# Chapter 1 Equations and Inequalities

## Ex 1.3

### Answer 1e.

Consider an equation $x - 2 = 0$. Substitute 2 for $x$ in this equation.

$$2 - 2 = 0$$
$$0 = 0$$

Since the resulting statement is true, 2 is a solution of the equation.

Thus, " if a number is substituted for a variable in an equation and the resulting statement is true, the number is called a(n) **solution** of the equation."

### Answer 1gp.

Subtract 9 from each side of the given equation.

$$4x + 9 - 9 = 21 - 9$$
$$4x = 12$$

Divide each side by 4.

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

The solution is 3.

**CHECK**

Substitute 3 for $x$ in the original equation.

$$4x + 9 = 21$$
$$4(3) + 9 \overset{?}{=} 21$$
$$12 + 9 \overset{?}{=} 21$$
$$21 = 21 ✓$$

Thus. the solution checks.

**Answer 2e.**

Two equations are equivalent if they have same solution, that is, same number satisfy both the equation.

Example of two equivalent equations

$$x + 2 = 0 \qquad\qquad \text{......(1)}$$

$$3x - 2 = -8 \qquad\qquad \text{......(2)}$$

Now, (1) and (2) will be equivalent equations if they have same solution. This can be done in two ways.

Firstly the two equations can be solved individually and then obtain their solution. If the solution is same for both the equations, we can say the two equations are equivalent.

Second way is to solve one of the two equations, obtain its solution and put this value in the other equation. If the solution of first equation also satisfies the other equation, then also we can say they have common solution. Hence two equations are equivalent.

We, here, apply the second way to check the equivalency of two given equations.

For this, we will solve equation (1) and substitute its solution in equation (2) to check whether it satisfies equation (2) also.

Consider linear equation (1) as

$$x + 2 = 0$$

Subtract 2 from each side, it becomes

$$x = -2$$

So, $\boxed{x = -2}$ is the solution of equation (1)

Next we will check that $x = -2$ is also the solution of equation (2) by substituting solution obtained from equation (1)

Put $x = -2$ in equation (2)

Left hand side of equation (2) $= 3x - 2$

Put $x = -2$, it becomes

Left hand side of equation (2) $= 3(-2) - 2$
$= -6 - 2$
$= -8$
$=$ right hand side of (2)
Hence, it has been checked that $x = -2$ also satisfy (2). So, $x = -2$ is solution of (2) also.

Thus $x = -2$ is the solution of equation (1) and (2) both.

So, equation (1) and (2) both are equivalent equations.

## Answer 2gp.

Given linear equation is:

$$7x - 41 = -13 \qquad \qquad \ldots\ldots(1)$$

Add 41 on both sides, it becomes

$$7x = -13 + 41$$
$$7x = 28$$

Divide both sides by 7, it becomes

$$x = \frac{28}{7}$$
$$x = 4$$

Thus, the solution of (1) is $\boxed{x = 4}$

Checking of the solution:

Left hand side $= 7x - 41$

Put $x = 4$

$$= 7(4) - 41$$
$$= 28 - 41$$
$$= -13$$
$$= right \text{ hand side}$$

Thus, the solution is checked.

## Answer 3e.

Subtract 8 from both sides of the given equation.
$$x + 8 - 8 = 11 - 8$$
$$x = 3$$

The solution is 3.

### CHECK
Substitute 3 for $x$ in the original equation.
$$x + 8 = 13$$
$$3 + 8 \overset{?}{=} 13$$
$$13 = 13 \checkmark$$

The solution checks.

## Answer 3gp.

Multiply each side of the equation using the least common denominator, 5.

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

Open the parentheses using the distributive property.

$$5\left(-\frac{3}{5}x\right) + 5(1) = 5(4)$$
$$-3x + 5 = 20$$

Subtract 5 from each side.
$$-3x + 5 - 5 = 20 - 5$$
$$-3x = 15$$

Divide each side by $-3$ and simplify.
$$\frac{-3x}{-3} = \frac{15}{-3}$$
$$x = -5$$

The solution is $-5$.

**Answer 4e.**

Given linear equation is:
$$y - 4 = 7 \qquad\qquad \ldots\ldots(1)$$
Add 4 on both sides, it becomes
$$(y - 4) + 4 = 7 + 4$$
$$y = 11$$
So, the solution of the linear equation given by (1) is $\boxed{y = 11}$

Checking of the solution
It is done by substituting value of $y = 11$ on both sides of equation (1)
Left Hand side $= y - 4$
Put $y = 11$
$$= 11 - 4 = 7$$
$$= \text{right hand side}$$
Thus, left hand side = Right hand side
So, $y = 11$ satisfies the equation (1).
Thus, the solution has been checked.

**Answer 4gp.**

Suppose the total selling by him in a year $= \$x$
Rate of commission in selling $= 4\%$
Total commission earned in a year $= 4\%$ of $\$x$

$$= \$ \frac{4}{100} \times x$$

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

Base salary of him in one year $= \$22000$

Thus, total earning of him in one year $= \frac{x}{25} + 22000$

Now, according to question, we want to find $x$ such that, his total earning in one year $= \$60000$

Thus,   $\frac{x}{25} + 22000 = 60000$

Subtract 22000 from both sides of equation, it becomes

$$\frac{x}{25} = 60000 - 22000$$

$$\frac{x}{25} = 38000$$

$$x = 38000 \times 25$$

$$x = 950000$$

Thus, his total selling in an year is $\$950000$

**Answer 5e.**

Add 13 to both sides of the given equation.
$z - 13 + 13 = -1 + 13$
$\qquad z = 12$

The solution is 12.

***CHECK***
Substitute 12 for $z$ in the original equation.

$$z - 13 = -1$$
$$12 - 13 \overset{?}{=} -1$$
$$-1 = -1 \checkmark$$

The solution checks.

## Answer 5gp.

Subtract $2x$ from each side of the given equation.
$$-2x + 9 - 2x = 2x - 7 - 2x$$
$$-4x + 9 = -7$$

Subtract 9 from each side.
$$-4x + 9 - 9 = -7 - 9$$
$$-4x = -16$$

Divide each side by –4.
$$\frac{-4x}{-4} = \frac{-16}{-4}$$
$$x = 4$$

The solution is 4.

***CHECK***
Substitute 4 for $x$ in the original equation.
$$-2x + 9 = 2x - 7$$
$$-2(4) + 9 \overset{?}{=} 2(4) - 7$$
$$-8 + 9 \overset{?}{=} 8 - 7$$
$$1 = 1 \checkmark$$

Thus. the solution checks.

## Answer 6e.

The given Linear equation is

$$-3 = w + 5 \qquad \qquad \ldots\ldots(1)$$

Subtract 5 from both sides, it becomes

$$-3 - 5 = w + 5 - 5$$
$$w + (5 - 5) = -8$$
$$w = -8$$

So, the Solution of the linear equation given by (1) is $\boxed{w = -8}$

Checking of the solution:

It is done by substituting the value of $w = -8$ on both sides of equation (1)

$$\text{Right hand side} = w + 5$$
$$\text{Put } w = -8$$
$$= -8 + 5$$
$$= -3$$
$$\text{Left hand side} = -3$$

Thus, Left hand side = Right hand side

So, $w = -8$ satisfies the equation (1)

Thus, the solution has been checked

## Answer 6gp.

Given linear equation is :

$$10 - x = -6x + 15 \qquad \qquad \ldots\ldots(1)$$

Add $6x$ on both sides, it becomes

$$(10 - x) + 6x = 15$$

Grouping like terms on left hand side

$$10 - x + 6x = 15$$
$$10 + 5x = 15$$

Subtract 10 on both sides, it becomes

$$5x = 15 - 10$$
$$5x = 5$$

Divide both sides by 5, it becomes

$$x = \frac{5}{5}$$
$$x = 1$$

Hence, the solution of (1) is $\boxed{x = 1}$

Checking the solution:

Left hand side $= 10 - x$

Put $x = 1$

$$= 10 - 1$$
$$= 9$$

Right hand side $= -6x + 15$

Put $x = 1$

$$= -6(1) + 15$$
$$= -6 + 15$$
$$= 9$$

Hence, left hand side $=$ right hand side

Thus, the solution is checked.

### Answer 7e.

Divide both sides of the equation by 5.
$$\frac{5d}{5} = \frac{30}{5}$$
$$d = 6$$

The solution is 6.

**CHECK**
Substitute 6 for $d$ in the original equation.
$$5d = 30$$
$$5(6) \overset{?}{=} 30$$
$$30 = 30 \checkmark$$

The solution checks.

### Answer 7gp.

Open the parentheses using the distributive property.
$$3(x) + 3(2) = 5(x) + 5(4)$$
$$3x + 6 = 5x + 20$$

Subtract $5x$ from each side.

$$3x + 6 - 5x = 5x + 20 - 5x$$
$$-2x + 6 = 20$$

Subtract 6 from each side.

$$-2x + 6 - 6 = 20 - 6$$
$$-2x = 14$$

Divide each side by $-2$ and simplify.

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

The solution is $-7$.

**CHECK**

Substitute $-7$ for $x$ in the original equation.

$$3(x + 2) = 5(x + 4)$$

$$3(-7 + 2) \overset{?}{=} 5(-7 + 4)$$
$$3(-5) \overset{?}{=} 5(-5)$$
$$-15 = -15 \checkmark$$

Thus. the solution checks.

## Answer 8e.

The given Linear equation is

$$4 = \frac{2}{5}g \qquad \qquad \dots\dots(1)$$

Multiply both sides by $\dfrac{5}{2}$, it becomes

$$4 \times \frac{5}{2} = \frac{2}{5}g \times \frac{5}{2}$$
$$2.5 = g$$
$$g = 10$$

So, the solution of linear equation given by (1) is $\boxed{g = 10}$

Checking of the solution:
It is done by substituting the value of $g=10$ in the equation (1)

Right hand side $=\dfrac{2}{5} \cdot g$

Put $g=10$

$=\dfrac{2}{5} \cdot 10$

$=2.2$

$=4$

$=$ left hand side

Thus, Left hand side = Right hand side

So, $g=10$ satisfies the equation (1)

Thus, the solution has been checked

**Answer 8gp.**

Given linear equation is:

$$-4(2x+5)=2(-x-9)-4x \qquad \qquad \dots\dots(1)$$

Apply distributive property on each side, it becomes

$$-4(2x)-4(5)=2(-x)+2(-9)-4x$$
$$-8x-20=-2x-18-4x$$

Grouping like terms on right hand side

$$-8x-20=-2x-4x-18$$
$$-8x-20=-6x-18$$

Add $6x$ on both sides, it becomes

$$-8x-20+6x=-18$$

Grouping like terms on left hand side

$$-8x+6x-20=-18$$
$$-2x-20=-18$$

Add $20$ on both sides, it becomes

$$-2x=-18+20$$
$$-2x=2$$

Divide each side by -2, it becomes

$$x=\dfrac{2}{-2}$$
$$x=-1$$

Hence, the solution of (1) is $\boxed{x=-1}$

Checking of the solution:

Left hand side $= -4(2x+5)$

Put $x = -1$

$$= -4\left[2(-1)+5\right]$$
$$= -4(-2+5)$$
$$= -4(3)$$
$$= -12$$

Right hand side $= 2(-x-9)-4x$

Put $x = -1$

$$= 2\left[-(-1)-9\right]-4(-1)$$
$$= 2(1-9)+4$$
$$= 2(-8)+4$$
$$= -16+4$$
$$= -12$$

Hence, left hand side $=$ right hand side

Thus, the solution is checked.

## Answer 9e.

Multiply both sides of the equation by 2.

$$2\left(\frac{9}{2}h\right) = 2(-1)$$
$$9h = -2$$

Divide both the sides by 9.

$$\frac{9h}{9} = \frac{-2}{9}$$

$$h = -\frac{2}{9}$$

The solution is $-\frac{2}{9}$.

