = 0$ always lie in the

(*a*) first quadrant. (*b*) second quadrant.

(*c*) third quadrant. (*d*) fourth quadrant.

Sol. (*a*) first quadrant.

Fill in the Blanks

6. The equation of x-axis is of the form $\boldsymbol{y = 0}$.

7. The linear equation of the type $y = mx$, $m \neq 0$ has **infinitely many** solutions.

8. The negative solutions of the equation $ax + by + c = 0$ always lie in the **III** quadrant.

9. If (2,0) is a solution of the linear equation $2x + 3y - k = 0$, then the value of k is **4**.

Sol. $2x + 3y - k = 0 \Rightarrow 2(2) + 3(0) - k = 0 \Rightarrow 4 - k = 0$ $\Rightarrow k = 4$

Assertion-Reason Type Questions

Directions (Q. Nos. 10 to 13): Each of these questions contains an assertion followed by reason. Read them carefully, and answer the question on the basis of the following options, select the one that best describes the two statements.

(a) Both Assertion (A) and Reason (R) are true and Reason (R) is the correct explanation of Assertion (A).

(b) Both Assertion (A) and Reason (R) are true but Reason (R) is not the correct explanation of Assertion (A).

(c) Assertion (A) is true but Reason (R) is false.

(d) Assertion (A) is false but Reason (R) is true.

10. Assertion (A): $x + y = 0$ is a linear equation in two variables.

Reason (R): The variables x and y have non-zero coefficients.

Sol. (*a*)

$x + y = 0$ is a linear equation in two variables with $a \neq 0$ and $b \neq 0$.

Thus, assertion and reason are correct and reason is correct explanation of assertion.

11. Assertion (A): $x = 2y$ represents the statement "ordinate of a point is twice its abscissa".

Reason (R): x-coordinate is called abscissa and y-coordinate is called ordinate.

Sol. (*d*)

x-coordinate is called abscissa and y-coordinate is called ordinate. Therefore, reason is correct but assertion is incorrect as $y = 2x$ represents the statement 'ordinate of a point is twice its abscissa'.

12. Assertion (A): A linear equation in two variables has infinitely many solutions.

Reason (R): A linear equation in two variables should have non-zero coefficient for two variables.

Sol. (*b*)

Both reason and assertion are correct but reason is not the correct explanation of assertion.

13. Assertion (A): (1, 1) is a solution of the equation $x + y = 1$.

Reason (R): Replacing (1, 1) in the equation, we get 2.

Sol. (*d*)

Assertion is wrong as replacing (1, 1) in equation $x + y$, we get $1 + 1 = 2$ which is not equal to RHS.

The reason is correct as when we replace (1, 1) in the equation $x + y$ we get 2.

Case Study Based Questions

14. Two friends Rahul and Anmol decided to travel the historical monuments in Delhi city. So, they book a cab for travelling. The taxi fare in the city is as follows.

Fare for the first kilometre is ₹ 10 and ₹ 6 for every subsequent kilometre.

Based on the above information, answer the following questions.

(*a*) Consider the distance covered as x km and the total fare as ₹ y, form the linear equation which represents the above situation.

Ans. $6x - y + 4 = 0$

(*b*) If they paid total fare ₹ 724, then find the total distance travelled.

Ans. 120 km

(*c*) (*i*) If the distance covered by them is 94 km, then find the total fare they have to pay.

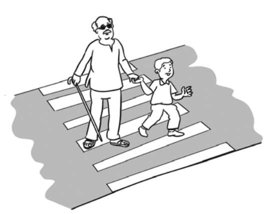
Ans. ₹ 568

or

(*ii*) If fare for first kilometre is ₹ 10 and ₹ 4.50 for every subsequent kilometre, then what amount they have to pay for 111 km?

Ans. ₹ 505

15. A boy walks across an x metre wide road at the speed of 1.5 m/s and crosses it in y_1 seconds. Next day, the boy is just about to cross the same road, when he spots a visually impaired man who also wants to cross that road. He helps that man to go across by reducing his walking speed to 0.5 m/s and crosses it in y_2 seconds. Based on this situation, answer the following questions.



