Linear Equations
Ex 8A

Definition of a Linear Equation

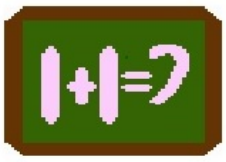
- A linear equation in one variable x is an equation that can be written in the form
- $ax + b = 0$
- where a and b are real numbers and $a \neq 0$.

Equation is a mathematical sentence indicating that two expressions are equal. The symbol "=" is used to indicate equality.

Ex.

$2x + 5 = 9$ is a conditional equation since its truth or falsity depends on the value of x

$2 + 9 = 11$ is identity equation since both of its sides are identical to the same number 11.



Solution Set of a Linear Equation

Example

$4x + 2 = 10$	this statement is either true of false
If $x = 1$, then $4x + 2 = 10$	is false because $4(1) + 2$ is $\neq 10$
If $x = 2$, then $4x + 2 = 10$	is true because $4(2) + 2 = 10$

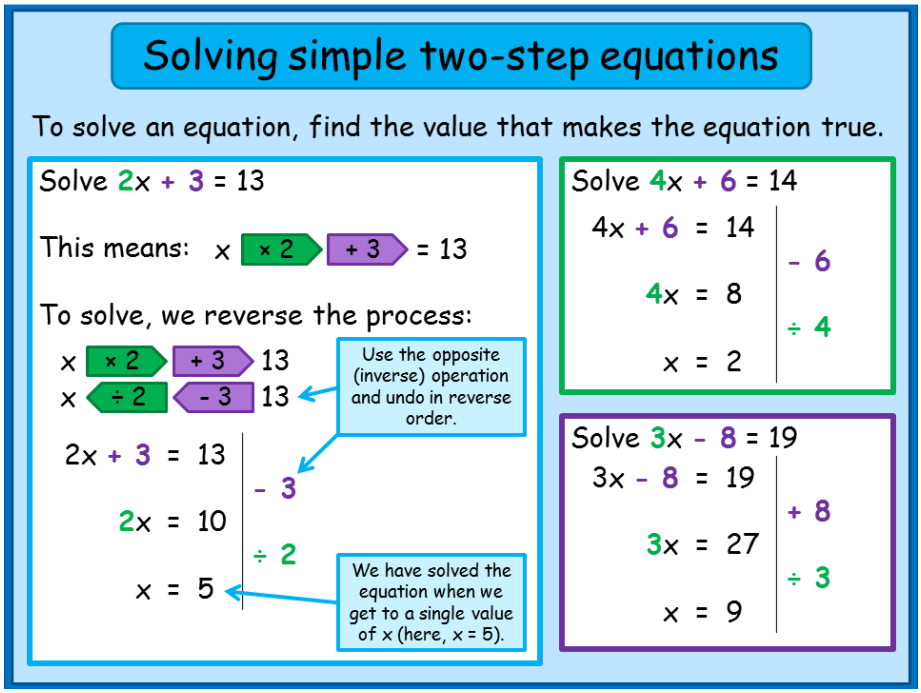
ONE STEP SUBTRACTION EXAMPLE

The Opposite of Subtraction is Addition

$$x - 120 = 80$$
$$+120 \quad +120$$
$$x = 200 \checkmark$$

The value which makes the equation true is 200.

$x - 4 = 7$	Original problem
$x - 4 = 7$	We want to remove the minus 4.
$x - 4 + 4 = 7 + 4$	The opposite of minus 4 is plus 4, so I added 4 to BOTH sides of the equation.
$x = 11$	-4+4 = 0, so x remains on the left and 7+4 = 11; therefore x = 11
Check: $x - 4 = 7$ $11 - 4 = 7$	This is a correct statement, so my answer is x = 11 is correct!



Q1

Answer :

$$\begin{aligned} & 8x + 3 = 27 + 2x \\ \Rightarrow\ & 8x - 2x = 27 - 3 \\ \Rightarrow\ & 6x = 24 \\ \Rightarrow\ & x = \tfrac{24}{6} = 4 \\ \therefore\ & x = 4 \end{aligned}$$

Q2

Answer :

$$\begin{aligned} & 5x + 7 = 2x - 8 \\ \Rightarrow\ & 5x - 2x = -8 - 7 \\ \Rightarrow\ & 3x = -15 \\ \Rightarrow\ & x = \tfrac{-15}{3} = -5 \\ \therefore\ & x = -5 \end{aligned}$$

Q3.

Answer :

$$\begin{aligned} & 2z - 1 = 14 - z \\ \Rightarrow\ & 2z + z = 14 + 1 \\ \Rightarrow\ & 3z = 15 \\ \Rightarrow\ & z = \tfrac{15}{3} = 5 \\ \therefore\ & z = 5 \end{aligned}$$

Q4.

Answer :

$$\begin{aligned} & 9x + 5 = 4(x - 2) + 8 \\ \Rightarrow\ & 9x + 5 = 4x - 8 + 8 \\ \Rightarrow\ & 9x + 5 = 4x \\ \Rightarrow\ & 9x - 4x = -5 \\ \Rightarrow\ & 5x = -5 \\ \Rightarrow\ & x = \tfrac{-5}{5} = -1 \\ \therefore\ & x = -1 \end{aligned}$$

Q5.

Answer :

$\frac{7y}{5} = y - 4$

By cross multiplication :

$\Rightarrow 7y = 5\left(y - 4\right)$

$\Rightarrow 7y = 5y - 20$

$\Rightarrow 7y - 5y = -20$

$\Rightarrow 2y = -20$

$\Rightarrow y = \frac{-20}{2} = -10$

$\therefore y = -10$

Q6.

Answer :

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

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

$\Rightarrow x = \frac{1}{1} - \frac{2}{3}$ $\left(\text{L.C.M. of } 1 \text{ and } 3 \text{ is } 3\right)$ $\Rightarrow x = \frac{3-2}{3}$

$\Rightarrow x = \frac{1}{3}$

$\Rightarrow x = \frac{1}{3}$

$\therefore x = \frac{1}{3}$

Q7.

Answer :

$15\left(y - 4\right) - 2\left(y - 9\right) + 5\left(y + 6\right) = 0$

$\Rightarrow 15y - 60 - 2y + 18 + 5y + 30 = 0$

$\Rightarrow 15y - 2y + 5y - 60 + 18 + 30 = 0$

$\Rightarrow 18y - 12 = 0$

$\Rightarrow 18y = 12$

$\Rightarrow y = \frac{12}{18} = \frac{2}{3}$

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

Q8.