**CHECK**

Substitute $-\frac{2}{9}$ for $h$ in the original equation.

$$\frac{9}{2}h = -1$$

$$\frac{9}{2}\left(-\frac{2}{9}\right) \overset{?}{=} -1$$

$$-1 = -1 \checkmark$$

The solution checks.

**Answer 9gp.**

Multiply each side of the equation using the least common denominator, 20.

$$20\left(\frac{1}{4}x + \frac{2}{5}x\right) = 20(39)$$

Open the parentheses using the distributive property.

$$20\left(\frac{1}{4}x\right) + 20\left(\frac{2}{5}x\right) = 20(39)$$

$$5x + 8x = 780$$

Combine the like terms.

$$13x = 780$$

Divide each side by 13, and simplify.

$$\frac{13x}{13} = \frac{780}{13}$$

$$x = 60$$

The solution is 60.

## CHECK

Substitute 60 for $x$ in the original equation.

$$\frac{1}{4}x + \frac{2}{5}x = 39$$

$$\frac{1}{4}(60) + \frac{2}{5}(60) \stackrel{?}{=} 39$$

$$15 + 24 \stackrel{?}{=} 39$$

$$39 = 39 ✓$$

Therefore, the solution for the given equation is 60.

**Answer 10e.**

The given Linear equation is

$$-16k = -8 \qquad\qquad\qquad\qquad \ldots\ldots(1)$$

Multiply both sides by $\dfrac{-1}{16}$, reciprocal of $(-16)$

$$-16k.\frac{-1}{16} = -8.\frac{-1}{16}$$

Simplifying and cancelling the term the equation becomes

$$k = \frac{1}{2}$$

Thus, the solution of Linear equation given by (1) is $\boxed{k = \dfrac{1}{2}}$

Checking of the solution:

Substitute value of $k = \dfrac{1}{2}$ on both sides of (1)

$$\text{Left hand side} = -16k$$

$$\text{Put } k = \frac{1}{2}$$

$$= -16.\frac{1}{2}$$

$$= -8$$

$$= \text{right hand side}$$

Therefore, $k = \dfrac{1}{2}$ satisfies the linear equation (1)

Thus, the solution has been checked

**Answer 10gp.**

Given linear equation is:

$$\frac{2}{3}x + \frac{5}{6} = x - \frac{1}{2} \qquad \ldots\ldots(1)$$

Subtract $x$ from both sides, it becomes

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

Grouping like terms on left hand side, it becomes

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

Subtract $\dfrac{5}{6}$ from both sides, it becomes

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

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

Multiply each side by LCD of 3, 1, 6 and 2, that is, 6

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

Apply distributive property on each side, it becomes

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

$$4x - 6x = -3 - 5$$

$$-2x = -8$$

Divide both sides by -2, it becomes

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

$$x = 4$$

Hence, the solution of (1) is $\boxed{x = 4}$

Checking of the solution:

Left hand side $= \dfrac{2}{3}x + \dfrac{5}{6}$

Put $x = 4$

$$= \dfrac{2}{3}(4) + \dfrac{5}{6}$$

$$= \dfrac{8}{3} + \dfrac{5}{6}$$

$$= \dfrac{16+5}{6}$$

$$= \dfrac{21}{6}$$

$$= \dfrac{7}{2}$$

Right hand side $= x - \dfrac{1}{2}$

Put $x = 4$

$$= 4 - \dfrac{1}{2}$$

$$= \dfrac{8-1}{2}$$

$$= \dfrac{7}{2}$$

Hence, left hand side = right hand side

Thus the solution is checked.

**Answer 11e.**

Add 3 to both sides of the given equation.

$6m - 3 + 3 = 21 + 3$

$6m = 24$

Divide both the sides by 6.

$$\frac{6m}{6} = \frac{24}{6}$$

$$m = 4$$

The solution is 4.

**CHECK**

Substitute 4 for $m$ in the original equation.

$$6m - 3 = 21$$

$$6(4) - 3 \stackrel{?}{=} 21$$

$$24 - 3 \stackrel{?}{=} 21$$

$$21 = 21 \checkmark$$

The solution checks.

## Answer 11gp.

*STEP 1*      **Write** a verbal model. Then write an equation.

Let $t$ be the time taken to wash the car.

Since the first person takes 9 minutes to wash a car, his rate will be $\frac{1}{9}$.

Similarly, the rate of the second person will be $\frac{1}{12}$.

| First person's rate $\left(\dfrac{\text{cars}}{\text{min}}\right)$ | · | Time (in min) | + | Second person's rate $\left(\dfrac{\text{cars}}{\text{min}}\right)$ | · | Time (in min) | = | Cars washed (cars) |
|---|---|---|---|---|---|---|---|---|
| ⇓ | | ⇓ | | ⇓ | | ⇓ | | ⇓ |
| $\dfrac{1\,\text{car}}{9\,\text{min}}$ | · | $t$ min | + | $\dfrac{1\,\text{car}}{12\,\text{min}}$ | · | $t$ min | = | 7 cars |

The equation is $\dfrac{1}{9}t + \dfrac{1}{12}t = 7$.

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**STEP 2** **Solve** for $t$.

Multiply each side of the equation by the least common denominator, 36.

$$36\left(\frac{1}{9}t + \frac{1}{12}t\right) = 36(7)$$

Open the parentheses using the distributive property.

$$36\left(\frac{1}{9}t\right) + 36\left(\frac{1}{12}t\right) = 36(7)$$

$$4t + 3t = 252$$

Combine the like terms.

$$7t = 252$$

Divide each term by 7, and simplify.

$$\frac{7t}{7} = \frac{252}{7}$$

$$t = 36$$

The time taken to wash the car is 36 minutes.

**CHECK** The first person will wash $\frac{1}{9}(36)$, or 4 cars, and the second person will

wash $\frac{1}{12}(36)$, or 3 cars. Together they will wash $3 + 4$, or 7 cars, which is

the same specified in the problem.

**Answer 12e.**

The given Linear equation is

$$4n - 10 = 12 \qquad\qquad \text{......(1)}$$

Add 10 on both sides, it becomes

$$4n - 10 + 10 = 12 + 10$$

$$4n = 22$$

Dividing both sides by 4

$$4n \times \frac{1}{4} = 22 \times \frac{1}{4}$$

$$n = \frac{11}{2}$$

So, the solution of Linear Equation given by **(1)** is $\boxed{n = \dfrac{11}{2}}$

Checking of the solution:

Substitute value of $n = \dfrac{11}{2}$ on both sides of (1)

Left hand side $= 4n - 10$

Put $n = \dfrac{11}{2}$

$= 4 \times \dfrac{11}{2} - 10$

Simplifying, it becomes

$= 2 \times 11 - 10$

$= 22 - 10$

$= 12$

$=$ right hand side

Thus, Left hand side = Right hand side

So, $n = \dfrac{11}{2}$ satisfies the linear equation (1)

Thus, the solution has been checked.

**Answer 13e.**

Subtract 5 from both sides of the given equation.

$3 - 5 = 2p + 5 - 5$

$-2 = 2p$

Divide both the sides by 2.

$\dfrac{-2}{2} = \dfrac{2p}{2}$

$-1 = p$

The solution is $-1$.

*CHECK*

Substitute $-1$ for $p$ in the original equation.

$3 = 2p + 5$

$3 \overset{?}{=} 2(-1) + 5$

$3 \overset{?}{=} -2 + 5$

$3 = 3 \checkmark$

The solution checks.

## Answer 14e.

The given Linear equation is

$$-3q + 4 = 13 \qquad \qquad \ldots\ldots(1)$$

Subtract 4 from both sides, it becomes

$$-3q + 4 - 4 = 13 - 4$$
$$-3q = 9$$

Multiplying both sides by $\dfrac{-1}{3}$; reciprocal of $-3$

$$-3q \times \dfrac{-1}{3} = 9 \times \dfrac{-1}{3}$$

Simplifying and cancelling the terms, the equation becomes

$$q = 3 \times -1$$
$$= -3$$

So, the solution of the linear equation given by (1) is $\boxed{q = -3}$

Checking of the solution:

Substitute value of $q = -3$ on both sides of (1)

Left hand side $= -3q + 4$

Put $q = -3$

$$= -3 \times -3 + 4$$
$$= 9 + 4$$
$$= 13$$

$$= \text{Right hand side}$$

Thus, Left hand side $=$ Right hand side

So, $\boxed{q = -3}$ satisfies linear equation (1)

Thus, the solution has been checked

## Answer 15e.

Add 5 to each side of the given equation.

$$1 + 5 = \frac{1}{3}a - 5 + 5$$
$$6 = \frac{1}{3}a$$

Multiply each side by 3.

$$3(6) = 3\left(\frac{1}{3}a\right)$$
$$18 = a$$

The solution is 18.

**CHECK**

Substitute 18 for $a$ in the original equation.

$$1 = \frac{1}{3}a - 5$$
$$1 \overset{?}{=} \frac{1}{3}(18) - 5$$
$$1 \overset{?}{=} 6 - 5$$
$$1 = 1 \checkmark$$

The solution checks.

**Answer 16e.**

Given linear equation is

$$\frac{3}{11}b + 5 = 5 \qquad\qquad ......(1)$$

Subtract 5 from both sides it becomes

$$\frac{3}{11}b + 5 - 5 = 5 - 5$$
$$\frac{3}{11}b = 0$$

Multiply both sides by multiplicative inverse of $\frac{3}{11}$, that is $\frac{11}{3}$ and it becomes

$$\frac{3}{11}b \times \frac{11}{3} = 0 \times \frac{11}{3}$$
$$b = 0$$

So, the solution of linear equation is $\boxed{b = 0}$

Checking the solution:
Substitute value of $b=0$ on both sides of (1)

$$\text{Left hand side} = \frac{3}{11}b+5$$

$$\text{Put } b=0$$
$$= \frac{3}{11}\times 0+5$$
$$= 0+5$$
$$= 5$$
$$= \text{right hand side}$$

Hence, left hand side = right hand side

So, it satisfies the solution.

Thus, the solution has been checked

**Answer 17e.**

Subtract 7 from both sides of the given equation.

$$7-\frac{5}{3}c-7 = 22-7$$
$$-\frac{5}{3}c = 15$$

Multiply each side by the reciprocal of $-\frac{5}{3}$, which is equal to $-\frac{3}{5}$.

$$\left(-\frac{3}{5}\right)\left(-\frac{5}{3}c\right) = \left(-\frac{3}{5}\right)(15)$$
$$c = -3(3)$$
$$= -9$$

The solution is $-9$.

### CHECK
Substitute $-9$ for $c$ in the original equation.
$$7-\frac{5}{3}c = 22$$
$$7-\frac{5}{3}(-9) \stackrel{?}{=} 22$$
$$7-5(-3) \stackrel{?}{=} 22$$
$$7+15 \stackrel{?}{=} 22$$
$$22 = 22 \checkmark$$

The solution checks.

## Answer 18e.

Given linear equation is

$$3 + \frac{8d}{7} = -1 \qquad \dots\dots(1)$$

Subtract 3 from each sides and it becomes,

$$3 + \frac{8d}{7} - 3 = -1 - 3$$

$$\frac{8d}{7} = -4$$

Multiply, both sides by $\frac{7}{8}$, that is multiplicative inverse of $\frac{8}{7}$

$$\frac{8d}{7} \times \frac{7}{8} = \frac{7}{8} \times -4$$

$$d = \frac{-7}{2}$$

So, the solution of linear equation is $\boxed{d = \frac{-7}{2}}$

Checking the solution:

Substitute the value $d = \frac{-7}{2}$ to left hand side it becomes

$$\begin{aligned}
\text{Left hand side} &= 3 + \frac{8}{7} \times \frac{-7}{2} \\
&= 3 - 4 \\
&= -1 \\
&= \text{right hand side}
\end{aligned}$$

Hence, the solution has been checked.