(*a*) Write a linear equation in two variables to express relationship between x and y_1.

Ans. $x/1.5 = y_1$

(*b*) Write the above equation in standard form.

Ans. $2x - 3y_1 = 0$

(*c*) (*i*) Write a linear equation in two variables to express relationship between x and y_2.

Ans. $x/0.5 = y_2$

or

(*ii*) Find the ratio between the times taken by the boy to cross the road on the first day and the second day.

Ans. 1 : 3

Very Short Answer Type Questions

16. What is the distance of the line $2x + 1 = 0$ from the origin?

Sol. From the given equation, we see that $2x = -1$

$\Rightarrow$ $x = -\frac{1}{2}$. Hence, the required distance of the line from the origin, i.e. from the y-axis is $\frac{1}{2}$.

17. How many linear equations in x and y can be satisfied by $x = -5$ and $y = \frac{1}{3}$?

Sol. We know that infinitely many straight lines can pass through a single point $(-5, \frac{1}{3})$. Hence, the number of linear equations satisfied by $x = -5$ and $y = \frac{1}{3}$ is infinite.

18. If 5 pens cost ₹ 25, find how many pens can be bought for ₹ 35. Also, find the cost of 3 pens.

Sol. Let x pens cost ₹ y. Since 5 pens cost ₹25,

$\therefore$ Each pen costs ₹25 ÷ 5 = ₹5

$\therefore$ $y = 5x$ …(1)

When $y = 35$, then $x = 7$ [From (1)]

and when $x = 3$, then $y = 15$ [From (1)]

Hence, 7 pens can be bought for ₹35 and the cost of 3 pens is ₹15.

19. Consider the linear equation $9x - 2y = 36$. If $(k, k + 3)$ is a solution of the given linear equation, find the value of k.

Sol. $(k, k + 3)$ is a solution of the linear equation $9x - 2y = 36$.

$\Rightarrow$ $9(k) - 2(k + 3) = 36$

$\Rightarrow$ $9k - 2k - 6 = 36$

$\Rightarrow$ $7k = 36 + 6$

$\Rightarrow$ $7k = 42$

$\Rightarrow$ $k = 6$

Short Answer Type Questions

20. Find the solution of the linear equation $2x + 5y = 19$, whose ordinate is $\frac{3}{2}$ times its abscissa.

Sol. Ordinate is $\frac{3}{2}$ times its abscissa.

$\Rightarrow$ $y = \frac{3}{2}x$ ...(1)

Putting the value of y from (1) in the linear equation $2x + 5y = 19$,

$\Rightarrow \quad 2x + 5\left(\frac{3}{2}x\right) = 19$

$\Rightarrow \quad \frac{4x + 15x}{2} = 19$

$\Rightarrow \quad 19x = 19 \times 2$

$\Rightarrow \quad x = 2$

$\Rightarrow \quad y = \frac{3}{2}x = \frac{3}{2} \times 2$

$\Rightarrow \quad y = 3$

$\therefore$ (2, 3) is the solution of the linear equation $2x + 5y = 19$.

21. If (3, 4) is a solution of the linear equation $3y = ax + 7$, then find the value of x.

Sol. (3, 4) is a solution of the linear equation $3y = ax + 7$

$\Rightarrow \quad 3 \times 4 = a \times 3 + 7$

$\Rightarrow \quad 3a = 12 - 7$

$\Rightarrow \quad a = \frac{5}{3}$

22. Read the following passage and answer the questions that follows:

The residents of a housing colony are facing problem of water shortage. All residents decided to do rainwater harvesting as it helps in preserving rainwater for different purposes and for the future needs as well. One of the ways to preserve rainwater is in underground tank. The rainwater was collected in an underground tank at the rate of 0.12 m^3/hour.

(*a*) If x cm^3 of rainwater is collected in the underground tank in y minutes, then write the linear equation in two variables to express this situation.