Answer :

$3\left(5x - 7\right) - 2\left(9x - 11\right) = 4\left(8x - 13\right) - 17$

$\Rightarrow 15x - 21 - 18x + 22 = 32x - 52 - 17$

$\Rightarrow 15x - 18x - 21 + 22 = 32x - 69$

$\Rightarrow -3x + 1 = 32x - 69$

$\Rightarrow 1 + 69 = 32x + 3x$

$\Rightarrow 70 = 35x$

$\Rightarrow 35x = 70$ $\left(by \text{ transposition}\right)$

$\Rightarrow x = \frac{70}{35} = 2$

$\therefore x = 2$

Q9.

Answer :

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

$\Rightarrow 10\left(\frac{x-5}{2}\right) - 10\left(\frac{x-3}{5}\right) = 10\left(\frac{1}{2}\right)$ $\left(\text{multiplying throughout by } 10, \text{ which is the L.C.M. of } 2, 2 \text{ and } 5\right)$ $\Rightarrow 5\left(x - 5\right) - 2\left(x - 3\right) = 5 \Rightarrow 5x - 25 - 2x + 6 = 5 \Rightarrow 5x - 2x - 25 + 6 = 5 \Rightarrow 3x - 19 = 5 \Rightarrow 3x = 5 + 19 \Rightarrow 3x = 24 \Rightarrow x = \frac{24}{3} = 8 \therefore x = 8$

Q10.

Answer :

$\frac{3t-2}{4} - \frac{2t+3}{3} = \frac{2}{3} - t$

$\Rightarrow \frac{3t-2}{4} - \frac{2t+3}{3} = \frac{2-3t}{3}$ $\left(3 \text{ is the L.C.M. of } 1 \text{ and } 3\right)$

$\Rightarrow 12\left(\frac{3t-2}{4}\right) - 12\left(\frac{2t+3}{3}\right) = 12\left(\frac{2-3t}{3}\right)$ $\left(\text{multiplying throughout by } 12, \text{ which is the L.C.M. of } 4, 3 \text{ and } 3\right)$

$\Rightarrow 3\left(3t-2\right) - 4\left(2t+3\right) = 4\left(2-3t\right)$

$\Rightarrow 9t - 6 - 8t - 12 = 8 - 12t$

$\Rightarrow 9t - 8t - 6 - 12 = 8 - 12t$

$\Rightarrow t - 18 = 8 - 12t$

$\Rightarrow t + 12t = 18 + 8$

$\Rightarrow 13t = 26$

$\Rightarrow t = \frac{26}{13} = 2$

$\therefore t = 2$

Q11.

Answer :

$\frac{2x+7}{5} - \frac{3x+11}{2} = \frac{2x+8}{3} - 5$

$\Rightarrow \frac{2x+7}{5} - \frac{3x+11}{2} = \frac{2x+8-15}{3}$ $\left(\text{L.C.M. of } 3 \text{ and } 1 \text{ is } 3\right)$

$\Rightarrow 30\left(\frac{2x+7}{5}\right) - 30\left(\frac{3x+11}{2}\right) = 30\left(\frac{2x+8-15}{3}\right)$

$\left(\text{multiplying } g \text{ throughout by } 30, \text{ which is the L.C.M. of } 5, 2 \text{ and } 3\right)$

$\Rightarrow 6\left(2x+7\right) - 15\left(3x+11\right) = 10\left(2x+8-15\right) \Rightarrow 12x + 42 - 45x - 165 = 20x - 70 \Rightarrow 12x - 45x + 42 - 165 = 20x - 70 \Rightarrow -33x - 123 = 20x - 70 \Rightarrow -33x - 20x = 123 - 70 \Rightarrow -53x = 53 \Rightarrow x = \frac{53}{-53} \Rightarrow x = -1 \therefore x = -1$

Q12.

Answer :

$\frac{5x-4}{6} = 4x + 1 - \frac{3x+10}{2}$

$\Rightarrow \frac{5x-4}{6} = \frac{2\left(4x+1\right)-3x-10}{2}$ $\left(\text{L.C.M. of } 1 \text{ and } 2 \text{ is } 2\right)$

$\Rightarrow \frac{5x-4}{6} = \frac{8x+2-3x-10}{2}$

$\Rightarrow \frac{5x-4}{6} = \frac{8x-3x+2-10}{2}$

$\Rightarrow \frac{5x-4}{6} = \frac{5x-8}{2}$

$\Rightarrow 2\left(5x-4\right) = 6\left(5x-8\right)$

$\Rightarrow 10x - 8 = 30x - 48$

$\Rightarrow 10x - 30x = -48 + 8$

$\Rightarrow -20x = -40$

$\Rightarrow x = \frac{-40}{-20} = 2$

$\therefore x = 2$

Q13.

Answer :

$5x - \frac{1}{3}\left(x + 1\right) = 6\left(x + \frac{1}{30}\right)$

$\Rightarrow 5x - \frac{1(x+1)}{3} = 6\left(\frac{30x+1}{30}\right)$ $\left(\text{L.C.M. of } 1 \text{ and } 30 \text{ is } 30\right)$

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

$\Rightarrow \frac{15x-x-1}{3} = \frac{30x+1}{5}$ $\left(\text{L.C.M. of } 1 \text{ and } 3 \text{ is } 3\right)$

$\Rightarrow \frac{14x-1}{3} = \frac{30x+1}{5}$

$\Rightarrow 5\left(14x - 1\right) = 3\left(30x + 1\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 70x - 5 = 90x + 3$

$\Rightarrow 70x - 90x = 3 + 5$

$\Rightarrow -20x = 8$

$\Rightarrow x = \frac{8}{-20} = \frac{-2}{5}$

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

Q14.

Answer :

$4 - \frac{2(z-4)}{3} = \frac{1}{2}\left(2z+5\right)$

$\Rightarrow \frac{12-2(z-4)}{3} = \frac{1(2z+5)}{2}$ $\left(\text{L.C.M. of } 1 \text{ and } 3 \text{ is } 3\right)$

$\Rightarrow \frac{12-2z+8}{3} = \frac{2z+5}{2}$

$\Rightarrow \frac{20-2z}{3} = \frac{2z+5}{2}$

$\Rightarrow 2\left(20-2z\right) = 3\left(2z+5\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 40 - 4z = 6z + 15$

$\Rightarrow 40 - 15 = 6z + 4z$

$\Rightarrow 25 = 10z$

$\Rightarrow 10z = 25$ $\left(\text{by transposition}\right)$

$\Rightarrow z = \frac{25}{10} = \frac{5}{2}$

$\therefore z = \frac{5}{2}$

Q15.