## Answer 19e.

Add 7 to both sides of the given equation.
$$4x - 7 + 7 = -15 + 7$$
$$4x = -8$$

Divide both the sides by 4.

$$\frac{4x}{4} = \frac{-8}{4}$$

$$x = -2$$

The solution is $-2$. which matches with **choice B**.

## Answer 20e.

Given linear equation is

$$3a + 4 = 2a + 15 \quad\quad\quad \dots\dots(1)$$

Subtract $2a$ from both sides, it becomes

$$(3a + 4) - 2a = (2a + 15) - 2a$$

Combining the like terms, that is, $3a$ and $2a$ and $2a$ and $2a$, it becomes

$$3a - 2a + 4 = 2a - 2a + 15$$

$$a + 4 = 15$$

Subtract 4 from both sides, it becomes

$$a = 15 - 4$$

$$a = 11$$

So, the solution of linear equation (1) is $\boxed{a = 11}$

Checking of Solution:

It is done by substituting value of $a = 11$ on both sides of equation (1)

$$\text{Left hand side} = 3a + 4$$

$$\text{Put } a = 11$$

$$= 3 \times 11 + 4$$

$$= 37$$

$$\text{Right hand side} = 2a + 15$$

$$= 2 \times 11 + 15$$

$$= 37$$

Hence, Left Hand side = Right hand side

So, $a = 11$ satisfies the equation (1)

Thus, the solution is being checked.

## Answer 21e.

Subtract $2w$ from each side of the equation.

$$5w + 2 - 2w = 2w + 5 - 2w$$

$$3w + 2 = 5$$

Now, subtract 2 from each side.

$$3w + 2 - 2 = 5 - 2$$

$$3w = 3$$

Divide each side by 3.

$$\frac{3w}{3} = \frac{3}{3}$$

$$w = 1$$

The solution is 1.

**CHECK**

Substitute 1 for $w$ in the original equation.

$$5w + 2 = 2w + 5$$

$$5(1) + 2 \overset{?}{=} 2(1) + 5$$

$$5 + 2 \overset{?}{=} 2 + 5$$

$$7 = 7 \checkmark$$

The solution checks.

**Answer 22e.**

Given linear equation is

$$6x + 7 = 2x + 59 \qquad\qquad \text{...... (1)}$$

Subtract $2x$ from both sides, it becomes

$$(6x + 7) - 2x = (2x + 59) - 2x$$

$$4x + 7 = 59$$

Subtract 7 from each side it becomes:-

$$4x = 59 - 7$$

$$4x = 52$$

Dividing both sides by 4, it becomes:

$$x = \frac{52}{4}$$

$$x = 13$$

So, the solution of linear equation (1) is $\boxed{x = 13}$

Checking of solution:-
Substitute value of $x = 13$ on both sides of $(1)$

Left hand side $= 6x + 7$
Put $x = 13$
$= 6 \times 13 + 7$
$= 78 + 7$
$= 85$

Right hand side $= 2x + 59$

Put $x = 13$
$= 2 \times 13 + 59$
$= 26 + 59$
$= 85$

Hence, left hand side $=$ right hand side

So, $x = 13$ satisfies the equation $(1)$.

Thus the solution is being checked.

**Answer 23e.**

Subtract $2b$ from each side of the equation.
$5b - 2b + 4 = 2b + 8 - 2b$
$3b + 4 = 8$

Add 4 to each side.
$3b - 4 + 4 = 8 + 4$
$3b = 12$

Divide each side by 3.
$\dfrac{3b}{3} = \dfrac{12}{3}$
$b = 4$

The solution is 4.

**CHECK**
Substitute 4 for $b$ in the original equation.
$5b - 4 = 2b + 8$
$5(4) - 4 \overset{?}{=} 2(4) + 8$
$20 - 4 \overset{?}{=} 8 + 8$
$16 = 16 \checkmark$

The solution checks.

**Answer 24e.**

Given linear equation is

$$3y + 7 = y - 3 \qquad \qquad \dots\dots(1)$$

Subtract y from both sides, it becomes

$$(3y + 7) - y = (y - 3) - y$$

$$2y + 7 = -3$$

Subtract 7 from both sides and it becomes

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

So, the solution of linear equation (1) is $\boxed{y = -5}$

Checking the solution:-

Left hand side $= 3y + 7$
$\qquad$ Put $y = -5$
$$= 3(-5) + 7$$
$$= -15 + 7$$
$$= -8$$

Right hand side $= y - 3$
$\qquad$ Put $y = -5$
$$= -5 - 3$$
$$= -8$$

Hence , left hand side $=$ right hand side

So, $y = -5$ satisfies the equation (1).

Thus the solution is being checked.

**Answer 25e.**

Subtract $6z$ from each side of the given equation.

$2z - 3 - 6z = 6z + 25 - 6z$

$-4z - 3 = 25$

Add 3 to each side.

$-4z - 3 + 3 = 25 + 3$

$-4z = 28$

Divide each side by $-4$.

$\dfrac{-4z}{-4} = \dfrac{28}{-4}$

$z = -7$

The solution is $-7$.

**CHECK**
Substitute $-7$ for $z$ in the original equation.

$2z - 3 = 6z + 25$

$2(-7) - 3 \overset{?}{=} 6(-7) + 25$

$-14 - 3 \overset{?}{=} -42 + 25$

$-17 = -17$ ✔

The solution checks.

**Answer 26e.**

Given linear equation is

$$4n - 7 = 5 - 2n \qquad\qquad \cdots\cdots(1)$$

Add $2n$ to both sides, it becomes

$$(4n - 7) + 2n = (5 - 2n) + 2n$$

$$6n - 7 = 5$$

Add 7 to both sides, it becomes

$$6n = 12$$

Divide both sides by 6

$$n = \dfrac{12}{6}$$

$$n = 2$$

So, the solution of linear equation (1) is $\boxed{n = 2}$

Checking the solution:-

Left hand side $= 4n - 7$

$$\text{Put } n = 2$$
$$= 4 \times 2 - 7$$
$$= 8 - 7$$
$$= 1$$

Right hand side $= 5 - 2n$

$$\text{Put } n = 2$$
$$= 5 - 2 \times 2$$
$$= 5 - 4$$
$$= 1$$

Hence, left hand side = right hand side

So, $n = 2$ satisfies the equation (1).

Thus the solution is being checked.

## Answer 27e.

Add $4c$ to each side of the given equation.
$$2c + 14 + 4c = 6 - 4c + 4c$$
$$6c + 14 = 6$$

Subtract 14 from each side.
$$6c + 14 - 14 = 6 - 14$$
$$6c = -8$$

Divide each side by 6.
$$\frac{6c}{6} = \frac{-8}{6}$$
$$c = -\frac{4}{3}$$

The solution is $-\dfrac{4}{3}$.

*CHECK*

Substitute $-\dfrac{4}{3}$ for $c$ in the original equation.

$$2c + 14 = 6 - 4c$$

$$2\left(-\dfrac{4}{3}\right) + 14 \stackrel{?}{=} 6 - 4\left(-\dfrac{4}{3}\right)$$

$$-\dfrac{8}{3} + 14 \stackrel{?}{=} 6 + \dfrac{16}{3}$$

$$\dfrac{34}{3} = \dfrac{34}{3} \quad \checkmark$$

Thus. the solution checks.

## Answer 28e.

Given linear equation is

$$5m - 2 = -m - 2 \qquad \text{...... (1)}$$

Add $m$ to both sides, it becomes

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

$$6m - 2 = -2$$

Add 2 to both sides of equation, it becomes

$$6m = 0$$

Divide both sides of equation by 6, it becomes

$$m = 0$$

So, the solution of linear equation (1) is $\boxed{m = 0}$

## Answer 29e.

Add $4p$ to each side of the given equation.

$$p + 5 + 4p = 25 - 4p + 4p$$

$$5p + 5 = 25$$

Subtract 5 from each side.

$$5p + 5 - 5 = 25 - 5$$

$$5p = 20$$

Divide each side by 5.

$$\frac{5p}{5} = \frac{20}{5}$$
$$p = 4$$

The solution is 4.

**CHECK**

Substitute 4 for $p$ in the original equation.

$$p + 5 = 25 - 4p$$
$$4 + 5 = 25 - 4(4)$$
$$9 \overset{?}{=} 25 - 16$$
$$9 = 9 \checkmark$$

Thus. the solution checks.

**Answer 30e.**

Given linear equation is

$$6 - 5q = q + 9 \qquad \qquad \text{...... (1)}$$

Subtract q from both sides it becomes

$$(6 - 5q) - q = (q + 9) - q$$
$$6 - 6q = 9$$

Subtract 6 from each side, it becomes

$$-6q = 9 - 6$$
$$-6q = 3$$

Divide each side by $-6$, it becomes

$$q = \frac{3}{-6}$$
$$q = \frac{-1}{2}$$

So, the solution of linear equation (1) is $\boxed{q = \dfrac{-1}{2}}$

Checking the solution –:

Left hand side $= 6 - 5q$

Put $q = \dfrac{-1}{2}$

$$= 6 - 5\left(\dfrac{-1}{2}\right)$$

$$= 6 + \dfrac{5}{2}$$

$$= \dfrac{12 + 5}{2}$$

$$= \dfrac{17}{2}$$

Right hand side $= q + 9$

Put $q = \dfrac{-1}{2}$

$$= \dfrac{-1}{2} + 9$$

$$= \dfrac{-1 + 18}{2}$$

$$= \dfrac{17}{2}$$

Hence, left hand side $=$ right hand side

Thus the solution is being checked.

**Answer 31e.**

Add $3r$ to each side of the given equation.
$$17 - 6r + 3r = 25 - 3r + 3r$$
$$17 - 3r = 25$$

Subtract 17 from each side.
$$17 - 3r - 17 = 25 - 17$$
$$-3r = 8$$

Divide each side by $-3$.

$$\frac{-3r}{-3} = \frac{8}{-3}$$

$$r = -\frac{8}{3}$$

The solution is $-\frac{8}{3}$.

**CHECK**

Substitute $-\frac{8}{3}$ for $r$ in the original equation.

$$17 - 6r = 25 - 3r$$

$$17 - 6\left(-\frac{8}{3}\right) = 25 - 3\left(-\frac{8}{3}\right)$$

$$17 + \frac{48}{3} \overset{?}{=} 25 + \frac{24}{3}$$

$$\frac{99}{3} = \frac{99}{3} \checkmark$$

Thus. the solution checks.

**Answer 32e.**

Given linear equation is:

$$7t - 5 = 3t + 11 \qquad\qquad \dots\dots(1)$$

Subtract $3t$ from both sides, it becomes

$$7t - 5 - 3t = 11$$

Grouping like terms, it becomes

$$7t - 3t - 5 = 11$$

$$4t - 5 = 11$$

Add 5 on both side of equation, it becomes

$$4t = 11 + 5$$
$$4t = 16$$

Divide both sides by 4, it becomes

$$t = \frac{16}{4}$$

$$t = 4$$

Thus, the solution of $(1)$ is $t = 4$

Clearly, option $\boxed{D}$ is correct.

## Answer 33e.

Open the parentheses using the distributive property.

$2(b) + 2(3) = 4b - 2$

$2b + 6 = 4b - 2$

Subtract $4b$ from each side.

$2b + 6 - 4b = 4b - 2 - 4b$

$-2b + 6 = -2$

Subtract 6 from each side.

$-2b + 6 - 6 = -2 - 6$

$-2b = -8$

Divide each side by $-2$ and simplify.

$\dfrac{-2b}{-2} = \dfrac{-8}{-2}$

$b = 4$

The solution is 4.

### CHECK
Substitute 4 for $b$ in the original equation.

$2(b + 3) = 4b - 2$

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

$2(7) \stackrel{?}{=} 16 - 2$

$14 = 14$ ✓

Thus. the solution checks.

