Unit 7 Linear Expressions and Equations

Exercise 7.1

1. Separate algebraic equations and algebraic expressions.

(i) $2x + 3 = 7$

Solution: Sign of equality "=" shows it is an algebraic equation.

(ii) $3n + 5\ell = 0$

Solution: Sign of equality "=" shows it is an algebraic equation.

(iii) $3\ell + 3m$

Solution: There is no sign of equality "=" so it is an algebraic expression.

(iv) $4\ell + m - n + 0$

Solution: There is no sign of equality "=" so it is an algebraic expression.

(v) $2x + 3 = 5x^2 + 0$

Solution: Sign of equality "=" shows it is an algebraic equation.

(vi) $x + y = 25$

Solution: Sign of equality "=" shows it is an algebraic equation.

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

Solution: Sign of equality "=" shows it is an algebraic equation.

(viii) $3a + 7b$

Solution: There is no sign of equality "=" so it is an algebraic expression.

(ix) $7x^3 - 3 - 7x + 2$

Solution: There is no sign of equality "=" so it is an algebraic expression.

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

Solution: Sign of equality "=" shows it is an algebraic equation.

2. Which of the following equations are linear in one variable?

(i) $7x - 8 = 0$

Solution: The highest power of variable in the given algebraic equation is 1 so it is a linear equation.

(ii) $2x^2 + x = 7$

Solution: The highest power of variable in the given algebraic equation is 2 so it is not a linear equation.

(iii) $7x^2 = 0$

Solution: The highest power of variable in the given algebraic equation is 2 so it is not a linear equation.

(iv) $5\ell - 5 + 3\ell = 0$

Solution: The highest power of variable in the given algebraic equation is 1 so it is a linear equation.

(v) $9m + 2 - 7m + 0 - 0$

Solution: The highest power of variable in the given algebraic equation is 1 so it is a linear equation.

(vi) $13t - 17 + 21t = 5t$

Solution: The highest power of variable in the given algebraic equation is 1 so it is a linear equation.

3. Write an equation for each of the following statements.

(i) Subtraction of 5 from a number, the result is 4.

Solution: Let's the number is 'x'

So, $x - 5 = 4$

(ii) After two years Atif will be twice as old as he is now.

Solution: Let's the current age of Atif is 'x'

So, $x + 2 = 2x$

(iii) The sum of a number and 7 is 12.

Solution: Let's the number is 'x'

So, $x + 7 = 12$

(iv) The difference of a number and 5 is 7.

Solution: Let's the number is 'x'

So, $x - 5 = 7$

(v) Ali and Arif's age is 20 years by adding.

Solution: Let's the age of Ali is 'x' and age of Arif is 'y'

So, $x + y = 20$

(vi) The price of 8 books is equal to the price of 1 bag.

Solution: Let's the price of book is 'x' and price of bag is 'y'

So, $8x = y$

(vii) A number increased by 4 is 6.

Solution: Let's the number is 'x'

So, $x + 4 = 6$

(viii) The length of a rectangle is thrice of its breadth.

Solution: Let's the length of rectangle is 'x' and width of rectangle is 'y'

So, $x = 3y$

4. Solve the following equations and verify the solution.

(i) $3x + 4 = 10$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$3x + 4 = 10$

Subtract 4 from both sides.

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

Same integers with opposite signs cancel each other.

$3x = 6$

Divide both sides by 3.

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

$x = 2$

Hence, the solution of given equation is 2.

Verification: To verify the given solution, we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 2$ use it into $3x + 4 = 10$

$3(2) + 4 = 10$

$6 + 4 = 10$

$10 = 10$

Both sides are same, it shows the solution is exact.

(ii) $9b - 9 = 0$

Solution: To solve the given algebraic equation we have to find the value of 'b'.

$$9b - 9 = 0$$

Add 9 on both sides.

$$9b - 9 + 9 = 0 + 9$$

Same integers with opposite signs cancel each other.

$$9b = 9$$

Divide both sides by 9.

$$\frac{\cancel{9}b}{\cancel{9}} = \frac{\cancel{9}^{1}}{\cancel{9}}$$

$$b = 1$$

Hence, the solution of given equation is 1.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $b = 1$ use it into $9b - 9 = 0$

$$9(1) - 9 = 0$$

$$9 - 9 = 0$$

Same integers with opposite signs cancel each other.

$$0 = 0$$

Both sides are same, it shows the solution is exact.