(*b*) What will be the volume of rainwater in the underground tank collected in 5 minutes?

Sol. (*a*) In 60 minutes, the amount of water collected

$= 0.12 \text{ m}^3$

$= 0.12 \times 100 \times 100 \times 100 \text{ cm}^3$

$= 120000 \text{ cm}^3$

$\therefore$ In y minutes, the amount of water collected

$= \frac{120000}{60} y \text{ cm}^3$

$= 2000y \text{ cm}^3$

$\therefore$ According to the problem, $x = 2000y$, which is the required equation.

(*b*) In 5 minutes, the amount of water collected

$= 2000 \times 5 \text{ cm}^3$ [From part (*a*)]

$= 10000 \text{ cm}^3$

Long Answer Type Questions

23. Solve the equation $3y - 2 = 10 - y$, and represent the solution(s) on

(*a*) the number line

(*b*) the Cartesian plane.

Sol. From the given equation, we have

$3y - 2 = 10 - y$

$\Rightarrow \quad 3y + y = 10 + 2$

$\Rightarrow \quad 4y = 12$

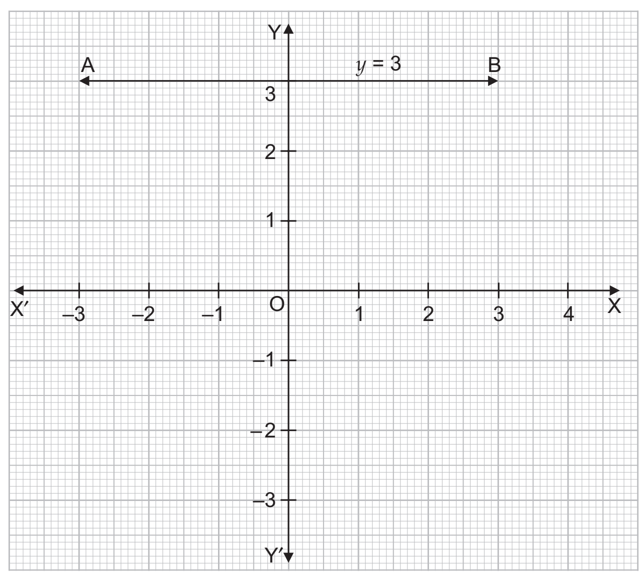
$\Rightarrow \quad y = \frac{12}{4} = 3$

which is the required solution.

(*a*) If we represent this solution on a number line, then it will be as follows:

Clearly, on a number line it represents a point P.

(*b*) On a Cartesian xy-plane, it will represent a straight line AB parallel to x-axis, as shown in the figure.



24. If the work done by a body on application of a constant force is directly proportional to the distance travelled by the body, express this in the form of an equation in two variables and draw the graph of the same by taking the constant force as 5 units. Also read from the graph, the work done when the distance travelled by the body is

(*a*) 2 units

(*b*) 0 unit. **[CBSE SP 2011, 2012]**

Sol. Let x be the displacement and y be the force.

Then $y \propto x$

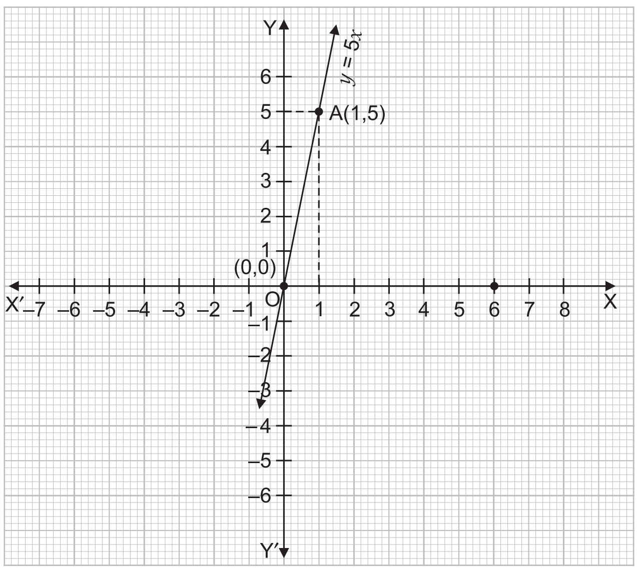
$\Rightarrow$ $y = kx$

where k is a constant force.