## Answer 34e.

Given linear equation is

$$5d + 17 = 4(d + 3) \qquad\qquad \text{...... (1)}$$

Apply distributive property on both sides, it becomes

$5d + 17 = 4.d + 4.3$

$5d + 7 = 4d + 12$

Subtract 4d from both sides of equation, it becomes

$5d + 7 - 4d = 12$

$d + 7 = 12$

Subtract 7 from both sides of equation, it becomes

$d = -5$

Thus the solution of linear equation becomes $\boxed{d = -5}$

Checking of the solution:-

Left hand side $= 5d + 17$

Put $d = -5$
$$= 5 \times -5 + 17$$
$$= -25 + 17$$
$$= -8$$

Right hand side $= 4(d + 3)$

Put $d = -5$
$$= 4(-5 + 3)$$
$$= 4 \times -2$$
$$= -8$$

Hence, left hand side = right hand side

Hence, the solution is checked.

**Answer 35e.**

Open the parentheses using the distributive property.
$$3(m) + 3(-5) = 6(m) + 6(1)$$
$$3m - 15 = 6m + 6$$

"

Subtract $6m$ from each side of the equation.
$$3m - 15 - 6m = 6m + 6 - 6m$$
$$-3m - 15 = 6$$

Add 15 to each side.
$$-3m - 15 + 15 = 6 + 15$$
$$-3m = 21$$

Divide each side by $-3$ and simplify.

$$\frac{-3m}{-3} = \frac{21}{-3}$$

$$m = -7$$

The solution is $-7$.

**CHECK**

Substitute $-7$ for $m$ in the original equation.

$$3(m-5) = 6(m+1)$$

$$3(-7-5) = 6(-7+1)$$

$$3(-12) \stackrel{?}{=} 6(-6)$$

$$-36 = -36 \checkmark$$

Thus. the solution checks.

**Answer 36e.**

Given linear equation is

$$-4(n+2) = 3(n-4) \qquad\qquad\qquad \dots\dots(1)$$

Applying distributive property on both sides, it becomes

$$-4.n - 4.2 = 3.n - 3.4$$

$$-4n - 8 = 3n - 12$$

Add $4n$ on both sides, it becomes

$$-4n - 8 + 4n = 3n - 12 + 4n$$

$$-4n + 4n - 8 = 3n + 4n - 12$$

$$-8 = 7n - 12$$

Add 12 on both sides, it becomes

$$-8 + 12 = 7n$$

$$4 = 7n$$

Divide each side by 7

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

So, the solution of linear equation (1) is $\boxed{n = \dfrac{4}{7}}$

Checking of the solution:

It is done by substituting value of $n = \dfrac{4}{7}$ on each side of equation (1)

Left hand side $= -4(n+2)$

Put $n = \dfrac{4}{7}$, it becomes

$$= -4\left(\dfrac{4}{7} + 2\right)$$

$$= -4\left(\dfrac{4+14}{7}\right)$$

$$= -4\left(\dfrac{18}{7}\right)$$

$$= \dfrac{-72}{7}$$

Right hand side $= 3(n-4)$

Put $n = \dfrac{4}{7}$, it becomes

$$= 3\left(\dfrac{4}{7} - 4\right)$$

$$= 3\left(\dfrac{4-28}{7}\right)$$

$$= 3\left(\dfrac{-24}{7}\right)$$

$$= \dfrac{-72}{7}$$

Thus, Left hand side $=$ Right hand side

Hence, the solution $n = \dfrac{4}{7}$ is being checked

**Answer 37e.**

Open the parentheses using the distributive property.

$12(r) + 12(3) = 2(r) + 2(5) - 3r$

$12r + 36 = 2r + 10 - 3r$

"

Combine the like terms.

$12r + 36 = -r + 10$

Add $r$ to each side.

$12r + 36 + r = -r + 10 + r$

$13r + 36 = 10$

Subtract 36 from each side.

$13r + 36 - 36 = 10 - 36$

$\qquad 13r = -26$

Divide each side by 13 and simplify.

$$\frac{13r}{13} = \frac{-26}{13}$$

$\qquad r = -2$

The solution is −2.

**CHECK**

Substitute −2 for $r$ in the original equation.

$12(r + 3) = 2(r + 5) - 3r$

$12(-2 + 3) = 2(-2 + 5) - 3(-2)$

$12(1) \overset{?}{=} 2(3) + 6$

$12 \overset{?}{=} 6 + 6$

$12 = 12 \; ✔$

Thus. the solution checks.

**Answer 38e.**

Given linear equation is

$$7(t-3)=2(t-9)+2t \qquad\qquad\qquad \text{......(1)}$$

Apply distributive property on both sides, it becomes

$7.t-7.3=2.t-2.9+2t$

$7t-21=2t-18+2t$

$7t-21=4t-18$

Subtract 4t from each side, it becomes

$7t-21-4t=-18$

$\qquad 3t-21=-18$

Add 21 to both sides of equation, it becomes

$\qquad 3t=-18+21$

$\qquad 3t=3$

Divide both sides of equation by 3, it becomes

$\qquad t=1$

Thus, the solution of linear equation (1) is $\boxed{t=1}$

Checking of the solution as below :-

Left hand side $= 7(t-3)$

        Put $t = 1$

           $= 7(t-3)$

           $= 7(1-3)$

           $= -14$

Right hand side $= 2(t-9) + 2t$

        Put $t = 1$

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

           $= 2(-8) + 2$

           $= -16 + 2$

           $= -14$

Hence left hand side $=$ right hand side

Hence the solution is checked.

## Answer 39e.

Open the parentheses using the distributive property.

$10(w) + 10(-4) = 4(w) + 4(4) + 4w$

     $10w - 40 = 4w + 16 + 4w$

Combine the like terms.

$10w - 40 = 8w + 16.$

Subtract $8w$ from each side.

  $10w - 40 - 8w = 8w + 16 - 8w$

     $2w - 40 = 16$

Add 40 to each side.

$2w - 40 + 40 = 16 + 40$

     $2w = 56$

Divide each side by 2 and simplify.

$$\frac{2w}{2} = \frac{56}{2}$$

$$w = 28$$

The solution is 28.

*CHECK*

Substitute 28 for $w$ in the original equation.

$$10(w-4) = 4(w+4)+4w$$

$$10(28-4) = 4(28+4)+4(28)$$

$$10(24) \overset{?}{=} 4(32)+112$$

$$240 \overset{?}{=} 128+112$$

$$240 = 240 \checkmark$$

Thus. the solution checks.

**Answer 40e.**

Given linear equation is

$$3(2x-5)-x=-7(x+3) \qquad\qquad \ldots\ldots(1)$$

Apply distributive property on both sides, it becomes

$$3.2x-3.5-x=-7x-7.3$$
$$6x-15-x=-7x-21$$
$$5x-15=-7x-21$$

Add $7x$ to each sides, it becomes

$$5x-15+7x=-21$$
$$12x-15=-21$$

Add 15 to each side, it becomes

$$12x=15-21$$
$$12x=-6$$

Divide each side by 12, it becomes

$$x=\frac{-6}{12}$$
$$x=\frac{-1}{2}$$

Thus, the solution of linear equation is $\boxed{x=\dfrac{-1}{2}}$

Checking of the solution as below:-

Left hand side $= 3(2x-5)-x$

Put $x = \dfrac{-1}{2}$

$= 3\left(2 \times \dfrac{-1}{2} - 5\right) - \dfrac{-1}{2}$

$= 3(-1-5) + \dfrac{1}{2}$

$= -18 + \dfrac{1}{2}$

$= \dfrac{-36+1}{2}$

$= \dfrac{-35}{2}$

Right hand side $= -7(x+3)$

Put $x = \dfrac{-1}{2}$

$= -7\left(\dfrac{-1}{2} + 3\right)$

$= -7\left(\dfrac{-1+6}{2}\right)$

$= -7\left(\dfrac{5}{2}\right)$

$= \dfrac{-35}{2}$

Hence, left hand side $=$ right hand side

Thus, the solution is checked.

**Answer 41e.**

In the third step, the reciprocal of $\dfrac{3}{7}$, or $\dfrac{7}{3}$ should be multiplied to each side of the equation. But in the given equation, it is subtracted from the right side of the equation.

Correct the error in the third step by multiplying both sides of the equation by $\dfrac{7}{3}$.

$\dfrac{7}{3}\left(\dfrac{3}{7}x\right) = \dfrac{7}{3}(15)$

$x = 7(5)$

$= 35$

Therefore, the solution for the given equation is 35.

**Answer 42e.**

In the given solution of the linear equation, the mistake lies in step 2.

This is explained as below:

The given linear equation is:

Step 1:    $\dfrac{1}{5}x + \dfrac{1}{2} = 1$                                        ......(1)

Step 2: $10\left(\dfrac{1}{5}x + \dfrac{1}{2}\right) = 1$                              ......(2)

This step (2) is wrong because here 10 is multiplied only on left hand side but not on right hand side.

If 10 is to be multiplied with the linear equation it has to be multiplied on both sides.

So, the corrected step will be

Multiply both sides of (1) by 10, it becomes

$$10\left(\dfrac{1}{5}x + \dfrac{1}{2}\right) = 10(1)$$

Apply distributive property on left hand side

$$2x + 5 = 10$$

Subtract 5 from each side, it becomes

$$2x = 10 - 5$$

$$2x = 5$$

Divide each side by 2

$$x = \dfrac{5}{2}$$

So, the solution of (1) is $\boxed{x = \dfrac{5}{2}}$

**Answer 43e.**

Multiply each side of the equation using the least common denominator, 6.

$$6\left(\frac{1}{2}t + \frac{1}{3}t\right) = 6(10)$$

Open the parentheses using the distributive property.

$$6\left(\frac{1}{2}t\right) + 6\left(\frac{1}{3}t\right) = 6(10)$$
$$3t + 2t = 60$$

Combine the like terms.
$5t = 60$

Divide each side by 5 and simplify.
$$\frac{5t}{5} = \frac{60}{5}$$
$$t = 12$$

The solution is 12.

## CHECK

Substitute 12 for $t$ in the original equation.

$$\frac{1}{2}t + \frac{1}{3}t = 10$$

$$\frac{1}{2}(12) + \frac{1}{3}(12) \overset{?}{=} 10$$
$$6 + 4 \overset{?}{=} 10$$
$$10 = 10 \checkmark$$

Thus. the solution checks.

**Answer 44e.**

Given linear equation is:

$$\frac{1}{5}d + \frac{1}{8}d = 2 \qquad \qquad \dots\dots(1)$$

Multiply both sides by LCD of 5 and 8, that is 40

$$\left(\frac{1}{5}d + \frac{1}{8}d\right) \times 40 = 2 \times 40$$

Apply distributive property

$$\left(\frac{1}{5}d\right) \times 40 + \left(\frac{1}{8}d\right) \times 40 = 80$$

$$8d + 5d = 80$$

Combining like terms and on adding, it becomes

$$13d = 80$$

Divide each side by 13

$$d = \frac{80}{13} \qquad \qquad \dots\dots(2)$$

Thus, $\boxed{d = \frac{80}{13}}$ is the solution to equation (1)

Checking of the solution:

Substituting the value of d in both sides of (1) it becomes

Left hand side $= \dfrac{1}{5}\left(\dfrac{80}{13}\right) + \dfrac{1}{8}\left(\dfrac{80}{13}\right)$

$$= \dfrac{16}{13} + \dfrac{10}{13}$$

$$= \dfrac{16 + 10}{13}$$

$$= \dfrac{26}{13}$$

$$= 2$$

$$= \text{right hand side}$$

Thus, left hand side = right hand side

Hence, the solution is verified.

**Answer 45e.**

Multiply each side of the equation using the least common denominator, 15.

$$15\left(\dfrac{2}{3}m - \dfrac{3}{5}m\right) = 15(4)$$

Open the parentheses using the distributive property.

$$15\left(\dfrac{2}{3}m\right) - 15\left(\dfrac{3}{5}m\right) = 15(4)$$

$$10m - 9m = 60$$

Combine the like terms.
$m = 60$

The solution is 60.