(iii) $6x = 36$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$6x = 36$$

Divide both sides by 6.

$$\frac{\cancel{6}x}{\cancel{6}} = \frac{\cancel{36}^{6}}{\cancel{6}}$$

$$x = 6$$

Hence, the solution of given equation is 6.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 6$ use it into $6x = 36$

$$6(6) = 36$$

$$36 = 36$$

Both sides are same, it shows the solution is exact.

(iv) $x + 2 = 2x - 1$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$x + 2 = 2x - 1$$

Subtract 2 from both sides.

$$x + 2 - 2 = 2x - 1 - 2$$

Same integers with opposite signs cancel each other.

$$x = 2x - 3$$

Subtract $2x$ from both sides.

$$x - 2x = 2x - 3 - 2x$$

$$-x = -3$$

Divide both sides by -1

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

$$x = 3$$

Hence, the solution of given equation is 3.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 3$ use it into $x + 2 = 2x - 1$

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

$$5 = 6 - 1$$

$$5 = 5$$

Both sides are same, it shows the solution is exact.

(v) $\frac{2}{3}x + 5 = 29$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$\frac{2}{3}x + 5 = 29$$

Subtract 5 from both sides.

$$\frac{2}{3}x + 5 - 5 = 29 - 5$$

Same integers with opposite signs cancel each other.

$$\frac{2}{3}x = 24$$

Multiply both sides by 3.

$$\frac{2x}{\cancel{3}} \times \cancel{3} = 24 \times 3$$

$$2x = 72$$

Divide both sides by 2

$$\frac{\cancel{2}x}{\cancel{2}} = \frac{\cancel{72}^{36}}{\cancel{2}}$$

$$x = 36$$

Hence, the solution of given equation is 36.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 36$ use it into $\frac{2}{3}x + 5 = 29$

$$\frac{2}{3}(36) + 5 = 29$$

$$\frac{2}{\cancel{3}}(\cancel{36}^{12}) + 5 = 29$$

$$2 \times 12 + 5 = 29$$

$$24 + 5 = 29$$

$$29 = 29$$

Both sides are same, it shows the solution is exact.

(vi) $\frac{2y}{3} = -8$

Solution: To solve the given algebraic equation we have to find the value of 'y'.

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

Multiply both sides by 3.

$$\frac{2y}{\cancel{3}} \times \cancel{3} = (-8) \times 3$$

$$2y = -24$$

Divide both sides by 2

$$\frac{\cancel{2}y}{\cancel{2}} = \frac{-\cancel{24}^{12}}{\cancel{2}}$$

$$y = -12$$

Hence, the solution of given equation is −12.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $y = -12$ use it into $\frac{2y}{3} = -8$

$$\frac{2}{3}(-12) = -8$$

$$\frac{2}{\cancel{3}}(-\cancel{12}^{4}) = -8$$

$$2 \times (-4) = -8$$

$$-8 = -8$$

Both sides are same, it shows the solution is exact.

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

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$3x - 2 = 2x + 4$$

Add 2 on both sides.

$$3x - 2 + 2 = 2x + 4 + 2$$

Same integers with opposite signs cancel each other.

$$3x = 2x + 6$$

Subtract $2x$ from both sides.

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

$$x = 6$$

Hence, the solution of given equation is 6.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 6$ use it into $3x - 2 = 2x + 4$

$$3(6) - 2 = 2(6) + 4$$

$$18 - 2 = 12 + 4$$

$$16 = 16$$

Both sides are same, it shows the solution is exact.