It is given that $k = 5$ units

$\therefore$ $y = 5x$ ...(1)

x	0	1
y	0	5



The graph of $y = 5x$ is OA as shown in the figure.

(*a*) When $x = 2$ units,

then $y = 2 \times 5$ units [From (1)]

$= 10$ units

(*b*) When $x = 0$ unit,

then $y = 5 \times 0$ unit

$= 0$ unit.

Let's Compete

(Page 54)

Multiple-Choice Questions

1. If the linear equation has solutions (–7, 7), (0, 0), (7, –7), then equation is

(*a*) $x + y = 0$ (*b*) $x - y = 0$

(*c*) $2x - y = 0$ (*d*) $x + 2y = 0$

Sol. (*a*) $x + y = 0$

From the given points, (–7, 7), (0, 0), (7, –7) satisfies the equation $y = -x$, i.e. $y + x = 0$.

2. Any point on the line $y = x$ is of the form

(*a*) $(k, 0)$ (*b*) $(0, k)$

(*c*) (k, k) (*d*) $(k, -k)$

Sol. (*c*) (k, k)

From the equation $y = x$, we see that abscissa = ordinate.

Hence, the point (k, k) where k is any real number is the required point.

3. The graph of the linear equation $2x - y = 3$ cuts the y-axis at the point

(*a*) (0, –3) (*b*) (0, 3)

(*c*) (3, 0) (*d*) (–3, 0)

Sol. (*a*) (0, –3)

At any point where the given line cuts the y-axis, we have $x = 0$.

$\therefore$ Putting $x = 0$ in the given equation, we see that $y = -3$. Hence, the required point is (0, –3).

4. At what point does the graph of the linear equation $x + y = 10$ meet a line which is parallel to y-axis at a distance of 6 units from the origin and in the positive direction of x-axis.

(*a*) (0, 6) (*b*) (0, 4)

(*c*) (4, 6) (*d*) (6, 4)

Sol. (*d*) (6, 4)

The equation of the line which is parallel to y-axis and lies at a distance of 6 units from the origin towards the positive direction of x-axis is $x = 6$.

Putting $x = 6$ is the given equation $x + y = 10$, we get $y = 10 - 6 = 4$.

$\therefore$ The required point of intersection of the two lines $x + y = 10$ and $x = 6$ is (6, 4).

5. The coordinates of the point on the graph of the equation $8x - 7y = 14$, whose ordinate is $\frac{6}{7}$ times its abscissa are

(*a*) (–7, 6) (*b*) (–6, 7)

(*c*) (6, 7) (*d*) (7, 6)

Sol. (*d*) (7, 6)

The ordinate $y = \frac{6}{7}$ times the abscissa x.

$\therefore$ $y = \frac{6x}{7}$

Putting $y = \frac{6x}{7}$ in the second equation $8x - 7y = 14$, we get

$$8x - 7 \times \frac{6x}{7} = 14$$

$$\Rightarrow \quad 2x = 14$$

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

$$\therefore \quad y = \frac{6}{7} \times 7 = 6$$

$\therefore$ The required point is (7, 6).

6. The measure of angle between the graph of the equations $y = 2$ and $x = 6$ is

(*a*) 0° (*b*) 45°

(*c*) 90° (*d*) None of these

Sol. (*c*) 90°

We know that the line $y = 2$ is parallel to x-axis and the line $x = 6$ is parallel to y-axis. Since the angle between x and y axes is 90°, hence, the angle between the lines $x = 6$ and $y = 2$ is also 90°.