*CHECK*
Substitute 60 for *m* in the original equation.

$$\dfrac{2}{3}m - \dfrac{3}{5}m = 4$$

$$\dfrac{2}{3}(60) - \dfrac{3}{5}(60) \overset{?}{=} 4$$

$$2(20) - 3(12) \overset{?}{=} 4$$

$$40 - 36 \overset{?}{=} 4$$

$$4 = 4 ✓$$

Thus, the solution checks.

**Answer 46e.**

Given linear equation is

$$\frac{4}{7}z + \frac{2}{3}z = 13 \qquad\qquad \dots\dots(1)$$

Multiply both sides by LCD of 7 and 3, that is 21

$$21\left(\frac{4}{7}z + \frac{2}{3}z\right) = 21 \times 13$$

Apply distributive property

$$21\left(\frac{4}{7}z\right) + 21\left(\frac{2}{3}z\right) = 273$$

$$12z + 14z = 273$$

Combining like terms and on adding, it becomes

$$26z = 273$$

Divide each side by 26

$$z = \frac{273}{26}$$

$$\boxed{z = \frac{21}{2}}$$

Checking of the solution:-

Substituting the value of z in (1), it becomes

Left hand side $= \dfrac{4}{7}z + \dfrac{2}{3}z$

Put $z = \dfrac{21}{2}$

$$= \frac{4}{7}\left(\frac{21}{2}\right) + \frac{2}{3}\left(\frac{21}{2}\right)$$

$$= 2 \times 3 + 7$$

$$= 6 + 7$$

$$= 13$$

$$= \text{right hand side}$$

Hence, solution is checked.

**Answer 47e.**

Multiply each side of the equation using the least common denominator, 63.

$$63\left(\frac{3}{7}w - \frac{2}{9}\right) = 63\left(\frac{4}{9}w + \frac{1}{7}\right)$$

Open the parentheses using the distributive property.

$$63\left(\frac{3}{7}w\right) - 63\left(\frac{2}{9}\right) = 63\left(\frac{4}{9}w\right) + 63\left(\frac{1}{7}\right)$$

$$27w - 14 = 28w + 9$$

Subtract $28w$ from each side.

$$27w - 14 - 28w = 28w + 9 - 28w$$

$$-w - 14 = 9$$

Add 14 to each side.

$$-w - 14 + 14 = 9 + 14$$

$$-w = 23 \quad \text{or} \quad w = -23$$

The solution is –23.

**CHECK**

Substitute –23 for $w$ in the original equation.

$$\frac{3}{7}w - \frac{2}{9} = \frac{4}{9}w - \frac{1}{7}$$

$$\frac{3}{7}(-23) - \frac{2}{9} \overset{?}{=} \frac{4}{9}(-23) - \frac{1}{7}$$

$$-\frac{69}{7} - \frac{2}{9} \overset{?}{=} -\frac{92}{9} - \frac{1}{7}$$

$$-\frac{653}{63} = -\frac{653}{63} \quad \checkmark$$

Thus. the solution checks.

**Answer 48e.**

Given linear equation is :

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

Add $\dfrac{2}{3}x$ on both sides, it becomes

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

Subtract 4 from each side, it becomes

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

Multiply each side by LCD of 2 and 3, that is, 6

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

Apply distributive property on each side

$$6\left(\frac{1}{2}x\right) + 6\left(\frac{2}{3}x\right) = 3 - 24$$
$$3x + 4x = -21$$
$$7x = -21$$

Divide each side by 7 it becomes

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

Thus $\boxed{x = -3}$ is the solution to equation (1)

Checking of the solution:

Substituting the value of x in both sides of (1) it becomes

Left hand side $= \dfrac{1}{2}x + 4$

      Put $x = -3$ it becomes

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

$$= \dfrac{-3}{2} + 4$$

$$= \dfrac{-3+8}{2}$$

$$= \dfrac{5}{2}$$

Right hand side $= \dfrac{-2}{3}x + \dfrac{1}{2}$

      Put $x = -3$ it becomes

Right hand side $= \dfrac{-2}{3}(-3) + \dfrac{1}{2}$

$$= 2 + \dfrac{1}{2}$$

$$= \dfrac{4+1}{2}$$

$$= \dfrac{5}{2}$$

$$= \text{right hand side}$$

Thus, left hand side = right hand side .

Hence, the solution is verified.

**Answer 49e.**

Multiply each side of the equation using the least common denominator, 30.

$$30\left(\dfrac{2}{5}k + \dfrac{1}{6}\right) = 30\left(\dfrac{3}{10}k + \dfrac{1}{3}\right)$$

Open the parentheses using the distributive property.

$$30\left(\frac{2}{5}k\right) + 30\left(\frac{1}{6}\right) = 30\left(\frac{3}{10}k\right) + 30\left(\frac{1}{3}\right)$$

$$12k + 5 = 9k + 10$$

Subtract $9k$ from each side.

$$12k + 5 - 9k = 9k + 10 - 9k$$

$$3k + 5 = 10$$

Subtract 5 from each side.

$$3k + 5 - 5 = 10 - 5$$

$$3k = 5$$

Divide each side by 3.

$$\frac{3k}{3} = \frac{5}{3}$$

$$k = \frac{5}{3}$$

The solution is $\frac{5}{3}$.

**CHECK**

Substitute $\frac{5}{3}$ for $k$ in the original equation.

$$\frac{2}{5}k + \frac{1}{6} = \frac{3}{10}k + \frac{1}{3}$$

$$\frac{2}{5}\left(\frac{5}{3}\right) + \frac{1}{6} \overset{?}{=} \frac{3}{10}\left(\frac{5}{3}\right) + \frac{1}{3}$$

$$\frac{2}{3} + \frac{1}{6} \overset{?}{=} \frac{3}{6} + \frac{1}{3}$$

$$\frac{5}{6} = \frac{5}{6} \checkmark$$

Thus. the solution checks.

**Answer 50e.**

Given linear equation is

$$\frac{2}{3}q - \frac{1}{12} = q + \frac{1}{8} \qquad \text{......(1)}$$

Subtract $q$ from each side. it becomes

$$\frac{2}{3}q - \frac{1}{12} - q = \frac{1}{8}$$

Combining like terms, it becomes

$$\frac{2}{3}q - q - \frac{1}{12} = \frac{1}{8}$$

Add $\dfrac{1}{12}$ on each side, it becomes

$$\frac{2}{3}q - q = \frac{1}{8} + \frac{1}{12}$$

Multiply each side by LCD of 8 and 12, that is, 24

$$24\left(\frac{2}{3}q - q\right) = 24\left(\frac{1}{8} + \frac{1}{12}\right)$$

Apply distributive property on both sides, it becomes

$$24\left(\frac{2}{3}q\right) - 24(q) = 24\left(\frac{1}{8}\right) + 24\left(\frac{1}{12}\right)$$

$$16q - 24q = 3 + 2$$

$$-8q = 5$$

Divide each side by $-8$

$$q = \frac{5}{-8}$$

$$q = \frac{-5}{8}$$

Hence, solution of (1) is $\boxed{q = \dfrac{-5}{8}}$

Checking of the solution:

Substitute the value of q on each side of (1)

Left hand side $= \dfrac{2}{3}q - \dfrac{1}{12}$

Put $q = \dfrac{-5}{8}$, it becomes

Left hand side $= \dfrac{2}{3}\left(\dfrac{-5}{8}\right) - \dfrac{1}{12}$

$$= \dfrac{-5}{12} - \dfrac{1}{12}$$

$$= \dfrac{-6}{12}$$

$$= \dfrac{-1}{2}$$

Right hand side $= q + \dfrac{1}{8}$

Put $q = \dfrac{-5}{8}$, it becomes

Right hand side $= \dfrac{-5}{8} + \dfrac{1}{8}$

$$= \dfrac{-4}{8}$$

$$= \dfrac{-1}{2}$$

Clearly, left hand side $=$ right hand side

Hence, the solution is checked.

## Answer 51e.

We know that the perimeter of a rectangle is $2(l + w)$, where $l$ is the length, and $w$ is the width of each side.
It is given that the perimeter is 46.
$2(l + w) = 46$

Substitute $2x + 3$ for $l$, and $x + 2$ for $w$ in the equation
$2(2x + 3 + x + 2) = 46$

Simplify.
$2(3x + 5) = 46$

Open the parentheses using the distributive property.
$$2(3x) + 2(5) = 46$$
$$6x + 10 = 46$$

Subtract 10 from each side.
$$6x + 10 - 10 = 46 - 10$$
$$6x = 36$$

Divide each side by 6.
$$\frac{6x}{6} = \frac{36}{6}$$
$$x = 6$$

Thus, the value of $x$ is 6.

The length of the rectangle will be $2(6) + 3$, 15.
Similarly, the width of the rectangle will be $6 + 2$, or 8.

We know that the opposite sides of a rectangle are equal. The length of each side of the figure will be 15, 8, 15, and 8.

Perimeter of triangle is given by:

$$\text{Perimeter} = 26$$

By definition of perimeter of triangle,

Sum of length of all sides of triangle $= 26$

$$(14-2x)+(3x-1)+(2x+1)=26$$
$$14-2x+3x-1+2x+1=26$$

Combining like terms, it becomes

$$(-2x+3x+2x)+(14-1+1)=26$$
$$3x+14=26$$

Subtract 14 from each side, it becomes

$$3x=26-14$$
$$3x=12$$

Divide each side by 3, it becomes

$$x=\frac{12}{3}$$
$$\boxed{x=4}$$

Next, substituting the value of x in the length of each side, their value becomes

Length of $1^{st}$ side $=14-2(4)$
$$=14-8$$
$$\boxed{=6}$$

Length of $2^{nd}$ side $=3(4)-1$
$$=12-1$$
$$\boxed{=11}$$

Length of $3^{rd}$ side $=2(4)+1$
$$\boxed{=9}$$

Hence, length of each side of triangle is $\boxed{6,11,9}$

**Answer 53e.**

We know that the perimeter of a triangle is sum of its three sides. It is given that the perimeter is 15.

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

Combine the like terms.
$$7x + 1 = 15.$$

Subtract 1 from each side.
$$7x + 1 - 1 = 15 - 1$$
$$7x = 14$$

Divide each term by 7 and simplify.
$$\frac{7x}{7} = \frac{14}{7}$$
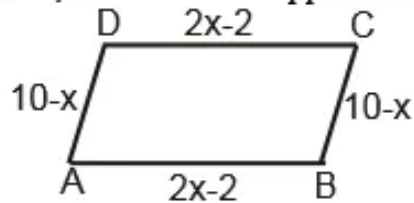$$x = 2$$

Thus, the value of $x$ is 2.

Find the length of each side.

$$2x + 2 = 2(2) + 2 \qquad\qquad 3x - 3 = 3(2) - 3$$
$$= 4 + 2 \qquad\qquad\qquad = 6 - 3$$
$$= 6 \qquad\qquad\qquad\quad = 3$$

Therefore, the length of each side of the figure is 6, 3, and 6.

**Answer 54e.**

For a given parallelogram, we know that opposite sides are equal in length



So,　length of $AB$ = length of $CD$
$$= 2x - 2$$

And,　length of $BC$ = length of $AD$
$$= 10 - x$$

Now, given is Perimeter of parallelogram $= 26$

By definition of perimeter:

Sum of length of all sides $= 26$

$$(2x-2)+(10-x)+(2x-2)+(10-x)=26$$
$$2x-2+10-x+2x-2+10-x=26$$

Combining like terms, it becomes

$$(2x+2x-x-x)+(-2+10-2+10)=26$$
$$2x+16=26$$

Subtract 16 from each side, it becomes

$$2x=26-16$$
$$2x=10$$

Divide both sides of 2, it becomes

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

Next, substituting the value of $x$ in the length of each side, their value becomes:

Length of side $AB = 2(5) - 2$
$$= 8$$

Length of Side $BC = 10 - 5$
$$= 5$$

Now, as length of opposite sides of a parallelogram is equal.