(viii) $\frac{2}{3}x - 8 = x + \frac{1}{4}$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$\frac{2}{3}x - 8 = x + \frac{1}{4}$$

Add 8 on both sides.

$$\frac{2}{3}x - 8 + 8 = x + \frac{1}{4} + 8$$

$$\frac{2}{3}x = x + \frac{1+32}{4}$$

$$\frac{2}{3}x = x + \frac{33}{4}$$

Subtract 'x' from both sides.

$$\frac{2}{3}x - x = x + \frac{33}{4} - x$$

$$\left(\frac{2}{3} - 1\right)x = \frac{33}{4}$$

$$\left(\frac{2-3}{3}\right)x = \frac{33}{4}$$

$$\left(\frac{-1}{3}\right)x = \frac{33}{4}$$

Multiply both sides by −3.

$$\frac{-x}{\cancel{3}} \times (-\cancel{3}) = \frac{33}{4} \times (-3)$$

$$(-x) \times (-1) = \frac{33 \times (-3)}{4}$$

$$x = -\frac{99}{4}$$

Hence, the solution of given equation is $-\frac{99}{4}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = -\frac{99}{4}$ use it into $\frac{2}{3}x - 8 = x + \frac{1}{4}$

$$\frac{2}{3} \times \left(-\frac{99}{4}\right) - 8 = \left(-\frac{99}{4}\right) + \frac{1}{4}$$

$$\frac{\cancel{2}}{\cancel{3}} \times \left(-\frac{\cancel{99}^{33}}{\cancel{4}_{2}}\right) - 8 = \left(\frac{-99+1}{4}\right)$$

$$-\frac{33}{2} - 8 = \left(\frac{-98}{4}\right)$$

$$\frac{-33-16}{2} = \left(\frac{-\cancel{98}^{49}}{\cancel{4}_{2}}\right)$$

$$-\frac{49}{2} = -\frac{49}{2}$$

Both sides are same, it shows the solution is exact.

(ix) $6x + 15 = 2x + 28$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$6x + 15 = 2x + 28$$

Subtract 15 from both sides.

$$6x + 15 - 15 = 2x + 28 - 15$$

Same integers with opposite signs cancel each other.

$$6x = 2x + 13$$

Subtract $2x$ from both sides.

$$6x - 2x = 2x + 13 - 2x$$

$$4x = 13$$

Divide both sides by 4

$$\frac{\cancel{4}x}{\cancel{4}} = \frac{13}{4} \text{ implies that } x = \frac{13}{4}$$

Hence, the solution of given equation is $\frac{13}{4}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = \frac{13}{4}$ use it into $6x + 15 = 2x + 28$

$$6\left(\frac{13}{4}\right) + 15 = 2\left(\frac{13}{4}\right) + 28$$

$$^{3}\cancel{6}\left(\frac{13}{\cancel{4}_{2}}\right) + 15 = \cancel{2}\left(\frac{13}{\cancel{4}_{2}}\right) + 28$$

$$\frac{39}{2} + 15 = \frac{13}{2} + 28$$

$$\frac{39+30}{2} = \frac{13+56}{2}$$

$$\frac{69}{2} = \frac{69}{2}$$

Both sides are same, it shows the solution is exact.

(x) $2x + 12 = 42$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$2x + 12 = 42$$

Subtract 12 from both sides.

$$2x + 12 - 12 = 42 - 12$$

Same integers with opposite signs cancel each other.

$$2x = 30$$

Divide both sides by 2.

$$\frac{\cancel{2}x}{\cancel{2}} = \frac{\cancel{30}^{15}}{\cancel{2}}$$

$$x = 15$$

Hence, the solution of given equation is 15.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 15$ use it into $2x + 12 = 42$

$$2(15) + 12 = 42$$

$$30 + 12 = 42$$

$$42 = 42$$

Both sides are same, it shows the solution is exact.

