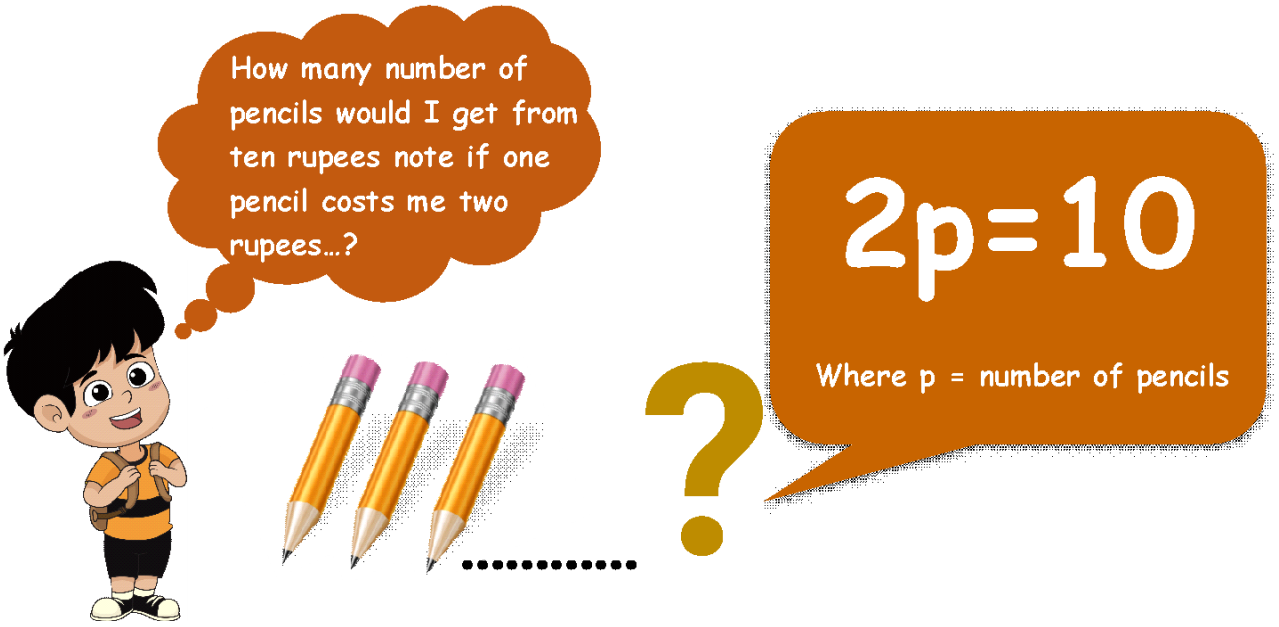
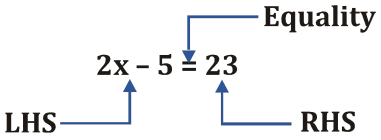
5 Linear Equations in One Variable



Linear equations

A statement of equality of two algebraic expressions which involves one or more unknown quantities (called variables) is known as an equation.

E.g : 2x – 5 = 23.



An equation has two parts. The part which is on the left side to the equality sign is known as left hand side (LHS) and the part which is on the right side to the equality sign is known as right hand side (RHS).

An equation in which the highest power of variable is one, is called a **linear equation**.

For example: 4x + 5 = 3x + 1, 2x + 3y = 4 are linear equations.

Quick Tips

The graph of a linear equation in one variable is a straight line parallel to either x-axis or y-axis.

SPOT LIGHT

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- $2xy + 1 = 3$ → This is not an example of linear equation as the degree is two.

Linear equations in one variable

A linear equation which has only one variable is called a linear equation in one variable.

The standard form of a linear equation in one variable is

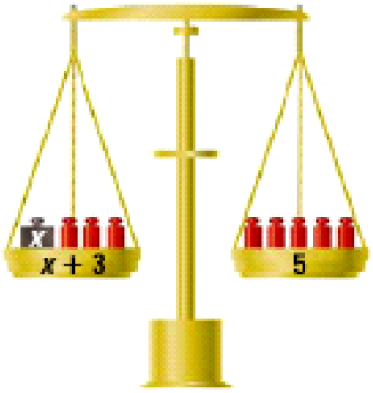
$ax + b = c$, where a, b and c are constants and x is a variable.

E.g : $3x = 8$; $\sqrt{\frac{3}{2}}\,x + 5 = 125$

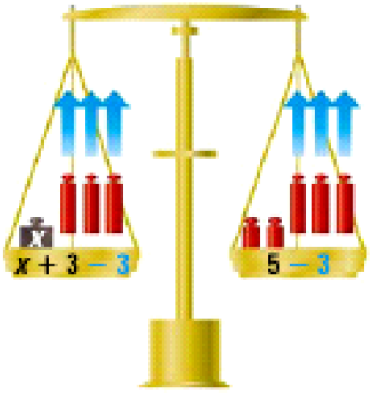
Solution of a linear equation

The value of the variable which satisfies the given equation is called a solution or the root of the equation.