So, length of side $CD$ = length of side AB
$$= 8$$

And, length of side $AD$ = length of side BC
$$= 5$$

Hence, length of each side of given parallelogram is

$$\boxed{8, 5, 8, 5}$$

**Answer 55e.**

Subtract 0.5 from each side of the given equation.

$$0.6g + 0.5 - 0.5 = 2.9 - 0.5$$
$$0.6g = 2.4$$

Divide each side by 0.6.

$$\frac{0.6g}{0.6} = \frac{2.4}{0.6}$$
$$g = 4$$

The solution is 4.

### CHECK

Substitute 4 for g in the original equation.

$$0.6g + 0.5 = 2.9$$
$$0.6(4) + 0.5 \overset{?}{=} 2.9$$
$$2.4 + 0.5 \overset{?}{=} 2.9$$
$$2.9 = 2.9 \checkmark$$

Thus. the solution checks.

**Answer 56e.**

Given linear equation is :

$$1.1h + 1.3 = 6.8 \qquad \qquad \text{......(1)}$$

Subtracting 1.3 from each side, it becomes

$$1.1h = 6.8 - 1.3$$
$$1.1h = 5.5$$

Dividing both sides by 1.1, it becomes

$$h = \frac{5.5}{1.1}$$
$$h = 5$$

So, $\boxed{h = 5}$ is the solution to equation (1)

Checking of the solution:

Substituting the value of h in both sides of (1) it becomes

Left hand side $= 1.1h + 1.3$

Put $h = 5$

Left hand side $= 1.1 \times 5 + 1.3$
$= 5.5 + 1.3$
$= 6.8$
$=$ right hand side

Hence, the solution is verified.

**Answer 57e.**

Subtract $1.3k$ from each side of the equation.
$0.4k - 0.6 - 1.3k = 1.3k + 1.2 - 1.3k$
$-0.9k - 0.6 = 1.2$

Add 0.6 to each side.
$-0.9k - 0.6 + 0.6 = 1.2 + 0.6$
$-0.9k = 1.8$

Divide each side by $-0.9$.
$\dfrac{-0.9k}{-0.9} = \dfrac{1.8}{-0.9}$
$k = -2$

The solution is $-2$.

**_CHECK_**
Substitute $-2$ for $k$ in the original equation.
$0.4k - 0.6 = 1.3k + 1.2$
$0.4(-2) - 0.6 \overset{?}{=} 1.3(-2) + 1.2$
$-0.8 - 0.6 \overset{?}{=} -2.6 + 1.2$
$-1.4 = -1.4$ ✔

Thus. the solution checks.

**Answer 58e.**

Given linear equation is

$$6.5m + 1.5 = 4.3m - 0.7 \qquad \qquad ......(1)$$

Subtracting $4.3m$ from each side, it becomes

$$6.5m + 1.5 - 4.3m = -0.7$$
$$2.2m + 1.5 = -0.7$$

Subtracting $1.5$ from each side, it becomes

$$2.2m = -0.7 - 1.5$$
$$2.2m = -2.2$$

Divide both sides by $2.2$, it becomes

$$m = \frac{-2.2}{2.2}$$
$$m = -1$$

So, $\boxed{m = -1}$ is the solution to equation $(1)$

Checking of the solution:

Substituting the value of m in both sides of $(1)$ it becomes

Left hand side $= 6.5m + 1.5$

Put $m = -1$

Left hand side $= 6.5(-1) + 1.5$
$$= -6.5 + 1.5$$
$$= -5.0$$
$$= -5$$

Right hand side $= 4.3m - 0.7$

Put $m = -1$

Right hand side $= 4.3(-1) - 0.7$
$$= -4.3 - 0.7$$
$$= -5.0$$
$$= -5$$

Thus, left hand side $=$ right hand side .

Hence, the solution is verified.

**Answer 59e.**

Open the parentheses using the distributive property.

$3.8w + 3.2 = 2.3(w) + 2.3(4)$

$3.8w + 3.2 = 2.3w + 9.2$

Subtract $2.3w$ from each side.

$3.8w + 3.2 - 2.3w = 2.3w + 9.2 - 2.3w$

$1.5w + 3.2 = 9.2$

Subtract 3.2 from each side.

$1.5w + 3.2 - 3.2 = 9.2 - 3.2$

$1.5w = 6$

Divide each side by 1.5 and simplify.

$\dfrac{1.5w}{1.5} = \dfrac{6}{1.5}$

$w = 4$

The solution is 4.

**CHECK**

Substitute 4 for $w$ in the original equation.

$3.8w + 3.2 = 2.3(w + 4)$

$3.8(4) + 3.2 \overset{?}{=} 2.3(4 + 4)$

$15.2 + 3.2 \overset{?}{=} 2.3(8)$

$18.4 = 18.4$ ✓

Thus. the solution checks.

**Answer 60e.**

Given linear equation is

$$1.7(x+5)=2.1x+9.7 \qquad \qquad \text{......(1)}$$

Apply distributive law, it becomes

$$1.7x+1.7(5)=2.1x+9.7$$
$$1.7x+8.5=2.1x+9.7$$

Subtracting $2.1x$ from each side, it becomes

$$1.7x+8.5-2.1x=9.7$$
$$-0.4x+8.5=9.7$$

Subtracting $8.5$ from each side, it becomes

$$-0.4x=9.7-8.5$$
$$-0.4x=1.2$$

Divide each side by $-0.4$, it becomes

$$x=\frac{1.2}{-0.4}$$
$$x=-3$$

So, the solution of equation (1) is $\boxed{x=-3}$

Checking of the solution:

Substituting the value of x in both sides of (1) it becomes

Left hand side $=1.7(x+5)$

Put $x=-3$

Left hand side $=1.7(-3+5)$
$$=1.7(2)$$
$$=3.4$$

Right hand side $=2.1x+9.7$

Put $x=-3$

Right hand side $=2.1(-3)+9.7$
$$=-6.3+9.7$$
$$=3.4$$

Thus, left hand side $=$ right hand side

Hence, the solution is verified.

## Answer 61e.

Subtract 1.75$b$ from each side.
$$2.25b + 3.81 - 1.75b = 1.75b + 5.26 - 1.75b$$
$$0.5b + 3.81 = 5.26$$

Subtract 3.81 from each side.
$$0.5b + 3.81 - 3.81 = 5.26 - 3.81$$
$$0.5b = 1.45$$

Divide each side by 0.5 and simplify.
$$\frac{0.5b}{0.5} = \frac{1.45}{0.5}$$
$$b = 2.9$$

The solution is 2.9.

### CHECK
Substitute 2.9 for $b$ in the original equation.
$$2.25b + 3.81 = 1.75b + 5.26$$
$$2.25(2.9) + 3.81 \stackrel{?}{=} 1.75(2.9) + 5.26$$
$$6.525 + 3.81 \stackrel{?}{=} 5.075 + 5.26$$
$$10.335 = 10.335 \checkmark$$

Thus. the solution checks.

## Answer 62e.

Given linear equation is

$$18.13 - 5.18c = 6.32c - 8.32 \qquad \qquad \ldots\ldots(1)$$

Subtracting 6.32$c$ from each side, it becomes

$$18.13 - 5.18c - 6.32c = -8.32$$
$$18.13 - 11.50c = -8.32$$

Subtracting 18.13 from each side, it becomes

$$-11.50c = -8.32 - 18.13$$
$$-11.50c = -26.45$$

Divide each side by $-11.50$, it becomes

$$c = \frac{-26.45}{-11.50}$$
$$c = 2.3$$

So, the solution of equation (1) is $\boxed{c = 2.3}$

Checking of the solution :

Substituting the value of c in both sides of (1) it becomes

Left hand side $= 18.13 - 5.18(2.3)$
$$= 18.13 - 11.914$$
$$= 6.216$$

Right hand side $= 6.32(2.3) - 8.32$
$$= 14.536 - 8.32$$
$$= 6.216$$

Thus, left hand side = right hand side
Hence, the solution is verified.

## Answer 63e.

Open the parentheses using the distributive property.
$$5(x) - 5(4) = 5x + 12$$
$$5x - 20 = 5x + 12$$

Subtract $5x$ from each side.
$$5x - 20 - 5x = 5x + 12 - 5x$$
$$-20 = 12$$

Since the resultant statement is false, the given equation has no solution.

## Answer 64e.

Given linear equation is:
$$3(x+5) = 3x + 15 \qquad \qquad \text{......(1)}$$
Apply distributive property, it becomes
$$3.x + 3.5 = 3x + 15$$
$$3x + 15 = 3x + 15$$
Subtracting $3x$ from each side, it becomes
$$(3x+15) - 3x = 15$$
$$(3x - 3x) + 15 = 15$$
$$15 = 15$$
This is always true for any real value of $x$.
Hence, solution of (1) is $\boxed{\text{all real numbers}}$

## Answer 65e.

Open the parentheses using the distributive property.

$5(2) - 5(x) = 3 - 2x + 7 - 3x$

$10 - 5x = 3 - 2x + 7 - 3x$

Combine the like terms.

$10 - 5x = 10 - 5x$

Add $5x$ to each side.

$10 - 5x + 5x = 10 - 5x + 5x$

$10 = 10$

Since the resultant statement is always true, the solution is all real numbers.

## Answer 66e.

Given linear equation is :

$$-2(4-3x)+7=6(x+1) \qquad \qquad \dots\dots(1)$$

Apply distributive property on both sides, it becomes

$$-2(4)+2(3x)+7=6(x)+6(1)$$

$$-8+6x+7=6x+6$$

$$6x-1=6x+6$$

Subtract $6x$ from both sides, it becomes

$$(6x-1)-6x=6$$

$$(6x-6x)-1=6$$

$$-1=6$$

This is never true for any real value of $x$

Hence, solution of (1) is $\boxed{\text{no solution}}$.

## Answer 67e.

Solve for $x$.

Subtract $cx$ from each side of the given equation.

$ax + b - cx = cx + d - cx$

$ax + b - cx = d$

Subtract $b$ from each side.

$ax + b - cx - b = d - b$

$ax - cx = d - b$

Factor out the common term, $x$, from the left side of the equation.

$x(a-c)=d-b$

Divide each side by $a-c$, and simplify.

$$\frac{x(a-c)}{a-c}=\frac{d-b}{a-c}$$

$$x=\frac{d-b}{a-c}$$

Thus, the solution for $x$ is $\dfrac{d-b}{a-c}$.

Let us assume that $a$ and $c$ are equal.
Substitute $a$ for $c$ in the given equation.

$ax+b=ax+d$

Subtract $ax$ from each side.

$ax+b-ax=ax+d-ax$

$$b=d$$

The system has no solution when the equation obtained is a false statement. This occurs when $a=c$, and $b \neq d$.

If $b$ and $d$ are equal, then the resultant statement is always true.

Thus, the system has no solution when $a=c$, and $b \neq d$ and has all real numbers as the solution when $a=c$. and $b=d$.

## Answer 68e.

Suppose number of T-shirts ordered  is $x$

$$\text{Cost of One T-Shirt} = \$15$$

$$\text{So, Cost of } x \text{ T-Shirt} = \$15 \times x$$

$$= \$15x$$

$$\text{Also, Cost of Shipping the T-shirts} = \$6$$

$$\text{So, total cost} = \$15x+6 \qquad \dots\dots(1)$$

According to question

$$\text{Total cost} = \$111 \qquad \dots\dots(2)$$

Equating $(1)$ and $(2)$

$$15x+6=111$$

Subtracting 6 from each side, it become

$$15x=111-6$$

$$15x=105$$

$$x=\frac{105}{15}$$

$$x=7$$

Hence, $\boxed{\text{number of T-shirts ordered is 7}}$

*STEP 1*     **Write** a verbal model. Then write an equation.