(xi) $m + 1 + 2m + 5 = 0$

Solution: To solve the given algebraic equation we have to find the value of 'm'.

$$m + 1 + 2m + 5 = 0$$

Add similar values.

$$m + 2m + 1 + 5 = 0$$

$$3m + 6 = 0$$

Subtract 6 from both sides.

$$3m + 6 - 6 = 0 - 6$$

$$3m = -6$$

Divide both sides by 3.

$$\frac{\cancel{3}m}{\cancel{3}} = \frac{-\cancel{6}^{2}}{\cancel{3}}$$

$$m = -2$$

Hence, the solution of given equation is -2.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $m = -2$ use it into $m + 1 + 2m + 5 = 0$

$$-2 + 1 + 2(-2) + 5 = 0$$

$$-2 + 1 - 4 + 5 = 0$$

Now arrange values and apply operation

$$-2 - 4 + 1 + 5 = 0$$

$$-6 + 6 = 0$$

$$0 = 0$$

Both sides are same, it shows the solution is exact.

(xii) $\frac{x}{2} + \frac{3x}{2} + \frac{x}{2} + \frac{5x}{2} = 25$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$\frac{x}{2} + \frac{3x}{2} + \frac{x}{2} + \frac{5x}{2} = 25$$

Add given like fractions.

$$\frac{x + 3x + x + 5x}{2} = 25$$

$$\frac{10x}{2} = 25$$

Multiply both sides by 2.

$$\frac{10x}{\cancel{2}} \times \cancel{2} = 25 \times 2$$

$$10x = 50$$

Divide both sides by 10.

$$\frac{\cancel{10}x}{\cancel{10}} = \frac{\cancel{50}^{5}}{\cancel{10}}$$

$$x = 5$$

Hence, the solution of given equation is 5.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 5$ use it into $\frac{x}{2} + \frac{3x}{2} + \frac{x}{2} + \frac{5x}{2} = 25$

$$\frac{5}{2} + \frac{3(5)}{2} + \frac{5}{2} + \frac{5(5)}{2} = 25$$

$$\frac{5}{2} + \frac{15}{2} + \frac{5}{2} + \frac{25}{2} = 25$$

$$\frac{5 + 15 + 5 + 25}{2} = 25$$

$$\frac{50}{2} = 25$$

$$\frac{^{25}\cancel{50}}{\cancel{2}} = 25$$

$$25 = 25$$

Both sides are same, it shows the solution is exact.

(xiii) $\mathbf{0.5x - 4 = 0.2x + 8}$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$0.5x - 4 = 0.2x + 8$$

Add 4 on both sides.

$$0.5x - 4 + 4 = 0.2x + 8 + 4$$

Same integers with opposite signs cancel each other.

$$0.5x = 0.2x + 12$$

Subtract $0.2x$ from both sides.

$$0.5x - 0.2x = 0.2x + 12 - 0.2x$$

$$(0.5 - 0.2)x = 12$$

$$0.3x = 12$$

Express decimal number as fraction.

$$\frac{3x}{10} = 12$$

Multiply both sides by 10

$$\frac{3x}{\cancel{10}} \times \cancel{10} = 12 \times 10$$

$$3x = 120$$

Divide both sides by 3

$$\frac{\cancel{3}x}{\cancel{3}} = \frac{\cancel{120}^{40}}{\cancel{3}}$$

$$x = 40$$

Hence, the solution of given equation is 40.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 40$ use it into $0.5x - 4 = 0.2x + 8$

$$0.5(40) - 4 = 0.2(40) + 8$$

$$\frac{5}{10}(40) - 4 = \frac{2}{10}(40) + 8$$

$$\frac{5}{\cancel{10}}\left(\cancel{40}^{4}\right) - 4 = \frac{2}{\cancel{10}}\left(\cancel{40}^{4}\right) + 8$$

$$20 - 4 = 8 + 8$$

$$16 = 16$$

Both sides are same, it shows the solution is exact.

(xiv) $\mathbf{8.5 - 2x = 2.3}$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$8.5 - 2x = 2.3$$

Subtract 8.5 from both sides.

$$8.5 - 2x - 8.5 = 2.3 - 8.5$$

Same integers with opposite signs cancel each other.

$$-2x = -6.2$$

Divide both sides by -2.

$$\frac{\cancel{-2}x}{\cancel{-2}} = \frac{\cancel{-6.2}^{3.1}}{\cancel{-2}}$$

$$x = 3.1$$

Hence, the solution of given equation is 3.1.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 3.1$ use it into $8.5 - 2x = 2.3$

$$8.5 - 2(3.1) = 2.3$$

$$8.5 - 6.2 = 2.3$$

$$2.3 = 2.3$$

Both sides are same, it shows the solution is exact.