Answer :

$\frac{3(y-5)}{4} - 4y = 3 - \frac{(y-3)}{2}$

$\Rightarrow \frac{3y-15}{4} - 4y = 3 - \frac{y-3}{2}$

$\Rightarrow \frac{3y-15-16y}{4} = 3 - \frac{y-3}{2}$ $\left(\text{L.C.M. of } 4 \text{ and } 1 \text{ is } 4\right)$

$\Rightarrow \frac{-13y-15}{4} = \frac{6-y+3}{2}$

$\Rightarrow \frac{-13y-15}{4} = \frac{9-y}{2}$

$\Rightarrow 2\left(-13y-15\right) = 4\left(9 - y\right)$

$\Rightarrow -26y - 30 = 36 - 4y$

$\Rightarrow -26y + 4y = 36 + 30$

$\Rightarrow -22y = 66$

$\Rightarrow 22y = -66$ $\left(\text{multiplying both the sides with a } -\text{ve sign}\right)$

$\Rightarrow y = -\frac{66}{22} = -3$

$\therefore y = -3$

Q16.

Answer :

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

$\Rightarrow 8x - 3 = 2\left(3x\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 8x - 3 = 6x$

$\Rightarrow 8x - 6x = 3$

$\Rightarrow 2x = 3$

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

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

Q17.

Answer :

$\frac{9x}{7-6x} = 15$

$\Rightarrow \frac{9x}{7-6x} = \frac{15}{1}$

$\Rightarrow 1\left(9x\right) = 15\left(7-6x\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 9x = 105 - 90x$

$\Rightarrow 9x + 90x = 105$

$\Rightarrow 99x = 105$

$\Rightarrow x = \frac{105}{99} = \frac{35}{33}$

$\therefore x = \frac{35}{33}$

Q18.

Answer :

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

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

$\Rightarrow 1\left(3x\right) = -4\left(5x+2\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 3x = -20x - 8$

$\Rightarrow 3x + 20x = -8$

$\Rightarrow 23x = -8$

$\Rightarrow x = \frac{-8}{23}$

$\therefore x = \frac{-8}{23}$

Q20.

Answer :

$\frac{2-9z}{17-4z} = \frac{4}{5}$

$\Rightarrow 5\left(2-9z\right) = 4\left(17-4z\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 10 - 45z = 68 - 16z$

$\Rightarrow 10 - 68 = 45z - 16z$

$\Rightarrow -58 = 29z$

$\Rightarrow 29z = -58$ $\left(\text{by transposition}\right)$

$\Rightarrow z = \frac{-58}{29} = -2$

$\therefore z = -2$

Q21.

Answer :

$\frac{4x+7}{9-3x} = \frac{1}{4}$

$\Rightarrow 4\left(4x+7\right) = 1\left(9-3x\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 16x + 28 = 9 - 3x$

$\Rightarrow 16x + 3x = 9 - 28$

$\Rightarrow 19x = -19$

$\Rightarrow x = \frac{-19}{19} = -1$

$\therefore x = -1$

Q22.

Answer :

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

$\Rightarrow 3\left(7y+4\right) = -4\left(y+2\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 21y + 12 = -4y - 8$

$\Rightarrow 21y + 4y = -8 - 12$

$\Rightarrow 25y = -20$

$\Rightarrow y = \frac{-20}{25} = \frac{-4}{5}$

$\therefore y = \frac{-4}{5}$

Q23.

Answer :

$\frac{15\left(2-y\right)-5\left(y+6\right)}{1-3y} = 10$

$\Rightarrow \frac{30-15y-5y-30}{1-3y} = 10$

$\Rightarrow \frac{-20y}{1-3y} = 10$

$\Rightarrow 1\left(-20y\right) = 10\left(1-3y\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow -20y = 10 - 30y$

$\Rightarrow -20y + 30y = 10$

$\Rightarrow 10y = 10$

$\Rightarrow y = \frac{10}{10} = 1$

$\therefore y = 1$

Q24.

Answer :

$\frac{2x-(7-5x)}{9x-(3+4x)} = \frac{7}{6}$

$\Rightarrow \frac{2x-7+5x}{9x-3-4x} = \frac{7}{6}$

$\Rightarrow \frac{7x-7}{5x-3} = \frac{7}{6}$

$\Rightarrow 6\left(7x-7\right) = 7\left(5x-3\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 42x - 42 = 35x - 21$

$\Rightarrow 42x - 35x = 42 - 21$

$\Rightarrow 7x = 21$

$\Rightarrow x = \frac{21}{7} = 3$

$\therefore x = 3$

Q25.

Answer :

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

$\Rightarrow \frac{2m-m+1}{2} = 1 - \frac{(m-2)}{3}$ $\left(L.C.M. \text{ of } 1 \text{ and } 2 \text{ is } 2\right)$

$\Rightarrow \frac{m+1}{2} = \frac{3-m+2}{3}$ $\left(L.C.M. \text{ of } 1 \text{ and } 3 \text{ is } 3\right)$

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

$\Rightarrow 3\left(m+1\right) = 2\left(5-m\right)$ $\left(\text{by cross multiplication}\right)$

$\Rightarrow 3m + 3 = 10 - 2m$

$\Rightarrow 3m + 2m = 10 - 3$

$\Rightarrow 5m = 7$

$\Rightarrow m = \frac{7}{5}$

$\therefore m = \frac{7}{5}$

Q26.

Answer :

$\frac{3x+5}{4x+2} = \frac{3x+4}{4x+7}$

$\Rightarrow (4x+7)(3x+5) = (4x+2)(3x+4)$ (by cross multiplication)

$\Rightarrow 12x^2 + 20x + 21x + 35 = 12x^2 + 16x + 6x + 8$

$\Rightarrow 12x^2 + 41x + 35 = 12x^2 + 22x + 8$

$\Rightarrow 12x^2 - 12x^2 + 41x - 22x = 8 - 35$

$\Rightarrow 19x = -27$

$\Rightarrow x = \frac{-27}{19}$

$\therefore x = \frac{-27}{19}$

Q27.