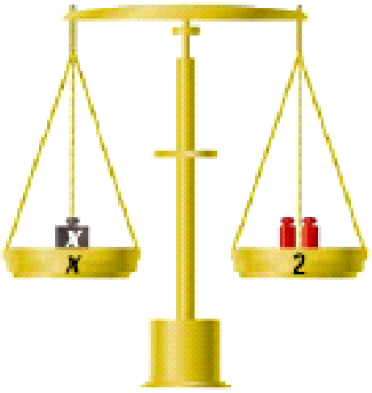
You can solve an equation by writing an equivalent equation that has the variable isolated on one side. Linear equations are **equivalent equations** if they have the same solution(s). To change, or transform, an equation into an equivalent equation, think of an equation as having two sides that need to be "in balance."



Original equation :
$x + 3 = 5$



Subtract 3 from both sides to isolate x on the left.
Scale stays in balance.



Simplify both sides.
Equivalent equation : $x = 2$

Balancing method

The following rules are important for solving linear equations.

Addition rule: Same quantity can be added to both sides of an equation.

Subtraction rule: Same quantity can be subtracted from both sides of an equation.

Two operations that undo each other, such as addition and subtraction are called inverse operations.

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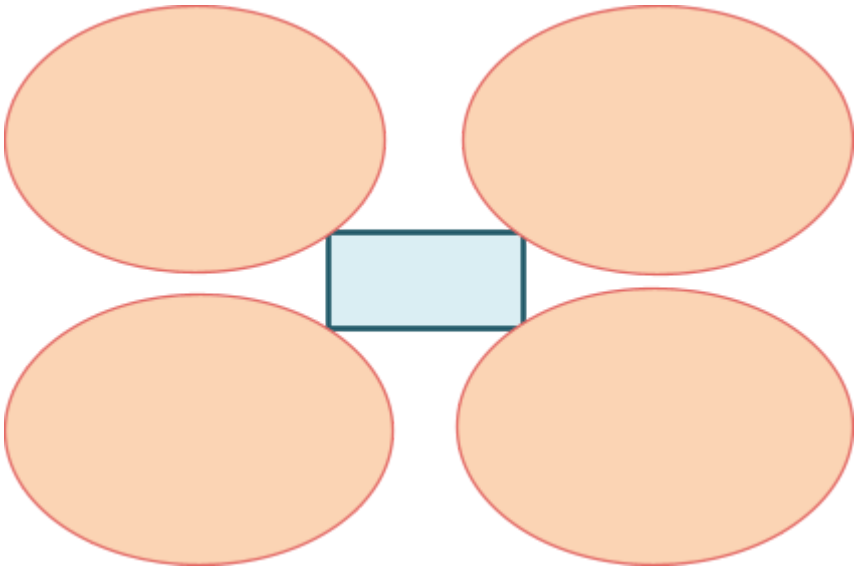
Multiplication rule: Same quantity can be multiplied to both sides of an equation.

Division rule: Both sides of an equation can be divided by the same non-zero quantity.

Any term can be transposed from one side of the equation to the other by changing its sign.

Transposition method

Transposing means moving from one side to the other(i.e., from LHS to RHS or from RHS to LHS). When a term is transposed from one side of the equation, its sign gets changed. Transposition of an expression can be carried out in the same way as the transposition of a term.



Addition will be
changed in subtraction.

$2x + 5 = 7$

$\Rightarrow 2x = 7 - 5$ (by transposing)

Subtraction will be changed in addition

$2x - 5 = 7$

$\Rightarrow 2x = 7 + 5$ (by transposing)

Multiplication will be
Changed in division

$2x \times 5 = 7$

$\Rightarrow 2x = \frac{7}{5}$ (by transposing)

Division will be
changed in multiplication

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$$\frac{2x}{5} = 7$$

$\Rightarrow$ 2x = 7 × 5 (by transposing)

Rules for transposition



Avoid these mistakes:

- $\left.\begin{aligned}&\frac{4x}{5}-1=7\\&\Rightarrow 4x-1=7\times 5\end{aligned}\right\}$ Incorrect $\qquad$ $\left.\begin{aligned}&\frac{4x}{5}-1=7\\&\Rightarrow \frac{4x-5}{5}=7\Rightarrow 4x-5=7\times 5\end{aligned}\right\}$ Correct

- $\left.\begin{aligned}&4x-2=7\\&\Rightarrow 4x-\frac{2}{7}=\frac{7}{7}\end{aligned}\right\}$ Incorrect $\qquad$ $\left.\begin{aligned}&4x-2=7\\&\Rightarrow \frac{4x-2}{7}=\frac{7}{7}\end{aligned}\right\}$ Correct

- Sum of 3a and 7a subtracted from 7 ≠ (3a + 7a) – 7

  Sum of 3a and 7a subtracted from 7 = 7 – (3a + 7a)

Solving equations with variables on one side

Some equations have variables on one side. To solve such equations, collect the numbers on the other side, after simplifying one or both sides of the equation, if needed. Then use inverse operations to isolate the variable.



Solve: 3x + 7 = – 8

Solution

To isolate the variable, undo the addition and then the multiplication.

3x + 7 = – 8

$\Rightarrow$ 3x + 7 – 7 = – 8 – 7 — Subtract 7 from each side to undo the addition. (Subtraction property of equality)

$\Rightarrow$ 3x = –15 — (Simplify both sides.)

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$\Rightarrow \frac{3x}{3} = \frac{-15}{3}$ (Divide each side by 3 to undo the multiplication.)