(xv) $0.2x - 5 = 9$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$0.2x - 5 = 9$$

Add 5 on both sides.

$$0.2x - 5 + 5 = 9 + 5$$

Same integers with opposite signs cancel each other.

$$0.2x = 14$$

Express decimal number as fraction

$$\frac{2x}{10} = 14$$

Multiply both sides by 10

$$\frac{2x}{\cancel{10}} \times \cancel{10} = 14 \times 10$$

$$2x = 140$$

Divide both sides by 2

$$\frac{\cancel{2}x}{\cancel{2}} = \frac{\cancel{140}^{70}}{\cancel{2}}$$

$$x = 70$$

Hence, the solution of given equation is 70.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 70$ use it into $0.2x - 5 = 9$

$$0.2(70) - 5 = 9$$

$$\frac{2}{10}(70) - 5 = 9$$

$$\frac{2}{\cancel{10}}\left(\cancel{70}^{7}\right) - 5 = 9$$

$$14 - 5 = 9$$

$$9 = 9$$

Both sides are same, it shows the solution is exact.

(xvi) $1.5x + 4 = 7$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$1.5x + 4 = 7$$

Subtract 4 from both sides.

$$1.5x + 4 - 4 = 7 - 4$$

Same integers with opposite signs cancel each other.

$$1.5x = 3$$

Express decimal number as fraction

$$\frac{15x}{10} = 3$$

Multiply both sides by 10

$$\frac{15x}{\cancel{10}} \times \cancel{10} = 3 \times 10$$

$$15x = 30$$

Divide both sides by 15

$$\frac{\cancel{15}x}{\cancel{15}} = \frac{\cancel{30}^{2}}{\cancel{15}}$$

$$x = 2$$

Hence, the solution of given equation is 2.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 2$ use it into $1.5x + 4 = 7$

$$1.5(2) + 4 = 7$$

$$\frac{15}{10}(2) + 4 = 7$$

$$\frac{^{3}\cancel{15}}{_{5}\cancel{10}}\left(\cancel{2}\right) + 4 = 7$$

$$3 + 4 = 7$$

$$7 = 7$$

Both sides are same, it shows the solution is exact.

(xvii) $0.25x + 1.5 = 7.5$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$0.25x + 1.5 = 7.5$$

Subtract 1.5 from both sides.

$$0.25x + 1.5 - 1.5 = 7.5 - 1.5$$

Same integers with opposite signs cancel each other.

$$0.25x = 6$$

Express decimal number as fraction

$$\frac{25x}{100} = 6$$

Multiply both sides by 100

$$\frac{25x}{\cancel{100}} \times \cancel{100} = 6 \times 100$$

$$25x = 600$$

Divide both sides by 25

$$\frac{\cancel{25}x}{\cancel{25}} = \frac{\cancel{600}^{24}}{\cancel{25}}$$

$$x = 24$$

Hence, the solution of given equation is 24.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 24$ use it into $0.25x + 1.5 = 7.5$

$$0.25(24) + 1.5 = 7.5$$

$$\frac{25}{100}(24) + 1.5 = 7.5$$

$$\frac{\cancel{25}}{\cancel{100}_{4}}\left(\cancel{24}^{6}\right) + 1.5 = 7.5$$

$$6 + 1.5 = 7.5$$

$$7.5 = 7.5$$

Both sides are same, it shows the solution is exact.