Answer :

$\frac{9x-7}{3x+5} = \frac{3x-4}{x+6}$

$\Rightarrow (x+6)(9x-7) = (3x+5)(3x-4)$

(by cross multiplication)

$\Rightarrow 9x^2 - 7x + 54x - 42 = 9x^2 - 12x + 15x - 20$

$\Rightarrow 9x^2 + 47x - 42 = 9x^2 + 3x - 20$

$\Rightarrow 9x^2 - 9x^2 + 47x - 3x = -20 + 42$

$\Rightarrow 44x = 22$

$\Rightarrow x = \frac{22}{44} = \frac{1}{2}$

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

Q28.

Answer :

$\frac{2-7x}{1-5x} = \frac{3+7x}{4+5x}$

$\Rightarrow (4+5x)(2-7x) = (1-5x)(3+7x)$ (by cross multiplication)

$\Rightarrow 8 - 28x + 10x - 35x^2 = 3 + 7x - 15x - 35x^2$

$\Rightarrow -35x^2 - 18x + 8 = -35x^2 - 8x + 3$

$\Rightarrow -35x^2 + 35x^2 - 18x + 8x = -8 + 3$

$\Rightarrow -10x = -5$

$\Rightarrow x = \frac{-5}{-10} = \frac{1}{2}$

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

Linear Equations
Ex 8B

Definition of a Linear Equation

- A linear equation in one variable x is an equation that can be written in the form
- $ax + b = 0$
- where a and b are real numbers and $a \neq 0$.

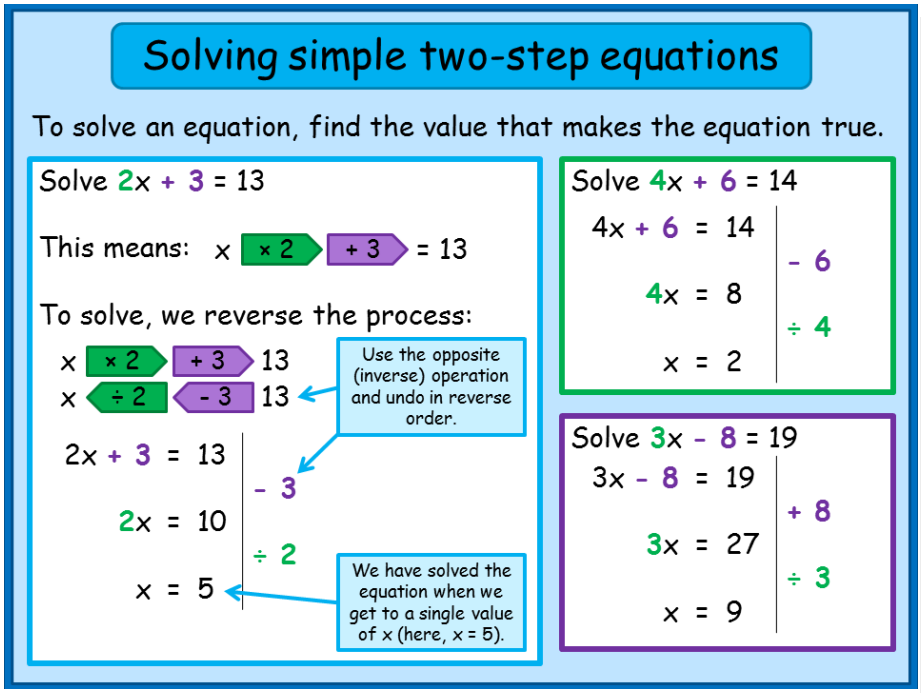
ONE STEP SUBTRACTION EXAMPLE

The Opposite of Subtraction is Addition

$$x - 120 = 80$$
$$+120 \quad +120$$
$$x = 200 \checkmark$$

The value which makes the equation true is 200.

x – 4 = 7	Original problem
x – 4 = 7	We want to remove the minus 4.
x – 4 +4 = 7 +4	The opposite of minus 4 is plus 4, so I added 4 to BOTH sides of the equation.
x = 11	-4+4 = 0, so x remains on the left and 7+4 = 11; therefore x = 11
Check: x – 4 = 7 11 – 4 = 7	 This is a correct statement, so my answer is x = 11 is correct!



Q1

Answer :

Let the numbers be 8x and 3x.

$$8x + 3x = 143$$
$$\Rightarrow 11x = 143$$
$$\Rightarrow x = \frac{143}{11}$$
$$\Rightarrow x = 13$$

$\therefore$ One number $= 8x = 8 \times 13 = 104$

Other number $= 3x = 3 \times 13 = 39$

Q2.

Answer :

Let the original number be x.

$\frac{2}{3}$ of the number is 20 less than the original number.

$$\therefore \frac{2}{3}x = x - 20$$
$$\Rightarrow \frac{2x}{3} = x - 20$$
$$\Rightarrow 2x = 3\left(x - 20\right) \quad \left(\text{by cross multiplication}\right)$$
$$\Rightarrow 2x = 3x - 60$$
$$\Rightarrow 2x - 3x = -60$$
$$\Rightarrow -x = -60$$
$$\Rightarrow x = 60$$

Therefore, the original number is 60.

Q3.

Answer :

Let the number be x.

Four fifths of the number is 10 more than two thirds of the number.

$$\therefore \frac{4}{5}x = 10 + \frac{2}{3}x$$
$$\Rightarrow \frac{4x}{5} = 10 + \frac{2x}{3}$$
$$\Rightarrow \frac{4x}{5} = \frac{30 + 2x}{3} \quad \left(L.C.M. \text{ of } 1 \text{ and } 3 \text{ is } 3\right)$$
$$\Rightarrow 3\left(4x\right) = 5\left(30 + 2x\right) \quad \left(\text{by cross multiplication}\right)$$
$$\Rightarrow 12x = 150 + 10x$$
$$\Rightarrow 12x - 10x = 150$$
$$\Rightarrow 2x = 150$$
$$\Rightarrow x = \frac{150}{2} = 75$$

Therefore, the number is 75.

Q4.

Answer :

Let one part be x.

7 times the first part $= 7x$

Let the other part be $\left(24-x\right)$.

5 times the second part $= 5\left(24-x\right)$

$\therefore 7x + 5\left(24 - x\right) = 146$

$\Rightarrow 7x + 120 - 5x = 146$

$\Rightarrow 7x - 5x = 146 - 120$

$\Rightarrow 2x = 26$

$\Rightarrow x = \frac{26}{2} = 13$

Therefore, one part is 13.