(Division property of equality)

$\Rightarrow x = -5$

Building Concepts 1

SCIENCE LINK: The temperature within Earth's crust increases about 30°C for each kilometre beneath the surface. If the temperature at Earth's surface is 24°C, at what depth would you expect the temperature to be 114°C?

Explanation 1

Verbal Model

Temperature inside Earth = Temperature at Earth's surface + Rate of temperature increase • Depth below surface

Labels

Temperature inside Earth = 114°C
Temperature at Earth's surface = 24°C
Rate of temperature increase = 30°C/km
Depth below surface = d

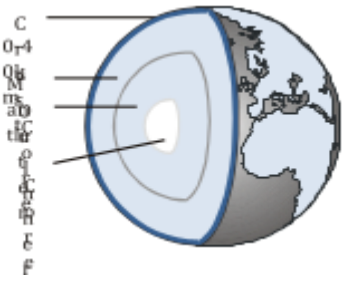
Algebraic Model

$114 = 24 + 30d$ (Write equation)

$90 = 30d$ (Subtract 24 from each side.)

$\frac{90}{30} = \frac{30d}{30}$ (Divide each side by 30.)

$3 = d$



Explanation 2

The temperature will be 114°C at a depth of 3 kilometres.

Numerical Ability 2

Solve: 7x – 3x – 8 = 24. (Combine like terms first)

Solution

$7x - 3x - 8 = 24$

$\Rightarrow 4x - 8 = 24$ (Combine like terms 7x and – 3x)

$\Rightarrow 4x - 8 + 8 = 24 + 8$ (Add 8 to each side to undo the subtraction.)

$\Rightarrow 4x = 32$

$\Rightarrow \frac{4x}{4} = \frac{32}{4}$ (Divide each side by 4 to undo the multiplication.)

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$\Rightarrow x = 8$



Solve the equation (Use the distributive property)

(i) $8x - 2(x + 7) = 16$ **(ii) $5x + 3(x + 4) = 28$**

Solution

(i) Distribute a negative number.

(ii) Distribute a positive number.

$8x - 2(x + 7) = 16$ $5x + 3(x + 4) = 28$

$\Rightarrow$ $8x - 2x - 14 = 16$ $5x + 3x + 12 = 28$

$\Rightarrow$ $6x - 14 = 16$ $8x + 12 = 28$

$\Rightarrow$ $6x - 14 + 14 = 16 + 14$ $8x + 12 - 12 =$ $28 - 12$

$\Rightarrow$ $6x = 30$ $8x = 16$

$\Rightarrow$ $\frac{6x}{6} = \frac{30}{6}$ $\frac{8x}{8} = \frac{16}{8}$

$\Rightarrow$ $x = 5$ $x = 2$

If two expressions are equal to each other and add or subtract the exact same thing to both sides, the two sides will remain equal.

SPOT LIGHT



Solve: $4 = \frac{2}{3}(x + 3)$. **(Multiply by a reciprocal first)**

Solution

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

$\Rightarrow$ $\frac{3}{2}(4) = \frac{3}{2}\left(\frac{2}{3}\right)(x+3)$ (Multiply each side by $\frac{3}{2}$, the reciprocal of $\frac{2}{3}$.)

$\Rightarrow$ $6 = x + 3$

$\Rightarrow$ $6 - 3 = x + 3 - 3$ (Subtract 3 from each side.)

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$\Rightarrow$ $3 = x$



1. If the temperature at Earth's surface is 24°C and increases about 30°C for each km. At what depth would you expect the temperature to be 174°C? Use the verbal model.

2. Solve the equation. Check your solution in the original equation.

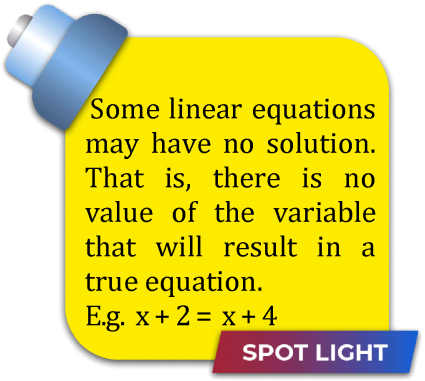
(i) $6(x + 2) = 15$ (ii) $8 - 4(x + 1) = 8$

(iii) $3m + 2(m - 5) = 10$ (iv) $6 = \frac{3}{4}(x + 7)$

(v) $\frac{4}{5}(x - 2) = 8$ (vi) $-\frac{3}{5}(x + 1) = 9$

Solving equations with variables on both sides

Some equations have variables on both sides. To solve these equations, you can first collect the variable terms on one side of the equation. The examples will show you that collecting the variable terms on the side with the greater coefficient of variable will result in a positive coefficient.





Solve: $7x + 19 = -2x + 55$ (Collect variables on left side)

Solution

Look at the coefficient of the x-terms. Since 7 is greater than – 2, collect the x-terms on the left side to get a positive coefficient.

$7x + 19 = -2x + 55$

$\Rightarrow$ $7x + 19 + 2x = -2x + 55 + 2x$ (Add 2x to each side.)