(xviii) $\dfrac{3x - 1.5}{0.9 - 1.5x} = 0$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$\frac{3x - 1.5}{0.9 - 1.5x} = 0$$

Multiply both sides by $(0.9 - 1.5x)$.

$$\frac{3x - 1.5}{\cancel{0.9 - 1.5x}} \times (\cancel{0.9 - 1.5x}) = 0 \times (0.9 - 1.5x)$$

$$3x - 1.5 = 0$$

Add 1.5 on both sides.

$$3x - 1.5 + 1.5 = 0 + 1.5$$

$$3x = 1.5$$

Divide both sides by 3.

$$\frac{\cancel{3}x}{\cancel{3}} = \frac{1.5^{0.5}}{\cancel{3}}$$

$$x = 0.5$$

Hence, the solution of given equation is 0.5.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 0.5$ use it into $\dfrac{3x - 1.5}{0.9 - 1.5x} = 0$

$$\frac{3(0.5) - 1.5}{0.9 - 1.5(0.5)} = 0$$

$$\frac{1.5 - 1.5}{0.9 - 1.5(0.5)} = 0$$

$$\frac{0}{0.9 - 0.75} = 0$$

If we divide 0 by any number the answer will be zero.

$$0 = 0$$

Both sides are same, it shows the solution is exact.

5. Solve the following and verify the solution.

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

Solution: To solve this type of expression take LCM of denominators. LCM of 2, 3 and 3 is 6. Now, multiply all fractions by 6.

$$\frac{x-7}{\cancel{2}}\times\cancel{6}^{3}-\frac{x+3}{\cancel{3}}\times\cancel{6}^{2}=\frac{2}{\cancel{3}}\times\cancel{6}^{2}$$

$$(x-7)\times 3-(x+3)\times 2=2\times 2$$

$$(3\times x)-(3\times 7)-(2\times x)-(2\times 3)=4$$

$$3x-21-2x-6=4$$

Arrange like terms and apply operations.

$$3x-2x-21-6=4$$

$$x-27=4$$

Add 27 on both sides.

$$x-27+27=4+27$$

$$x=31$$

Hence, the solution of given equation is 31.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 31$ use it into $\frac{x-7}{2}-\frac{x+3}{3}=\frac{2}{3}$

$$\frac{31-7}{2}-\frac{31+3}{3}=\frac{2}{3}$$

$$\frac{24}{2}-\frac{34}{3}=\frac{2}{3}$$

$$\frac{72-68}{6}=\frac{2}{3}$$

$$\frac{4}{6}=\frac{2}{3}$$

Divide numerator and denominator by 2.

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

Both sides are same, it shows the solution is exact.

(ii) $\frac{2x+5}{15}+\frac{7x-2}{3}=\frac{1}{3}$

Solution: To solve this type of expression take LCM of denominators. LCM of 15, 3 and 3 is 15. Now, multiply all fractions by 15.

$$\frac{2x+5}{\cancel{15}}\times\cancel{15}^{1}+\frac{7x-2}{\cancel{3}}\times\cancel{15}^{5}=\frac{1}{\cancel{3}}\times\cancel{15}^{5}$$

$$(2x+5)\times 1+(7x-2)\times 5=1\times 5$$

$$(1\times 2x)+(1\times 5)+(5\times 7x)-(5\times 2)=5$$

$$2x+5+35x-10=5$$

Arrange like terms and apply operations.

$$2x+35x+5-10=5$$

$$37x-5=5$$

Add 5 on both sides.

$$37x-5+5=5+5$$

$$37x=10$$

Divide both sides by 37.

$$\frac{\cancel{37}\,x}{\cancel{37}}=\frac{10}{37}$$

$$x=\frac{10}{37}$$

Hence, the solution of given equation is $\frac{10}{37}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = \frac{10}{37}$ use it into $\frac{2x+5}{15}+\frac{7x-2}{3}=\frac{1}{3}$

$$\frac{2\left(\frac{10}{37}\right)+5}{15}+\frac{7\left(\frac{10}{37}\right)-2}{3}=\frac{1}{3}$$

$$\frac{\left(\frac{20}{37}\right)+5}{15}+\frac{\left(\frac{70}{37}\right)-2}{3}=\frac{1}{3}$$

$$\frac{\frac{20+185}{37}}{15}+\frac{\frac{70-74}{37}}{3}=\frac{1}{3}$$

$$\frac{\frac{205}{37}}{15}+\frac{\frac{-4}{37}}{3}=\frac{1}{3}$$

$$\frac{205}{37\times 15}-\frac{4}{37\times 3}=\frac{1}{3}$$

$$\frac{205}{555}-\frac{4}{111}=\frac{1}{3}$$

LCM of 555 and 111 is 555.

$$\frac{205-20}{555}=\frac{1}{3}$$

$$\frac{185}{555}=\frac{1}{3}$$

Divide numerator and denominator by 185.