Let $t$ be the total time taken to repair of the bicycle.
Since for 1 hour the cost of the labor is $25, for $t$ hours the cost of the labor will be $25t$. The cost of parts is given as $105.

The bill for the repair is given as $180.

| The cost of parts (dollars) | | The cost of labour (dollars) | | Total time taken (hours) | | Total amount for the repair of bicycle (dollars) |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| ⇓ | + | ⇓ | · | ⇓ | = | |
| $105 | + | $25 | · | $t$ | = | $180 |

Thus, the equation is $105 + 25t = 180$.

*STEP 2*     **Solve** for $t$.
Subtract 105 from each side.
$$105 + 25t - 105 = 180 - 105$$
$$25t = 75$$

Divide each term by 25 and simplify.
$$\frac{25t}{25} = \frac{75}{25}$$
$$t = 3$$

The total time taken for the repair of the bicycle is 3 hours.

*CHECK*     We have the cost of parts as $105 and the cost of the labor as $3(25)$, or $75.
The total cost for the repair will be $105 + $75, or $180, which is the same as specified in the problem.

**Answer 70e.**

Suppose the total selling by him in a year $= \$x$

Rate of commission in selling $= 5\%$

Total commission earned in a year $= 5\%$ of $\$x$

$$= \$ \frac{5}{100} \times x$$

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

Base salary of him in one year $= \$25000$

Thus, total earning of him in one year $= \frac{x}{20} + 25000$

Now, according to question, we want to find $x$ such that, his total earning in one year $= \$50000$

$$\frac{x}{20} + 25000 = 50000$$

Subtract $25000$ from both sides of equation, it becomes

$$\frac{x}{20} = 50000 - 25000$$

$$\frac{x}{20} = 25000$$

$$x = 25000 \times 20$$

$$= 500000$$

Thus, total selling of him in one year is $\boxed{\$500000}$

**Answer 71e.**

*STEP 1*     **Write** a verbal model. Then write an equation.

Let $t$ be the time taken for the second job.
It is given that for the first job the person earns $7.75 per hour. For 25 hours, the person will earn $7.75(25). In the second job, the person earns $6.25 per hour. For $t$ hours, the person earns $6.25t$.

The total amount that should be earned is $250 per week.

| Amount earned for first job (dollars) | Time taken (hours) | | Amount earned for second job (dollars) | Time taken (hours) | | Total amount earned per week (dollars) |
|:---:|:---:|:---:|:---:|:---:|:---:|:---:|
| ⇓ | ⇓ | | ⇓ | ⇓ | | ⇓ |
| 7.75 · | 25 | + | 6.25 · | $t$ | = | 250 |

The equation is $7.75(25) + 6.25t = 250$.

*STEP 2*     **Solve** for $t$.
$$193.75 + 6.25t = 250.$$

Subtract 193.75 from each side.
$$193.75 + 6.25t - 193.75 = 250 - 193.75$$
$$6.25t = 56.25$$

Divide each term by 6.25, and simplify.
$$\frac{6.25t}{6.25} = \frac{56.25}{6.25}$$
$$t = 9$$

Thus, the time taken for the second job is 9 hours.

*CHECK*     For the first job the person earns $193.75, and for the second job the person earns $6.25(9) or $56.25.
The total earning per week will be $193.75 + $56.25, or $250, which is the same as specified in the problem.

**Answer 72e.**

Suppose the number of CDs bout $= x$

Then, the number of DVDs bought $= 10 - x$

Because, the total number of CDs and DVDs bought were 10

Now, cost of 1 CD $= \$15$

Thus, cost of $x$ CDs $= \$15 \times x$

$= \$15x$

Also, cost of 1 DVD $= \$22$

Thus, cost of $(10 - x)$ DVD $= \$22 \times (10 - x)$

$= \$22(10 - x)$

Then, total cost of 10 CDs and DVD $= \$\left[15x + 22(10 - x)\right]$ ......(1)

According to question,

Total cost of 10 CDs and DVDs $= \$199$ ......(2)

Equating (1) and (2)

$15x + 22(10 - x) = 199$

Apply distributive property

$-7x = -21$

$x = \dfrac{-21}{-7}$

$x = 3$

Thus, number of CDs bought $= x$

$= 3$

And, number of DVDs bought $= 10 - x$

$= 10 - 3$

$= 7$

Hence, number of CDS and DVDs bought is $\boxed{3, 7}$

Next, if total cost of CDs and DVDs $= \$185$ ......(3)

Equating (1) and (3)

$15x + 22(10 - x) = 185$

$15x + 22(10) - 22(x) = 199$

$15x + 220 - 22x = 199$

$(15x - 22x) + 220 = 199$

$-7x + 220 = 199$

$-7x = 199 - 220$

$-7x = 185 - 220$

$-7x = -35$

$x = \dfrac{-35}{-7}$

$x = 5$

CDs bought $= 5$

DVDs bought $= 5$

Hence, number of CDS and DVDs bought is $\boxed{5, 5}$

**Answer 73e.**

**(a)** It is given that $c$ is the column width, and $g$ is the gap between the columns. Since there are 3 columns and 2 gaps, the total column width will be $3c$ and the total gap between the columns will be $2g$. We know that the margin width is $\frac{1}{2}$ in. and there are 2 margins. Thus, the total margin width is $2\left(\frac{1}{2}\right)$, or 1 in.

The data can be written as a verbal model.

| Margin width | · | Number of margins | + | Column width | · | Number of columns | + | Gap width | · | Number of gaps | = | Total width of the page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ⇓ | | ⇓ | | ⇓ | | ⇓ | | ⇓ | | ⇓ | | ⇓ |
| $\frac{1}{2}$ | · | 2 | + | $c$ | · | 3 | + | $g$ | · | 2 | = | 9 |

The equation is $2\left(\frac{1}{2}\right) + 3c + 2g = 9$, or $1 + 3c + 2g = 9$

Simplify.
Subtract 1 from each side.
$$1 + 3c + 2g - 1 = 9 - 1$$
$$3c + 2g = 8$$

Thus, the equation that relates the column width and the gap between the columns to the total width of the page is $3c + 2g = 8$.

**(b)** Let us find the column width when the gap between the columns is $\frac{5}{8}$ in.

Substitute $\frac{5}{8}$ for $g$ in the equation $3c + 2g = 8$.

$$3c + 2\left(\frac{5}{8}\right) = 8$$

Solve for $c$.
Multiply each side of the equation using the least common denominator, 8.

$$8\left[3c + 2\left(\frac{5}{8}\right)\right] = 8(8)$$

Open the parentheses using the distributive property.

$$8(3c) + 8\left[2\left(\frac{5}{8}\right)\right] = 8(8)$$

$$24c + 10 = 64$$

Subtract 10 from each side.

$$24c + 10 - 10 = 64 - 10$$

$$24c = 54$$

Divide each side by 24, and simplify.

$$\frac{24c}{24} = \frac{54}{24}$$

$$c = \frac{9}{4} \quad \text{or} \quad 2\frac{1}{4}$$

Thus, the column width will be $2\frac{1}{4}$ in. when the gap between the columns is $\frac{5}{8}$ in.

Similarly, we will get $2\frac{5}{12}$ in. as the column width when the gap is $\frac{3}{8}$ in.

Find the gap between the columns when the column width is $2\frac{1}{3}$ or $\frac{7}{3}$ in.

Substitute $\frac{7}{3}$ for $c$ in the equation $3c + 2g = 8$.

$$3\left(\frac{7}{3}\right) + 2g = 8$$

Simplify.

$$\not{3}\left(\frac{7}{\not{3}}\right) + 2g = 8$$

$$7 + 2g = 8$$

Subtract 7 from each side.

$$7 + 2g - 7 = 8 - 7$$
$$2g = 1$$

Divide each side by 2, and simplify.

$$\frac{2g}{2} = \frac{1}{2}$$
$$g = \frac{1}{2}$$

The gap between the columns is $\frac{1}{2}$ in. when the column width is $2\frac{1}{3}$ in.

Similarly, we will get $\frac{1}{4}$ in. as the gap width when column width is $2\frac{1}{2}$ in.

Complete the table.

| Gap, $g$ (in.) | $\frac{5}{8}$ | $\frac{1}{2}$ | $\frac{3}{8}$ | $\frac{1}{4}$ |
|---|---|---|---|---|
| Column width, $c$ (in.) | $2\frac{1}{4}$ | $2\frac{1}{3}$ | $2\frac{5}{12}$ | $2\frac{1}{2}$ |

**Answer 74e.**

(a) Given is:

Length of inner portion of frame $= 4x$ inches

Breath of inner portion of frame $= 5x$ inches

As frame is 1 inch wide from all 4 sides.

So, length of outer portion of frame increases by 1 inch each form left and right.

Similarly, breadth of outer portion of frame increases by 1 inch each from top and bottom.

So, length of outer portion of frame $\quad (l) = 4x + 1 + 1$
$$= (4x + 2) \text{ inch}$$

And, breadth $\quad (b) = 5x + 1 + 1$
$$= (5x + 2) \text{ inch}$$

As the frame is a rectangular figure

So, its perimeter $(p) = 2(l + b)$

Put the value of $l$ and $b$ in $p$, it becomes

$$p = 2[(4x+2)+(5x+2)]$$

$$= 2[4x+2+5x+2]$$

Grouping like terms

$$= 2[(4x+5x)+(2+2)]$$

$$= 2(9x+4)$$

Apply distributive property

$$p = 2(9x)+2(4)$$

$$p = 18x+8$$

So, the expression for outer perimeter of picture frame is:

$$\boxed{p=18x+8} \qquad\qquad \ldots\ldots(1)$$

(b) put $x = 1.5$ in (1)

$$p = 18(1.5)+8$$
$$= 27+8$$
$$= 35$$

So, for $x = 1.5, p = 35$

Put $x = 2$ in (1)

$$p = 18(2)+8$$
$$= 36+8$$
$$= 44$$

So, for $x = 2, p = 44$

put $x = 2.5$ in (1)

$$p = 18(2.5) + 8$$
$$= 45 + 8$$
$$= 53$$

So, for $x = 2.5$ , $p = 53$

put $x = 3$ in (1)

$$p = 18(3) + 8$$
$$= 54 + 8$$
$$= 62$$

So, for $x = 3$, $p = 62$

put $x = 3.5$ in (1)

$$p = 18(3.5) + 8$$
$$= 63 + 8$$
$$= 71$$

So, for $x = 3.5$, $p = 71$

Hence, combining all the valves of $x$ and $p$ Following table is formed:

| $x$ | 1.5 | 2 | 2.5 | 3 | 3.5 |
|---|---|---|---|---|---|
| $p$ | 35 | 44 | 53 | 62 | 71 |

Clearly, $p = 53$ for $\boxed{x = 2.5}$

(c) Given expression for outer perimeter of frame $(p) = 18x + 8$ (using (1))

Also, outer perimeter of frame $(p) = 53$ inches (In question)

Equating these two values, it becomes:

$$18x + 8 = 53 \qquad\qquad ......(2)$$

Solution of above equation:

Subtracting 8 from both sides

$$18x = 53 - 8$$
$$18x = 45$$
$$x = \frac{45}{18}$$

$$\boxed{x = 2.5}$$

Now value of x tells us that we should enlarge the original photo by $\boxed{2.5 \text{ times}}$ to fit into the picture frame.

**Answer 75e.**

*STEP 1*　　　**Write** a verbal model. Then write an equation.

Let $t$ be the time taken by the two people to complete the work.

The part of work done by you in 1 minute will be $\dfrac{1}{30}$ and the part of work

done by your brother in 1 minute will be $\dfrac{1}{45}$.