$\Rightarrow$ $9x + 19 = 55$

$\Rightarrow$ $9x + 19 - 19 = 55 - 19$ (Subtract 19 from each side)

$\Rightarrow$ $9x = 36$

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$\Rightarrow \quad \frac{9x}{9} = \frac{36}{9}$ (Divide each side by 9.)

$x = 4$



Solve: 80 – 9y = 6y (Collect variables on right side)

Solution

Remember that 80 – 9y is the same as 80 + (–9y). Since 6 is greater than –9, collect the y-terms on the right side to get a positive coefficient.

$80 - 9y = 6y$

$\Rightarrow \quad 80 - 9y + 9y = 6y + 9y$ (Add 9y to each side.)

$\Rightarrow \quad 80 = 15y$

$\Rightarrow \quad \frac{80}{15} = \frac{15y}{15}$ (Divide each side by 15.)

$\Rightarrow \quad \frac{16}{3} = y$



Solve: 3x – 10 + 4x = 5x – 7. (Combine like terms first)

Solution

$3x - 10 + 4x = 5x - 7$

$\Rightarrow \quad 7x - 10 = 5x - 7$

$\Rightarrow \quad 7x - 10 - 5x = 5x - 7 - 5x$ (Subtract 5x from each side)

$\Rightarrow \quad 2x - 10 = -7$

$\Rightarrow \quad 2x - 10 + 10 = -7 + 10$ (Add 10 to each side)

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$\Rightarrow \quad 2x = 3$

$\Rightarrow \quad \frac{2x}{2} = \frac{3}{2}$ (Divide each side by 2)

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



RATIONAL NUMBERS: A number is as much greater than 84 as it is less than 108. Find it.

Explanation

Verbal Model: Number − 84 = 108 − Number

Labels: Let the number be x

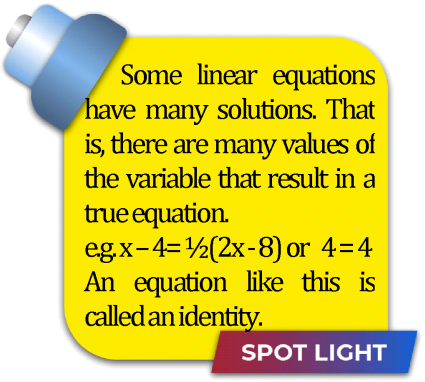
Algebraic Model: $x - 84 = 108 - x$

$\Rightarrow \quad x - 84 + x = 108 - x + x$ (adding x to each side)

$\Rightarrow \quad 2x - 84 = 108 \Rightarrow 2x = 108 + 84 \Rightarrow 2x = 192$

$\Rightarrow \quad x = \frac{192}{2} = 96$

The number is 96.



Reducing equations to simpler form

You have learnt several ways to transform an equation into an equivalent equation. As you solve more complicated equations, you will continue to use these same steps to isolate the variable.



Solve: 4(1 − x) + 3x = − 2(x + 1) (A more complicated equation)

Solution

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

$\Rightarrow$ $4 - 4x + 3x = -2x - 2$ (Use distributive property)

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

$\Rightarrow$ $4 - x + 2x = -2x - 2 + 2x$ (Add 2x to each side)

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

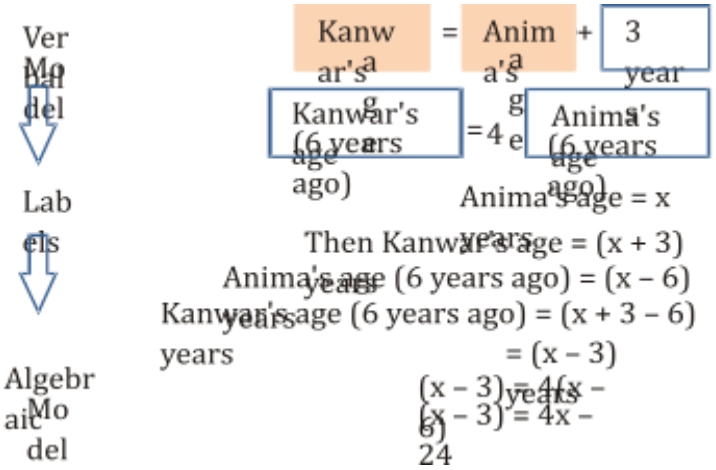
$\Rightarrow$ $4 + x - 4 = -2 - 4$ (Subtract 4 from each side)

$\Rightarrow$ $x = -6$

Building Concepts 3

AGE RELATED TASK: Kanwar is three years older than Anima. Six years ago, Kanwar's age was four times Anima's age. Find the present ages of Kanwar and Anima.

Explanation



$-3 + 24 = 4x - x$

$\Rightarrow$ $21 = 3x$

$\Rightarrow$ $\frac{21}{3} = x$

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$\Rightarrow$ $x = 7$

$\Rightarrow$ $(x + 3) = 7 + 3 = 10$

Anima's age = 7 years, Kanwar's age = 10 years.