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

Both sides are same, it shows the solution is exact.

(iii) $\dfrac{x+5}{3}=\dfrac{x+8}{2}$

Solution: To solve this type of expression take LCM of denominators. LCM of 3 and 2 is 6. Now, multiply both fractions by 6.

$$\frac{x+5}{\cancel{3}}\times\cancel{6}^{2}=\frac{x+8}{\cancel{2}}\times\cancel{6}^{3}$$

$$(x+5)\times 2=(x+8)\times 3$$

$$(2\times x)+(2\times 5)=(3\times x)+(3\times 8)$$

$$2x+10=3x+24$$

Subtract 10 from both sides.

$$2x+10-10=3x+24-10$$

$$2x=3x+14$$

Subtract $3x$ from both sides.

$$2x-3x=3x+14-3x$$

$$-x=14$$

Divide both sides by -1.

$$x=-14$$

Hence, the solution of given equation is -14.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = -14$ use it into $\dfrac{x+5}{3}=\dfrac{x+8}{2}$

$$\frac{(-14)+5}{3}=\frac{(-14)+8}{2}$$

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

$$-3=-3$$

Both sides are same, it shows the solution is exact.

(iv) $\dfrac{7x-2}{3}-\dfrac{2x+3}{5}-5=0$

Solution: To solve this type of expression take LCM of denominators. LCM of 3 and 5 is 15. Now, multiply all fractions by 15.

$$\frac{7x-2}{\cancel{3}}\times\cancel{15}^{5}-\frac{2x+3}{\cancel{5}}\times\cancel{15}^{3}-5\times 15=0$$

$$(7x-2)\times 5-(2x+3)\times 3-75=0$$

$$(5\times 7x)-(5\times 2)-(3\times 2x)-(3\times 3)-75=0$$

$$35x-10-6x-9-75=0$$

Arrange like terms and apply operations.

$$35x-6x-10-9-75=0$$

$$29x-94=0$$

Add 94 on both sides.

$$29x-94+94=0+94$$

$$29x=94$$

Divide both sides by 29.

$$\frac{\cancel{29}x}{\cancel{29}}=\frac{94}{29}$$

$$x=\frac{94}{29}$$

Hence, the solution of given equation is $\dfrac{94}{29}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = \dfrac{94}{29}$ use it into $\dfrac{7x-2}{3}-\dfrac{2x+3}{5}-5=0$

$$\frac{7\left(\frac{94}{29}\right)-2}{3}-\frac{2\left(\frac{94}{29}\right)+3}{5}-5=0$$

$$\frac{\left(\frac{658}{29}\right)-2}{3}-\frac{\left(\frac{188}{29}\right)+3}{5}-5=0$$

$$\frac{\frac{658-58}{29}}{3}-\frac{\frac{188+87}{29}}{5}-5=0$$

$$\frac{\frac{600}{29}}{3}-\frac{\frac{275}{29}}{5}-5=0$$

$$\frac{600}{29\times 3}-\frac{275}{29\times 5}-5=0$$

$$\frac{\cancel{600}^{200}}{29\times\cancel{3}}-\frac{\cancel{275}^{55}}{29\times\cancel{5}}-5=0$$

$$\frac{200}{29}-\frac{55}{29}-5=0$$

LCM of 29 and 29 is 29.

$$\frac{200-55-145}{29}=0$$

$$\frac{0}{29}=0$$

$$0=0$$

Both sides are same, it shows the solution is exact.