Thus, in 1 minute part of the work done by both will be $\dfrac{1}{t}$

| Your work per minute | + | Your brother's work per minute | = | Work per minute together |
|:---:|:---:|:---:|:---:|:---:|
| ⇓ | | ⇓ | | ⇓ |
| $\dfrac{1}{30}$ | $+$ | $\dfrac{1}{45}$ | $=$ | $\dfrac{1}{t}$ |

Thus, the equation is $\dfrac{1}{30} + \dfrac{1}{45} = \dfrac{1}{t}$

*STEP 2*　　　**Solve** for $t$.

Multiply each side of the equation using the least common denominator, $90t$.

$$90t\left(\frac{1}{30} + \frac{1}{45}\right) = 90t\left(\frac{1}{t}\right)$$

Open the parentheses using the distributive property.

$$90t\left(\frac{1}{30}\right) + 90t\left(\frac{1}{45}\right) = 90$$

$$3t + 2t = 90$$

$$5t = 90$$

Divide each term by 5, and simplify.

$$\frac{5t}{5} = \frac{90}{5}$$

$$t = 18$$

Thus, you and your brother together take 18 minutes to rake the leaves.

*CHECK*     In 18 minutes, you will complete $\frac{1}{30}(18)$ of the work and your brother will complete $\frac{1}{45}(18)$ of the work.

Together in 18 minutes, both will be complete $\frac{1}{30}(18) + \frac{1}{45}(18)$, or 1, or the entire work.

## Answer 76e.

Given is:

Area of community mural painted by he in 3 hours $= 2$ square yards

Area of community mural painted by he in 1 hour $= \frac{2}{3}$ square yards

Also, area of community mural painted by his friend in 5 hours $= 4$ square yards

Area of community mural painted by his friend in 1 hour $= \frac{4}{5}$ square yards

Area of community mural painted by both working together in 1 hour

$$= \left( \frac{2}{3} + \frac{4}{5} \right) \text{ square yards}$$

Suppose, area of community mural painted by both of them working together in t hours

$$= (\text{area painted by both in 1 hour}) \times t$$

$$= \left( \frac{2}{3} + \frac{4}{5} \right) \times t$$

Apply distributive property, it becomes

$$= \left( \frac{2}{3} \right) \times t + \left( \frac{4}{5} \right) \times t$$

$$= \frac{2}{3}t + \frac{4}{5}t \qquad \qquad ......(1)$$

Now, total area to be painted $= 11$ square yards $\qquad ......(2)$

Equating (1) and (2), it becomes

$$\frac{2}{3}t + \frac{4}{5}t = 11$$

Multiplying both sides by LCD of 3 and 5, that is 15, it becomes

$$15\left(\frac{2}{3}t + \frac{4}{5}t\right) = 11 \times 15$$

Apply distributive property, it becomes

$$15 \times \frac{2}{3}t + 15 \times \frac{4}{5}t = 165$$

$$10t + 12t = 165$$

Adding like terms, it becomes

$$22t = 165$$

Dividing both sides by 22

$$t = \frac{165}{22}$$

$$t = \frac{15}{2}$$

$$t = 7.5$$

So, time taken by them working together is $\boxed{7.5 \text{ hours.}}$

**Answer 77e.**

Let $t$ be the total time taken by the students to write names on 440 diplomas.

It is given that the first student takes 6 minutes to write 7 names. Thus, the rate of the first student is $\frac{7}{6}$. Similarly, the rate of the second student is $\frac{17}{10}$ and the rate of the third student is $\frac{23}{15}$.

Write as a verbal model.

| Rate of first student (names/min) | Time (min) | | Rate of second student (names/min) | Time (min) | | Rate of third student (names/min) | Time (min) | | Total diplomas |
|---|---|---|---|---|---|---|---|---|---|
| ⇓ | | | ⇓ | ⇓ | | ⇓ | ⇓ | | ⇓ |
| $\frac{7}{6}$ | $t$ | + | $\frac{17}{10}$ | $t$ | + | $\frac{23}{15}$ | $t$ | = | 440 |

The equation is $\frac{7}{6}t + \frac{17}{10}t + \frac{23}{15}t = 440$.

Solve for $t$.
Multiply each side of the equation using the least common denominator, 900.

$$900\left(\frac{7}{6}t + \frac{17}{10}t + \frac{23}{15}t\right) = 900(440)$$

Open the parentheses using the distributive property.

$$900\left(\frac{7}{6}t\right) + 900\left(\frac{17}{10}t\right) + 900\left(\frac{23}{15}t\right) = 900(440)$$

$$1050t + 1530t + 1380t = 396,000$$

Combine the like terms.
$$3960t = 396,000$$

Divide each term by 3960, and simplify.
$$\frac{3960t}{3960} = \frac{396,000}{3960}$$
$$t = 100$$

The total time taken by the students to write names on 440 diplomas working together will be 100 minutes.
The answer matches with **choice B**.

**Answer 78e.**

Given is:

Diameter of a cylinder thermos $(d_1) = 2\frac{1}{2}$ inches
$$= \frac{2 \times 2 + 1}{2} \text{ inches}$$
$$= \frac{5}{2} \text{ inches}$$

So, radius of a cylinder thermos $(r_1) = \frac{d_1}{2}$
$$= \frac{5}{4} \text{ inches}$$

On pouring liquid into it, the liquid rises to height $h_1$, where
$$h_1 = 9 \text{ inches}$$

Again, diameter of given cylindrical travel mug $(d_2) = 3\frac{1}{2}$ inches
$$= \frac{3 \times 2 + 1}{2} \text{ inches}$$
$$= \frac{7}{2} \text{ inches}$$

So, radius of a cylindrical travel mug $(r_2) = \frac{d_2}{2}$

Now, on pouring the whole liquid which was in cylinder thermos into this cylindrical travel mug, suppose it rises to height $h_2 = h$

For finding h:

We                                                                    have,
(volume of liquid in cylindrical thermos) = (volume of liquid in cylindrical travel mug)

As, volume of cylinder $= \pi r^2 h$

So,                        $\pi r_1^2 h_1 = \pi r_2^2 h_2$

Cancelling $\pi$ on both sides, we have

$$r_1^2 h_1 = r_2^2 h_2$$

Putting $r_1 = \dfrac{5}{4}$, $h_1 = 9, h_2 = h$ and $r_2 = \dfrac{7}{4}$, it becomes

$$\left(\frac{5}{4}\right)^2 \times 9 = \left(\frac{7}{4}\right)^2 \times h$$

Solving power of expression, it becomes

$$\frac{25}{16} \times 9 = \frac{49}{16} \times h$$

Multiplying by multiplicative inverse of $\frac{49}{16}$ that is $\frac{16}{49}$ on both sides, it becomes

$$\frac{25}{16} \times 9 \times \frac{16}{49} = \frac{49}{16} \times h \times \frac{16}{49}$$

On cancelling like terms, it becomes

$$\frac{25}{16} \times 9 = h$$

So,                     $h = \frac{225}{49}$

Hence, height (h) of liquid is $\boxed{\dfrac{225}{49} \text{ inches}}$

## Answer 79e.

We know that the area of a square is $a^2$, where $a$ is the length of each side.

Since the side length of the given square is 10 m, the area will be $(10 \text{ m})^2$, or $100 \text{ m}^2$.

## Answer 80e.

A rectangle of 4 in. by 6 in.
That is, length of given rectangle $l = 4$ in.
          Breadth of given rectangle $b = 6$ in.
Then, Area of given rectangle $A = l \times b$
                              $= 4 \text{ in} \times 6 \text{ in}$
                              $= 4 \times 6$ sq. in.
Hence, $\boxed{\text{Area of given rectangle } = 24 \text{ Sq. in.}}$

## Answer 81e.

We know that the area of a circle is given by the formula,
$A = \pi r^2$, where $r$ is the radius of the circle.

Substitute 3 for $r$ in the formula and simplify.

$$\begin{aligned} A &= \pi(3)^2 \\ &= 9\pi \\ &= 9(3.14) \\ &\approx 28.27 \end{aligned}$$

Therefore, the area of the circle with radius 3 in. is approximately 28.27 in$^2$.

## Answer 82e.

Given is a circle with a diameter of 15$cm$
That is, diameter of given circle $d = 15cm$

Then, radius of given circle $r = \dfrac{d}{2}$

$$r = \frac{15}{2}cm$$

Now, Area og fiven circle $A = \pi r^2$

$$\begin{aligned} &= \frac{22}{7} \times \left(\frac{15}{2}\right)^2 \\ &= \frac{22}{7} \times \frac{225}{4} \\ &= \frac{11 \times 225}{7 \times 2} \\ &= \frac{2475}{14} \end{aligned}$$

Hence, $\boxed{\text{Area of given circle } (A) = 176.785 \text{ Sq. cm (approx)}}$

## Answer 83e.

Observe the given statement.
We can see that the numbers and the operation symbols on both the sides are the same. On the left side of the equation, the product of 10 and 13 are grouped while on the right-side, the product of 13 and 2 are grouped. This shows that the order in which the numbers are multiplied is changed.

According to the associative property of multiplication, the change in the order of multiplication does not change the result.
Therefore, the given statement illustrates the associative property of multiplication.

## Answer 84e.

Given expression is:

$$23 + (-23) = 0$$

This shows that on adding $-23$ to $23$, the result is $0$, which is the additive identity for real numbers. Hence, $-23$ is called the additive inverse of $23$.

Thus, the given expression represents the $\boxed{\text{property of additive inverse for real numbers}}$.

## Answer 85e.

Observe the given statement.

We can see that the numbers and the operation symbols on both the sides are the same. On the left side of the equation the sum of $5$ and $4$ are grouped while on the right side, the sum of $4$ and $5$ are grouped.

We know that according to the commutative property of addition, the order in which the numbers are added does not change the result.

Therefore, the given statement illustrates the commutative property of addition.

## Answer 86e.

Given expression is

$$4(1 + 0.25) = 4(1) + 4(0.25)$$

Here, in left hand side of (1), the number 4 is being multiplied by the sum of 1 and 0.25. However, on right hand side, it can be seen that, 4 is being multiplied by 1 and 0.25 separately and then their sum is taken. This shows the multiplication of 4 is being distributive over the numbers 1 and 0.25 over their sum.

Hence, this shows the distributive property of real numbers. Also, as 4 is being multiplied on left side of the number 1 and 0.25 on both sides of given equation (1), so, this property is also called $\boxed{\text{Left distributive property of real numbers}}$

## Answer 87e.

Group the like terms.
$$7x^2 + 8 - 3x - 5x^2 = (7x^2 - 5x^2) - 3x + 8$$

Next, combine the like terms.
$$(7x^2 - 5x^2) - 3x + 8 = 2x^2 - 3x + 8$$

Therefore, the given expression simplifies to $2x^2 - 3x + 8$.

**Answer 88e.**

Given expression is:
$$5y - 3y^3 + 7y - y^2$$
Arrange the terms in decreasing order of power of variable y and grouping like terms,
$$= -3y^3 - y^2 + (5y + 7y)$$
$$= -3y^3 - y^2 + 12y$$
Thus, $\boxed{5y - 3y^3 + 7y - y^2 = -3y^3 - y^2 + 12y}$

**Answer 89e.**

Open the parentheses of the given expression, using the distributive property.
$$2(z) - 2(5) + 9(z) + 9(2) = 2z - 10 + 9z + 18$$

Group the like terms.
$$2z - 10 + 9z + 18 = (2z + 9z) + (18 - 10)$$

Next, combine the like terms.
$$(2z + 9z) + (18 - 10) = 11z + 8$$

Therefore, the given expression simplifies to $11z + 8$.

**Answer 90e.**

Given expression is:

$$-5(\omega + 3) - (\omega + 2)$$
$$= -5\omega - 15 - \omega - 2$$
$$= -5\omega - \omega - 15 - 2$$
$$= -6\omega - 17$$
Thus, $\boxed{-5(\omega + 3) - (\omega + 2) = -6\omega - 17}$