1. Depth = 5 km

2. (i) $x = 1/2$ (ii) $x = -1$ (iii) $m = 4$

(iv) $x = 1$ (v) $x = 12$ (vi) $x = -16$



1. Solve the equations. Check your solution in the original equations.

(i) $34 - 3x = 14x$ (ii) $5y - 2y = y + 10$

(iii) $-6x + 4 = -8x$ (iv) $5x - 3x + 4 = 3x + 8$

(v) $6x + 3 = 8 + 7x + 2x$

2. Solve the equations

(i) $6(x + 3) + 3x = 3(x - 2)$ (ii) $4x + (2 - x) = -3(x + 2)$

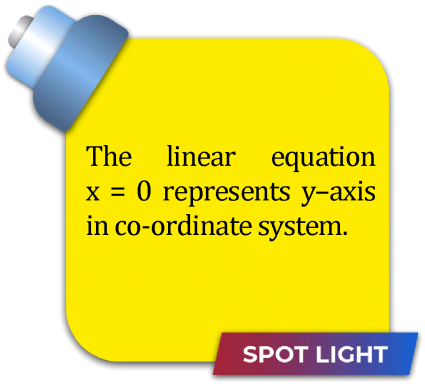
(iii) $-2(4x + 2) = -2(x + 3) + 9$ (iv) $(3y - 12) = 6 - 2(y - 1)$

Fraction in algebraic expressions

To solve equations that contain fractional coefficients, you can get rid of all the fractional coefficients by multiplying both sides of the equation by any common multiple of the denominators of the fractions. You don't have to remove fractions, but it can make solving the equation a lot easier.

The most efficient thing to multiply by is the least common multiple (LCM).





Solve and check the root of $\frac{2}{3}x - \frac{5}{6}x - 3 = \frac{1}{2}x - 5$.

Solution

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LCM of 3, 6 and 2 is 6.

$$\frac{6}{1}\times\frac{2}{3}x-\frac{6}{1}\times\frac{5}{6}x-\frac{6}{1}\times3=\frac{6}{1}\times\frac{1}{2}x-\frac{6}{1}\times5$$

$\Rightarrow \quad 2 \times 2x - 1 \times 5x - 6 \times 3 = 3 \times 1x - 6 \times 5$

$\Rightarrow \quad 4x - 5x - 18 = 3x - 30 \Rightarrow -x - 18 = 3x - 30$

$\Rightarrow \quad -x - 3x = -30 + 18 \Rightarrow -4x = -12$

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

Fractional coefficient in algebraic expressions

Some equations contain fractional coefficients and you can't isolate the variables until you sort out the fractions.

(x – 2) is all divided by 5. You need to deal with the fraction before you can get x on its own.

$$\frac{x-2}{5}-\frac{x-3}{6}=\frac{3}{10}$$

The denominators are all different, so multiply the equation by the LCM of all three denominators.

If there are fractional coefficients in the equation, multiply both sides of the equation by the least common multiple of the denominators of the fractions to remove the fractional coefficients.

You need to keep each numerator (x – 2, x – 3, and 3) as a group. Then you can apply the distributive property to eliminate the grouping symbols.



Solve: $\frac{x-2}{5}-\frac{x-3}{6}=\frac{3}{10}$.

Solution

There are three different denominators, so you need the LCM. List the prime factors, and use them to work out the LCM.

5 = 5 6 = 2 × 3 10 = 2 × 5

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So, LCM = 2 × 3 × 5 = 30

Multiply both sides of the equation by 30 to clear the fractional coefficients.

$$\frac{30}{1}\times\frac{(x-2)}{5}-\frac{30}{1}\times\frac{(x-3)}{6}=\frac{30}{1}\times\frac{3}{10}$$

$\Rightarrow$ $6(x-2)-5(x-3)=3\times3$

$\Rightarrow$ $6x-12-5x+15=9$

$\Rightarrow$ $6x-5x-12+15=9$

$\Rightarrow$ $x+3=9$

$\Rightarrow$ $x=6$

Check your Answers 2

1. (i) x = 2 (ii) y = 5 (iii) x = – 2 (iv) x = – 4 (v) x = $-\frac{5}{3}$

2. (i) x = – 4 (ii) x = $-\frac{4}{3}$ (iii) x = $-\frac{7}{6}$ (iv) y = 4

Check your Concepts 3

1. Solve the equations for the unknown variable.

(i) $\frac{1}{2}x-1=x$ (ii) $\frac{1}{10}x-3=\frac{1}{4}x$ (iii) $\frac{1}{10}x-1=2-\frac{1}{5}x$ (iv) $4-\frac{1}{3}x=\frac{1}{5}x+8$

2. Solve the equations

(i) $\frac{1}{4}(2c-1)-\frac{1}{6}(c+2)=\frac{c}{3}-\frac{1}{12}(2c-3)$

(ii) $\frac{b+2}{3}-\frac{3-b}{5}=\frac{5b+2}{10}$

(iii) $\frac{\ell-7}{4}-\frac{\ell+5}{5}=-\frac{3}{4}$

(iv) $\frac{2x+7}{3}-4+\frac{3x-8}{7}=9-\frac{2(x-5)}{21}+2$

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Building Concepts 4

COIN TASK : 70 coins of 10-paise and 50-paise coins are mixed in a purse. If the total value of the money in the purse is ₹ 19, find the number of each type of coins.