Other part $= \left(24 - x\right) = \left(24 - 13\right) = 11$

Q5.

Answer :

Let the number be x.

Fifth part increased by $5 = \frac{x}{5} + 5$

Fourt part diminished by $5 = \frac{x}{4} - 5$

$\therefore \frac{x}{5} + 5 = \frac{x}{4} - 5$

$\Rightarrow 5 + 5 = \frac{x}{4} - \frac{x}{5}$

$\Rightarrow 10 = \frac{5x - 4x}{20}$

$\Rightarrow 10 = \frac{x}{20}$

$\Rightarrow 200 = x$

$\Rightarrow x = 200$

Therefore, the number is 200.

Q6.

Answer :

Let the common multiple for the given three numbers be x.

Then, the three numbers would be 4x, 5x and 6x.

$\therefore 4x + 6x = 5x + 55$

$\Rightarrow 10x = 5x + 55$

$\Rightarrow 10x - 5x = 55$

$\Rightarrow 5x = 55$

$\Rightarrow x = \frac{55}{5} = 11$

$\therefore$ Smallest number $= 4x = 4\left(11\right) = 44$

Largest number is $= 6x = 6\left(11\right) = 66$

Third number $= 5x = 5\left(11\right) = 55$

Therefore, *the* three numbers are 44, 55 and 66.

Q7.

Answer :

Let the number be x.

$\therefore 10 + 4x = 5x - 5$

$\Rightarrow 10 + 5 = 5x - 4x$

$\Rightarrow 15 = x$

$\Rightarrow x = 15$ (by transposition)

Therefore, the number is 15.

Q8.

Answer :

Let us consider *x* as the common multiple of both the number.

Then, first number = 3*x*

Second number = 5*x*

$\therefore \frac{3x + 10}{5x + 10} = \frac{5}{7}$

$\Rightarrow 7\left(3x + 10\right) = 5\left(5x + 10\right)$ (by cross multiplication)

$\Rightarrow 21x + 70 = 25x + 50$

$\Rightarrow 21x - 25x = 50 - 70$

$\Rightarrow -4x = -20$

$\Rightarrow x = \frac{-20}{-4} = 5$

Therefore, the common multiple of both the numbers is 5.

First number = $3x = 3 \times 5 = 15$

Second number = $5x = 5 \times 5 = 25$

Q9.

Answer :

Let the first odd number be x.

Let the second odd number be $\left(x+2\right)$.

Let the third odd number be $\left(x+4\right)$.

$\therefore x + \left(x+2\right) + \left(x+4\right) = 147$

$\Rightarrow x + x + 2 + x + 4 = 147$

$\Rightarrow 3x + 6 = 147$

$\Rightarrow 3x = 147 - 6$

$\Rightarrow 3x = 141$

$\Rightarrow x = \frac{141}{3} = 47$

Therefore, the first odd number is 47.

$Second\ odd\ number = \left(x+2\right) = \left(47+2\right) = 49$

$Third\ odd\ number = \left(x+4\right) = \left(47+4\right) = 51$

Q10.

Answer :

Let the first even number *be* x.

Let the second even number *be* $x+2$.

Let the third even number be $x+4$.

$\therefore x + x+2+x+4 = 234$

$\Rightarrow x + x + 2 + x + 4 = 234$

$\Rightarrow 3x + 6 = 234$

$\Rightarrow 3x = 234 - 6$

$\Rightarrow 3x = 228$

$\Rightarrow x = \frac{228}{3} = 76$

$\therefore First\ even\ number = x = 76$

$Second\ even\ number = x+2 = 76+2 = 78$

$Third\ even\ number = x+4 = 80$

Q11. **Answer :**

Let the digit in *the* units place be x.

$Digit\ in\ the\ tens\ place = \left(12-x\right)$

$\therefore\ Original\ number = 10\left(12 - x\right) + x = 120 - 9x$

On reversing the digits, we have x at the tens place and $\left(12-x\right)$ at the units place.

$\therefore New\ number = 10x + 12 - x = 9x + 12$

$New\ number - Original\ number = 54$

$\Rightarrow 9x + 12 - \left(120 - 9x\right) = 54$

$\Rightarrow 9x + 12 - 120 + 9x = 54$

$\Rightarrow 18x - 108 = 54$

$\Rightarrow 18x = 54 + 108$

$\Rightarrow 18x = 162$

$\Rightarrow x = \frac{162}{18} = 9$

Therefore, the digit in *the* units place is 9.

$Digit\ in\ tens\ place = \left(12-x\right) = \left(12-9\right) = 3$

Therefore, the original number is 39.

Check :

The original number is 39.

$Sum\ of\ the\ digits\ in\ the\ original\ number = \left(3+9\right) = 12$

$New\ number\ obtained\ on\ reversing\ the\ digits = 93$

$New\ number - Original\ number = \left(93 - 39\right) = 54$

Thus, both the given conditions are satisfied by 39.

Hence, the original number *is* 39.

Q12.

Answer :

Let the digit in *the* units place be x.
*D*igit in *the* tens place $= 3x$
*O*riginal number $= 10\left(3x\right) + x = 30x + x$

On reversing the digits, we have x at the tens place and $\left(3x\right)$ at the units place.

$\therefore$ *N*ew number $= 10\left(x\right) + 3x = 10x + 3x$

New number $=$ Original number $- 36$
$\Rightarrow 10x + 3x = 30x + x - 36$
$\Rightarrow 13x = 31x - 36$
$\Rightarrow 36 = 31x - 13x$
$\Rightarrow 36 = 18x$
$\Rightarrow 18x = 36$
$\Rightarrow x = \frac{36}{18} = 2$
Therefore, the digit in *the* units place is 2.
*D*igit in *the* tens place $= \left(3x\right) = 3 \times 2 = 6$
Therefore, the original number is 62.

Check :
New number $+ 36 =$ Original Number
$26 + 36 = 62$
Hence, both the conditions are satisfied.
Therefore, the original number *is* 62.

Q13.

Answer :

Let the numerator be x.
The denominator is greater than the numerator by 7.
$\therefore \left(x+7\right)$
$\therefore \frac{x+17}{(x+7)-6} = 2$
$\Rightarrow \frac{x+17}{x+1} = 2$
$\Rightarrow x + 17 = 2\left(x + 1\right)$ $\left(\text{by cross multiplication}\right)$
$\Rightarrow x + 17 = 2x + 2$
$\Rightarrow x - 2x = 2 - 17$
$\Rightarrow -x = -15$
$\Rightarrow x = 15$
Therefore, the numerator is 15.
Denominator $= \left(x+7\right) = \left(15+7\right) = 22$
$\therefore$ Original number $= \frac{15}{22}$

Q14.