7. Thrice the ordinate of point when decreased by twice the abscissa is 4. The given statement is

(*a*) $3x - 2y = 4$ (*b*) $3y - 2x = 4$

(*c*) $2x - 4 = 3y$ (*d*) None of these

Sol. (*b*) $3y - 2x = 4$

According to the problem $3y - 2x = 4$.

8. The x and y intercepts made by the graph of the linear equation $7x + 8y = 5$ on the x-axis and y-axis respectively are in the ratio

(*a*) 25 : 56 (*b*) 56 : 25

(*c*) 8 : 7 (*d*) 7 : 5

Sol. (*c*) 8 : 7

x-intercept is obtained from the given equation by putting $y = 0$ and the y-intercept is obtained by putting $x = 0$ in the given equation.

$\therefore$ x-intercept $= \frac{5}{7}$ and y-intercept $= \frac{5}{8}$

$\therefore$ Ratio of x-intercept and y-intercept

$$= \frac{5}{7} : \frac{5}{8}$$

$$= \frac{1}{7} : \frac{1}{8}$$

$$= \frac{1}{7} \times 56 : \frac{1}{8} \times 56$$

$$= 8 : 7$$

9. The graph of linear equation $3x - y = 6$ cuts x-axis at

(*a*) (2, 0) (*b*) (3, 0)

(*c*) (0, –2) (*d*) (0, –3)

Sol. (*a*) (2, 0)

Putting $y = 0$ in the given equation, we get

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

$\therefore$ The line $3x - y = 6$ cuts the x-axis at the point (2, 0).

10. The number of solution(s) of the equation $3x - 2 = -2x + 1$ on the number line and on the Cartesian plane respectively is

(*a*) one and two.

(*b*) one and infinitely many solutions.

(*c*) infinitely many solutions and one.

(*d*) two and one.

Sol. (*b*) one and infinitely many solutions

Solving the given equation, we get

$$3x + 2x = 1 + 2$$

$$\Rightarrow \quad 5x = 3$$

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

This represent only one point on the number line at a distance $\frac{3}{5}$ from the number 0 on the right side, but on a Cartesian xy-plane, it will represent a line parallel to y-axis and lying at a distance of $\frac{3}{5}$ units from the origin towards the positive direction of x-axis. We know that a line consists of infinitely many points representing the solution of the equation.

Hence, in the first case, $x = \frac{3}{5}$ will represent only one solution and in the second case, it will represent infinite number of solutions. Hence, (*b*) is the correct choice.

Life Skills

(Page 55)

1. A boy walks across an x metre wide road at a speed of 1.75 m/s and crosses it in t_1 seconds.

(*a*) Write a linear equation in two variables x and t_1 to express this situation.

(*b*) Next day, the boy is just about to cross the same road, when he spots a visually impaired old man who also wants to cross the road. The boy then helps that old man to go across the road by reducing his walking speed to 0.75 m/s. If t_2 seconds represents the time taken by them to cross the road, write a relationship between x and t_2.

(*c*) Hence, find the ratio between the time taken by the boy to cross the road on the first day and the second day.

Sol. (*a*) We know that

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

$$x = 1.75\, t_1$$

$$= 1\frac{3}{4}\, t_1$$

$$= \frac{7t_1}{4}$$

$$\Rightarrow \quad 4x = 7t_1$$

$$\Rightarrow \quad 4x - 7t_1 = 0$$

which is the required equation.

(*b*) In this case, speed = 0.75 m/s = $\frac{3}{4}$ m/s .

$$\therefore \quad x = 0.75t_2$$

$$= \frac{3}{4}t_2$$

$$\Rightarrow \quad 4x - 3t_2 = 0$$

which is the required equation.

(*c*) From (*a*), we have $t_1 = \frac{4x}{7}$ and from (*b*), $t_2 = \frac{4x}{3}$

$$\therefore \quad t_1 : t_2 = \frac{4x}{7} : \frac{4x}{3}$$

$$= \frac{1}{7} : \frac{1}{3}$$

$$= \frac{1}{7} \times 21 : \frac{1}{3} \times 21$$

$$= 3 : 7$$

which is the required ratio.