Explanation

Verbal Model

$$\text{Number of 10 paisa coins} + \text{Number of 50 paisa coins} = 70$$

$$₹\frac{10}{100} \times \text{Number of 10 paisa coins} + ₹\frac{50}{100} \times \text{Number of 50 paisa coins} = ₹19$$

Labels

Number of 10-paisa coins = x

Number of 50-paisa coins = (70 – x) (Total coins = 70)

Algebraic Model

$$\frac{10}{100}x + \frac{50}{100}(70-x) = 19$$

$$\Rightarrow \quad \frac{x}{10} + \frac{70-x}{2} = 19$$

$$\Rightarrow \quad x + 5(70 - x) = 10 \times 19 \qquad \text{(Multiplying both sides by 10)}$$

$$\Rightarrow \quad x + 350 - 5x = 190$$

$$\Rightarrow \quad -4x = 190 - 350$$

$$\Rightarrow \quad -4x = -160$$

$$\Rightarrow \quad x = \frac{-160}{-4} \Rightarrow x = 40$$

Number of 50 paisa coins = (70 – x) = 30

Number of 10-paisa coins = 40

Equations reducible to linear form

Consider the following equation involving ratios of linear expressions.

$$\frac{x+1}{2x+3} = \frac{3}{8}$$

It is not a linear equation, since the expression in LHS is not linear. But we can put it in the form of a linear equation, by multiplying both the sides of the equation by (2x + 3).

$$\left(\frac{x+1}{2x+3}\right) \times (2x+3) = \frac{3}{8} \times (2x+3) \Rightarrow (x+1) = \frac{3(2x+3)}{8}$$

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Now the equation is in linear form and we know how to solve it. The above step can be directly obtained by **cross multiplication**.

In cross multiplication, we multiply the numerator of LHS by the denominator of RHS and the denominator of LHS by the numerator of RHS. The resultant expressions are equal to each other.

Consider an equation, $\frac{ax+b}{cx+d}=\frac{m}{n}$

Using cross multiplication, we get (ax + b) × n = (cx + d) × m

When dealing with problems involving money, it is important to find the value of the coins/notes not just their number.

SPOT LIGHT

Building 5 Concepts

FRACTIONS: The denominator of a rational number is greater than it's numerator by 3. If 3 is subtracted from the numerator and 2 is added to it's denominator, the new number becomes 1/5. Find the rational number.

Explanation

Verbal Model: Denominator = Numerator + 3

$$\frac{\text{Numerator}-3}{\text{Denominator}+2}=\frac{1}{5}$$

Labels: Numerator = x, Denominator x + 3

Algebraic Model: $\frac{x-3}{(x+3)+2}=\frac{1}{5}$

5(x – 3) = (x + 5) (By cross-multiplication)

⇒ 5x – 15 = x + 5

⇒ 5x – x = 15 + 5

⇒ 4x = 20

⇒ $x=\frac{20}{4}=5$

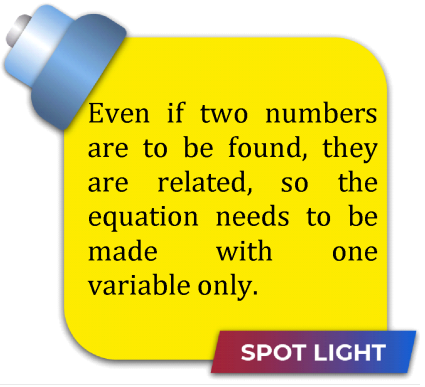
⇒ x + 3 = 5 + 3 = 8

Numerator = 5, Denominator = 8, Rational number = 5/8

Numerical Ability 11

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Solve : $\frac{2x+7}{x+6}=\frac{3}{4}$



Solution

Using cross multiplication, we get

$4 \times (2x + 7) = 3 \times (x + 6)$

Or $8x + 28 = 3x + 18$

Transposing the terms, we get

$8x - 3x = 18 - 28$ or $5x = -10$

Dividing both sides by 5, we get $x = -2$

Check your Answers 3

1. (i) $x = -2$ (ii) $x = -20$ (iii) $x = 10$ (iv) $x = \frac{-15}{2}$

2. (i) $c = 5$ (ii) $b = 4$ (iii) ✦ = 40 (iv) $x = 12$

Check your Concepts 4

1. Solve the following:

(i) $\frac{2x-1}{x+1}=\frac{5}{4}$ (ii) $\frac{9x-(3+4x)}{2x-(7-5x)}=\frac{6}{7}$ (iii) $\frac{4-7x}{9-8x}=\frac{10}{9}$

More applications: Practical problems often involve some known and some unknown quantities. We convert such problems into equations and then solve them to solve a word-problem, use the following three-step problem solving plan.

Step-I : Explore the problem: To solve a verbal problem, first read the problem carefully and explore what the problem is about.

- Identify what information is given.
- Identify what you are asked to find.

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Step-II : Plan the solution: One strategy you can use to solve a problem is to write an equation. Choose a variable to represent one of the unspecified numbers in the problem. This is called defining a variable. Then use the variable to write expressions for the other unspecified numbers.

Step-III : Solve the problem: Use the strategy you choose in Step-II to solve the problem.



MENSURATION: A wire of length 21 cm is bent in the form of a rectangle in such a way that it's length becomes $1\frac{1}{2}$ cm less than twice its breadth. Find the length and the breadth of the rectangle.