Denominator, d = x

It is given that twice the numerator is equal to two more than the denominator.

$\therefore$ Twice of numerator, $2n = x + 2$

$\therefore$ Numerator, $n = \frac{x+2}{2}$

$\therefore \frac{n+3}{d+3} = \frac{2}{3}$

$\Rightarrow 3(n + 3) = 2(d + 3)$ (*by cross multiplication*)

$\Rightarrow 3n + 9 = 2d + 6$

$\Rightarrow 3n - 2d = 6 - 9$

$\Rightarrow 3n - 2d = -3$

On replace d by x and n by $\frac{x+2}{2}$:

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

$\Rightarrow \frac{3x+6-4x}{2} = -3$ (taking the L.C.M. of 2 and 1 as 2)

$\Rightarrow 6 - x = -6$ (by cross multiplication)

$\Rightarrow -x = -6 - 6$

$\Rightarrow x = 12$

The denominator is 12.

$\therefore$ Numerator $= \frac{x+2}{2} = \frac{12+2}{2} = \frac{14}{2} = 7$

$\therefore$ Original fraction $= \frac{7}{12}$

Q15.

Answer :

Let the breadth of the original rectangle be x cm.

Then, its length will be (x + 7) cm.

The area of the rectangle will be (x)(x + 7) cm^2.

$\therefore (x + 3)(x + 7 - 4) = (x)(x + 7)$

$\Rightarrow (x + 3)(x + 3) = x^2 + 7x$

$\Rightarrow x^2 + 3x + 3x + 9 = x^2 + 7x$

$\Rightarrow x^2 + 6x + 9 = x^2 + 7x$

$\Rightarrow 9 = x^2 - x^2 + 7x - 6x$

$\Rightarrow 9 = x$

$\Rightarrow x = 9$ (by transposition)

Breadth of the original rectangle = 9 cm

Length of the original rectangle = (x + 7) = (9 + 7) = 16 cm

Q16.

Answer :

Let the width of the rectangle be x cm.

It is $\frac{2}{3}$ of the length of the rectangle.

This means that the length of the rectangle will be $\frac{3}{2}x$.

Perimeter of the rectangle $= 2(x) + 2\left(\frac{3}{2}\right)x = 180$ m

$\therefore 2x + \frac{6x}{2} = 180$

$\Rightarrow \frac{4x+6x}{2} = 180$ (taking the L.C.M. of 1 on the L.H.S. of the equation)

$\Rightarrow 10x = 2 \times 180$ (by cross multiplication)

$\Rightarrow 10x = 360$

$\Rightarrow x = \frac{360}{10} = 36$

Therefore, the width of the rectangle is 36 m.

Length of the rectangle will be $= \frac{3}{2}x = \frac{3}{2}(36) = 54$ m

Q17.

Let the length of the base of the triangle be x cm.

Then, its altitude will be $\frac{5}{3}x$ cm.

Area of the triangle $= \frac{1}{2}\left(x\right)\left(\frac{5}{3}x\right) = \frac{5}{6}x^2$

$\therefore \frac{1}{2}\left(x-2\right)\left(\frac{5}{3}x+4\right) = \frac{5}{6}x^2$

$\Rightarrow \left(\frac{x-2}{2}\right)\left(\frac{5x+12}{3}\right) = \frac{5x^2}{6}$

$\Rightarrow \frac{(x-2)(5x+12)}{6} = \frac{5x^2}{6}$

$\Rightarrow \frac{5x^2+12x-10x-24}{6} = \frac{5x^2}{6}$

$\Rightarrow 5x^2 + 2x - 24 = 5x^2$ (cancelling the denominators from both the sides since they are same)

$\Rightarrow 5x^2 - 5x^2 + 2x = 24$

$\Rightarrow 2x = 24$

$\Rightarrow x = \frac{24}{2} = 12\,m$

Therefore, the base of the triangle is 12 m.

Altitude of the triangle $= \frac{5}{3}x = \frac{5}{3}\left(12\right) = 20\,m$

Q18

Answer :

Let the common multiple of all the three angles be x.

Then, the first angle will be 4x.

And the second angle *will* be 5x.

In a triangle, sum of all the three angles will be equal to 180°.

$\therefore$ *T*hird angle $= 180 - \left(4x + 5x\right) = 180 - 9x$

$\therefore 4x + 5x = 180 - 9x$

$\Rightarrow 9x = 180 - 9x$

$\Rightarrow 9x + 9x = 180$

$\Rightarrow 18x = 180$

$\Rightarrow x = \frac{180}{18} = 10$

First angle $= 4x = 4 \times 10 = 40^\circ$

Second angle $= 5x = 5 \times 10 = 50^\circ$

Third angle $= 4x + 5x = 9x = 9 \times 10 = 90^\circ$

Q19

Answer :

Let the speed of the steamer in still water be x km/h.

Speed (downstream) $= (x + 1)$ km/h

Speed (upstream) $= (x - 1)$ km/h

Distance covered in 9 hours while going downstream $= 9(x+1)$ km

Distance covered in 10 hours while going upstream $= 10(x-1)$ km

But both of these distances will be same.

$9(x + 1) = 10(x - 1)$

$\Rightarrow 9x + 9 = 10x - 10$

$\Rightarrow 9 + 10 = 10x - 9x$

$\Rightarrow 19 = x$

$\Rightarrow x = 19$

Therefore, the speed of the steamer in still water is 19 km/h.

Distance between the ports $= 9(x+1) = 9(19+1) = 9 \times 20 = 180$ km

Q20

Answer :

Let the speed of one motorcyclist be x km/h.

So, the speed of the other motorcyclist will be $\left(x+7\right)$ km/h.

Distance travelled by the first motorcyclist in 2 hours $= 2x$ km

Distance travelled by the second motorcyclist in 2 hours $= 2\left(x+7\right)$ km

Therefore,

$300 - \left(2x + \left(2x + 14\right)\right) = 34$

$\Rightarrow 300 - \left(2x + 2x + 14\right) = 34$

$\Rightarrow 300 - 4x - 14 = 34$

$\Rightarrow 286 - 4x = 34$

$\Rightarrow 286 - 34 = 4x$

$\Rightarrow 252 = 4x$

$\Rightarrow x = \frac{252}{4} = 63$

Therefore, the speed of the first motorcyclist is 63 km/h.