Explanation

Verbal Model: 2 Length $+ 2$ Breadth $= 21$ cm

Length $= 2$ Breadth $- 1\frac{1}{2}$



Labels: Breadth = x cm

Length $= \left(2x - 1\frac{1}{2}\right)$ cm $= \left(2x - \frac{3}{2}\right)$

Algebraic Model: $2\left[x + \left(2x - \frac{3}{2}\right)\right] = 21$

$\Rightarrow \quad 2\left[3x - \frac{3}{2}\right] = 21$

$\Rightarrow \quad 6x - 3 = 21$

$\Rightarrow \quad 6x = 21 + 3 = 24$

$\Rightarrow \quad x = \frac{24}{6} = 4$

Length $= 2x - \frac{3}{2} = 2 \times 4 - \frac{3}{2} = 8 - \frac{3}{2} = \frac{13}{2} = 6\frac{1}{2}$ cm

Breadth = x = 4 cm.

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Check your Answers 4

1. (i) x = 3 (ii) x = 3 (iii) x = $\frac{54}{17}$

Do You Remember ?

- $S = \frac{D}{T}$; $D = S \times T$; $T = \frac{D}{S}$

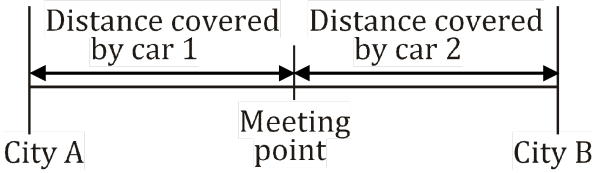
  Where S= Speed in km/hr
  T = Time in hours
  D = Distance in km.

- x km/hr = $x \times \frac{5}{18}$ m/sec

- $x \text{ m/sec} = x \times \frac{18}{5}$ km/hr

Building Concepts 7

SPEED, DISTANCE & TIME : The distance between city A and B is 510 km. Two cars begin their journey from these cities and move directly towards each other. From city A, the car is moving at a speed of 100 km per hour and from city B, the car is moving at 70 km per hour. Assuming the cars start at the same time, find after how many hours will they meet and how far is their meeting point from city A?



Explanation:

Ver Mo bet dol

Spee d of r 1 × Tim e to ee t + Spee d of r 2 × Time to ee t = T Dista nce al

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Labels ⇩ Algebr Express ion

Time to meet = t hours
Speed of car-1 = 100 km per hour
Speed of car-2 = 70 km per hour
100t + 70t = 510

$\Rightarrow$ 170t = 510

$\Rightarrow$ t = $\frac{510}{170}$ = 3 hours

The two cars will meet after 3 hours from the start.
Distance of the meeting point from city A = Speed of car 1 × Time to reach meeting point
= 100 × 3 = 300 km (d = s × t)

Building Concepts 8

A gazelle can run 73 feet per second for several minutes. A cheetah can run faster (88 feet per second) but can only sustain its top speed for about 20 seconds before it is worn out. How far away from the cheetah does the gazelle need to stay for it to be safe?

Explanation

You can use a diagram to picture the situation. If the gazelle is too far away for the cheetah to catch it within 20 seconds, the gazelle is probably safe.



Ver Mo bal del ⇩

Dista gazelle runs in 20 sec. + Gazelle's distance starting chee from tah = Distance runs in 20 cheetah sec.

To find the "safety zone" you can first find the starting distance for which the cheetah reaches the gazelle in 20 seconds.

Labels ⇩

Gazelle's distance = 73 × 20 (feet)

Gazelle's starting distance from cheetah = x (feet)

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Algebraic model Cheetah's distance = 88 × 20 (feet)

$73 \times 20 + x = 88 \times 20$

$1460 + x = 1760$

$x = 1760 - 1460$

$x = 300$

Gazelle needs to stay more than 300 feet away from the cheetah to be safe.

Building Concepts 9

NUMBERS: Find two consecutive even numbers such that, three-fourth of the first exceeds two-fifth of the other by 9.

Explanation:

Verbal model: An even number = Consecutive even number + 9

Labels: An even number = 2x.

Consecutive even number = 2x + 2

Algebraic Model:

$\frac{3}{4}(2x) = \frac{2}{5}(2x + 2) + 9,$

$\Rightarrow \frac{3x}{2} = \frac{4x+4}{5} + 9$

$\Rightarrow 10\left(\frac{3x}{2}\right) = 10\left(\frac{4x+4}{5}\right) + 90$ (Multiplying by LCM of 2 and 5)

$\Rightarrow 15x = 8x + 8 + 90$

$\Rightarrow 15x - 8x = 98 \Rightarrow 7x = 98 \Rightarrow x = 14$

The first number = $2x = 2 \times 14 = 28$

The next number = $2x + 2 = 28 + 2 = 30$

Building Concepts 10

2-DIGIT NUMBER: The sum of the digits of a two digit number is 14. The number obtained by inter-changing the digits is 36 more than the given number.