The speed of the second motorcyclist is $\left(x+7\right) = \left(63+7\right) = 70$ km/h.

Check :

The distance covered by the first motorcyclist in 2 hours $= 63 \times 2 = 126$ km

The distance covered by the second motorcyclist in 2 hours $= 70 \times 2 = 140$ km

The distance between the motorcyclists after 2 hours $= 300 - \left(126 + 140\right) =$ 34 km (which is the same as given)

Therefore, the speeds of the motorcyclists are 63 km/h and 70 km/h, respectively.

Q21

Answer :

Let the first number be x.

Then, the second number will be $\frac{5}{6}x$.

Third number $= \frac{4}{5}\left(\frac{5}{6}x\right) = \frac{2}{3}x$

$\therefore x + \frac{5x}{6} + \frac{2x}{3} = 150$

$\Rightarrow \frac{6x+5x+4x}{6} = 150$ (multiplying the L.H.S. by 6, which is the L.C.M. of 1, 6 and 3)

$\Rightarrow 15x = 150 \times 6$ (by cross multiplication)

$\Rightarrow 15x = 900$

$\Rightarrow x = \frac{900}{15} = 60$

Therefore, the first number is 60.

Second number $= \frac{5}{6}x = \frac{5}{6}\left(60\right) = 50$

Third number $= \frac{2}{3}x = \frac{2}{3}\left(60\right) = 40$

Q22

Answer :

Let the first part be x.

Let the second part be $\left(4500 - x\right)$.

$\therefore 5\%\ of\ x = 10\%\ of\ \left(4500 - x\right)$

$\Rightarrow \left(\frac{5}{100}\right)x = \left(\frac{10}{100}\right)\left(4500 - x\right)$

$\Rightarrow \frac{5x}{100} = \frac{45000 - 10x}{100}$

$\Rightarrow 5x = 45000 - 10x$ (by cancellation of same denominators from both the sides) $\Rightarrow 5x + 10x = 45000 \Rightarrow 15x = 45000 \Rightarrow x = \frac{45000}{15} = 3000$ Therefore, the first part is 3000. Second part $= \left(4500 - x\right) = \left(4500 - 3000\right) = 1500$

Q23

Answer :

Let the present age of Rakhi be x.
Then, the present age of Rakhi's mother will be 4x.
After five years, Rakhi's age will be (x + 5).
After five years, her mother's age will be (4x + 5).

$4x + 5 = 3(x + 5)$
$\Rightarrow 4x + 5 = 3x + 15$
$\Rightarrow 4x - 3x = 15 - 5$
$\Rightarrow x = 10$

Present age of Rakhi $= 10$ years
Present age of Rakhi's mother $= 4(x) = 4 \times 10 = 40$ years

Q24

Answer :

Let the age of Monu's father be x years.
The age of Monu's grandfather will be $(x + 26)$.
Then, the age of Monu will be $(x - 29)$.

$\therefore x + (x + 26) + (x - 29) = 135$
$\Rightarrow x + x + 26 + x - 29 = 135$
$\Rightarrow 3x - 3 = 135$
$\Rightarrow 3x = 135 + 3$
$\Rightarrow 3x = 138$
$\Rightarrow x = \frac{138}{3} = 46$

$\therefore$ Age of Monu's father $= 46$ years
Age of Monu's grandfather $= (x + 26) = (46 + 26) = 72$ years
Age of Monu $= (x - 29) = 46 - 29 = 17$ years

Q25

Answer :

Let the age of the grandson be x years.
Then, his grandfather's age will be 10x.
Also, the grandfather is 54 years older than his grandson.
$\therefore$ Age of the grandson $= x + 54$

$10x = x + 54$
$\Rightarrow 10x - x = 54$
$\Rightarrow 9x = 54$
$\Rightarrow x = \frac{54}{9} = 6$

Therefore, the grandson's age is 6 years.
Grandfather's age $= 10(x) = 10 \times 6 = 60$ years

Q26

Answer :

Let the age of the younger cousin be x.
Then, the age of the elder cousin will be $(x + 10)$.
15 years ago :
Age of the younger cousin $= (x - 15)$
Age of elder cousin $= (x + 10 - 15)$
$= (x - 5)$

$\therefore (x - 5) = 2(x - 15)$
$\Rightarrow x - 5 = 2x - 30$
$\Rightarrow x - 2x = -30 + 5$
$\Rightarrow -x = -25$
$\Rightarrow x = 25$

Therefore, the present age of the younger cousin is 25 years.
Present age of elder cousin $= (x + 10) = (25 + 10) = 35$ years

Q27

Answer :

Let the number of deer in the herd be x.

The number of deer grazing in the field is $\left(\frac{1}{2}\right)$x.

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

Number of deer playing nearby $= \frac{3}{4}\left(\frac{x}{2}\right) = \frac{3}{8}x$

The number of deer drinking water from the pond is 9.

$\therefore 9 + \frac{3}{8}x + \frac{1}{2}x = x$

$\Rightarrow \frac{72+3x+4x}{8} = x$ $\left(\text{multiplying the L.H.S. by } 8, \text{ which is the L.C.M. of } 1, 8 \text{ and } 2\right)$

$\Rightarrow 72 + 7x = 8x$ $\left(\text{by cross multiplication}\right) \Rightarrow 72 = 8x - 7x \Rightarrow 72 = x \Rightarrow x = 72$Total number of deer in the herd $= 72$

Linear Equations
Ex 8C

Q1

Answer :

(c) 5

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

Q2

Answer :

$(b) \ -5$

$$5x + \frac{7}{2} = \frac{3}{2}x - 14$$
$$\Rightarrow \frac{10x + 7}{2} = \frac{3x - 28}{2}$$
$$\Rightarrow 10x + 7 = 3x - 28$$
$$\Rightarrow 10x - 3x = -28 - 7$$
$$\Rightarrow 7x = -35$$
$$\Rightarrow x = \frac{-35}{7} = -5$$

Q3

Answer :

(a) 40

$$z = \frac{4}{5}\left(z + 10\right)$$
$$\Rightarrow 5z = 4\left(z + 10\right)$$
$$\Rightarrow 5z = 4z + 40$$
$$\Rightarrow 5z - 4z = 40$$
$$\Rightarrow z = 40$$