Explanation

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Verbal Model: Unit digit + tens digit = 14 ; Number obtained by reversing the digits = Original number + 36

Labels: Unit digit = x, tens digit = 14 – x

Original number = 10 (tens digit) + unit digit

Algebraic Expression: 10(14 – x) + x = 140 = – 10x + x = 140 – 9x

Number obtained by reversing the digits = 10 (x) + (14 – x) = 9x + 14

A.T.Q

$\Rightarrow$ 9x + 14 = 36 + (140 – 9x)

$\Rightarrow$ 9x + 9x = 140 + 36 – 14

$\Rightarrow$ 18x = 162

$\Rightarrow$ $x = \frac{162}{18} = 9 \Rightarrow (14 - x) = 14 - 9 = 5$

Original Number = 10 (5) + 9 = 59

Building Concepts 11

ECONOMICS: A video store charges `8 to rent a video game for five days. You must be a member to rent from the store, but the membership is free. A video game club in town charges only `3 to rent a game for five days. But membership in the club is `50 per year. Which rental plan is more economical?

Explanation:

Find the number of rentals for which the two plans would cost the same.

Verbal Model: Store rental fee (Video store) × Number rented = Rental fee (Video club) × Number rented + Club membership fee



Labels: Store rental fee = 8 (rupees per game)

Number of games to be rented = x

Club rental fee = ₹ 3 (per game)

Club membership fee = ₹ 50

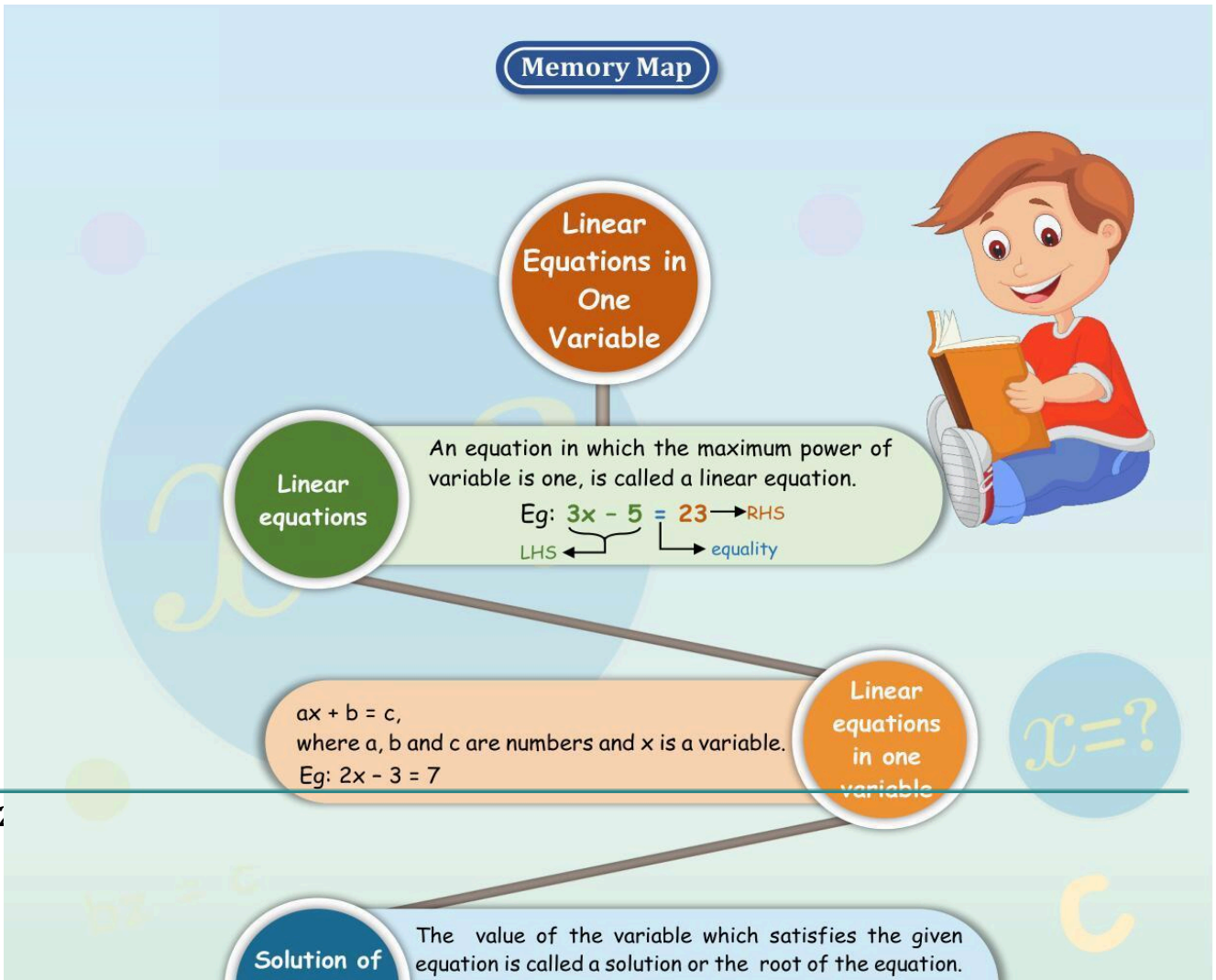
Algebraic Model: 8x = 3x + 50

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$\Rightarrow$ $5x = 50$

$\Rightarrow$ $x = 10$

If you rent 10 video games in a year, the cost would be the same at either the store or the club. If you rent more than 10, the club is more economical. If you rent fewer than 10, the store is more economical.



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