Q4

Answer :

(c) $\frac{4}{5}$

$$3m = 5m - \frac{8}{5}$$
$$\Rightarrow 3m = \frac{25m - 8}{5}$$
$$\Rightarrow 15m = 25m - 8$$
$$\Rightarrow 15m - 25m = -8$$
$$\Rightarrow -10m = -8$$
$$\Rightarrow m = \frac{-8}{-10} = \frac{4}{5}$$

Q5

Answer :

(b) -1

$$5t - 3 = 3t - 5$$
$$\Rightarrow 5t - 3t = 3 - 5$$
$$\Rightarrow 2t = -2$$
$$\Rightarrow t = \frac{-2}{2} = -1$$

Q6

Answer :

(d) $\frac{7}{3}$

$$2y + \frac{5}{3} = \frac{26}{3} - y$$
$$\Rightarrow \frac{6y + 5}{3} = \frac{26 - 3y}{3}$$
$$\Rightarrow 6y + 5 = 26 - 3y$$
$$\Rightarrow 6y + 3y = 26 - 5$$
$$\Rightarrow 9y = 21$$
$$\Rightarrow y = \frac{21}{9} = \frac{7}{3}$$

Q7

Answer :

(b) -1

$$\frac{6x+1}{3} + 1 = \frac{x-3}{6}$$
$$\Rightarrow \frac{6x+1+3}{3} = \frac{x-3}{6}$$
$$\Rightarrow 6\left(6x+4\right) = 3\left(x-3\right)$$
$$\Rightarrow 36x + 24 = 3x - 9$$
$$\Rightarrow 36x - 3x = -24 - 9$$
$$\Rightarrow 33x = -33$$
$$\Rightarrow x = \frac{-33}{33} = -1$$

Q8

Answer :

(c) 36

$$\frac{n}{2} - \frac{3n}{4} + \frac{5n}{6} = 21$$
$$\Rightarrow \frac{6n - 9n + 10n}{12} = 21$$
$$\Rightarrow 7n = 21 \times 12$$
$$\Rightarrow 7n = 252$$
$$\Rightarrow n = \frac{252}{7} = 36$$

Q9

Answer :

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

$$\frac{x+1}{2x+3} = \frac{3}{8}$$
$$\Rightarrow 8\left(x+1\right) = 3\left(2x+3\right)$$
$$\Rightarrow 8x + 8 = 6x + 9$$
$$\Rightarrow 8x - 6x = 9 - 8$$
$$\Rightarrow 2x = 1$$
$$\Rightarrow x = \frac{1}{2}$$

Q10

Answer :

(c) 8

$$\frac{4x+8}{5x+8} = \frac{5}{6}$$
$$\Rightarrow 6\left(4x+8\right) = 5\left(5x+8\right)$$
$$\Rightarrow 24x + 48 = 25x + 40$$
$$\Rightarrow 24x - 25x = -48 + 40$$
$$\Rightarrow -x = -8$$
$$\Rightarrow x = 8$$

Q11

Answer :

(d) 12

$$\frac{n}{n+15} = \frac{4}{9}$$
$$\Rightarrow 9n = 4\left(n+15\right)$$
$$\Rightarrow 9n = 4n + 60$$
$$\Rightarrow 9n - 4n = 60$$
$$\Rightarrow 5n = 60$$
$$\Rightarrow n = \frac{60}{5} = 12$$

Q12

Answer :

(a) -2

$$3\left(t-3\right) = 5\left(2t+1\right)$$
$$\Rightarrow 3t - 9 = 10t + 5$$
$$\Rightarrow 3t - 10t = 9 + 5$$
$$\Rightarrow -7t = 14$$
$$\Rightarrow -t = \frac{14}{7} = 2$$
$$\Rightarrow t = -2$$

Q13

Answer :

(c) 80

Let the number be x.

$\therefore \frac{4}{5}x = \frac{3}{4}x + 4$

$\Rightarrow \frac{4x}{5} = \frac{3x+16}{4}$

$\Rightarrow 16x = 15x + 80$

$\Rightarrow 16x - 15x = 80$

$\Rightarrow x = 80$

Q14

Answer :

(b) 28 years

Let x be the common multiple of the ages of A and B.

Then. the ages of A and B would be 5x and 7x, respectively.

$\therefore \frac{5x+4}{7x+4} = \frac{3}{4}$

$\Rightarrow 4\left(5x+4\right) = 3\left(7x+4\right)$

$\Rightarrow 20x + 16 = 21x + 12$

$\Rightarrow 16 - 12 = 21x - 20x$

$\Rightarrow 4 = x$

$\Rightarrow x = 4$

$\therefore$ Age of $B = 7\left(x\right) = 7 \times 4$

$= 28$ years

Q15

Answer :

(b) 5 cm

Let the equal side of the isosceles triangle be x.

Then, the perimeter of the triangle would be $\left(x + x + 6\right)$.

$\therefore 2x + 6 = 16$

$\Rightarrow 2x = 16 - 6$

$\Rightarrow 2x = 10$

$\Rightarrow x = \frac{10}{2} = 5$

$\therefore$ Length of each equal side $= 5$ cm

Q16

Answer :

(d) 17

Let the three consecutive integers be x, x + 1 and x + 2.

Equation $= x + x + 1 + x + 2 = 51$

$\Rightarrow 3x + 3 = 51$

$\Rightarrow 3x = 51 - 3$

$\Rightarrow 3x = 48$

$\Rightarrow x = \frac{48}{3} = 16$

Middle integer $= x + 1 = 16 + 1 = 17$

Q17

Answer :

(a) 40

Let the numbers be x and x + 15.

$\therefore x + x + 15 = 95$

$\Rightarrow 2x + 15 = 95$

$\Rightarrow 2x = 95 - 15$

$\Rightarrow 2x = 80$

$\Rightarrow x = 40$

The smaller number is 40.

Q18

Answer :

(c) 48

Let the number of boys in the class be x.

Then, the number of girls will be $\left(x-8\right)$.

The equation becomes :

$\frac{x}{x-8} = \frac{7}{5}$

$\Rightarrow 5x = 7x - 56$

$\Rightarrow 5x - 7x = -56$

$\Rightarrow -2x = -56$

$\Rightarrow x = \frac{-56}{-2} = 28$

Therefore, the number of boys is 28.

Number of girls $= \left(x-8\right) = 28 - 8 = 20$

Total strength of the class $= 28 + 20 = 48$