(v) $\frac{2x+15}{2} = \frac{2(3+2x)}{3}$

Solution: To solve this type of expression take LCM of denominators. LCM of 2 and 3 is 6. Now, multiply all fractions by 6.

$$\frac{2x+15}{\cancel{2}} \times \cancel{6}^{3} = \frac{2(3+2x)}{\cancel{3}} \times \cancel{6}^{2}$$

$$(2x+15)\times 3 = (6+4x)\times 2$$

$$(3\times 2x)+(3\times 15) = (2\times 6)+(2\times 4x)$$

$$6x+45 = 12+8x$$

Subtract 45 from both sides.

$$6x+45-45 = 12+8x-45$$

$$6x = -33+8x$$

Subtract $8x$ from both sides.

$$6x-8x = -33+8x-8x$$

$$-2x = -33$$

Divide both sides by -2.

$$\frac{\cancel{-2}x}{\cancel{-2}} = \frac{-33}{-2}$$

$$x = \frac{33}{2}$$

Hence, the solution of given equation is $\frac{33}{2}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = \frac{33}{2}$ use it into $\frac{2x+15}{2} = \frac{2(3+2x)}{3}$

$$\frac{2\left(\frac{33}{2}\right)+15}{2} = \frac{2\left(3+2\left(\frac{33}{2}\right)\right)}{3}$$

$$\frac{\cancel{2}\left(\frac{33}{\cancel{2}}\right)+15}{2} = \frac{2\left(3+\cancel{2}\left(\frac{33}{\cancel{2}}\right)\right)}{3}$$

$$\frac{33+15}{2} = \frac{2(3+33)}{3}$$

$$\frac{48}{2} = \frac{2(36)}{3}$$

$$\frac{48}{2} = \frac{72}{3}$$

$$24 = 24$$

Both sides are same, it shows the solution is exact.

Exercise 7.2

1. Ali and Shakeel bought a time clock for Rs.60. Ali paid Rs.12 more than Shakeel. What amount did Ali pay?

Solution: Suppose that Shakeel paid Rs. x

So, Ali paid = Rs. $x + 12$

According to given condition

Price of the clock = $x + 12 + x = 60$

$$2x + 12 = 60$$

Subtract 12 from both sides

$$2x + 12 - 12 = 60 - 12$$

$$2x = 48$$

Dividing both sides by 2

$$x = 24$$

Ali paid = Rs. $x + 12$

= Rs. $24 + 12$ = Rs. 36

Hence, Ali paid Rs. 36 to bought the clock.

2. The age of Asma's brother is 10 years less than twice of Asma's age. What will be the age of Asma when her brother is 20 years old?

Solution: Suppose that Asma's age is 'x' years
So, Asma's brother age = $2x - 10$ years
According to given condition

$$2x - 10 = 20$$
$$2x = 20 + 10$$
$$2x = 30$$

Dividing both sides by 2

$$x = 15$$

Hence, Asma's age will be 15 year when his brother age is 20 years.

3. The sum of the two numbers is 12. Find the numbers when one number is twice of the other. (Hint: Suppose the one number is x then the other is $2x$).

Solution: Suppose that one number is x and other is $2x$.
According to given condition

$$x + 2x = 12$$
$$3x = 12$$

Dividing both sides by 3

$$x = 4$$

Hence, one number is 4 and other number is 8.

4. A man is 30 years older than his son. After 12 years, the man will be three times as old as his son. Find their present ages.

Solution: Suppose that age of son is 'x' years
So, age of the man = $x + 30$ years
According to given condition, after 12 years
The age of son = $x + 12$ years
The age of the man = $3(x + 12) = x + 30 + 12$

$$3x + 36 = x + 30 + 12$$
$$3x + 36 = x + 42$$

Subtract x from both sides

$$3x + 36 - x = x + 42 - x$$
$$2x + 36 = 42$$

Subtract 36 from both sides

$$2x + 36 - 36 = 42 - 36$$
$$2x = 6$$

Dividing both sides by 2

$$x = 3$$

The age of son = $x + 12$ years
= 3 + 12 years
=15 years

The age of the man = $3(x + 12)$
= $3(3 + 12)$ = 3×15
= 45 years

Hence, the present ages of the man and his son are 45 years and 15 years respectively.

5. After 20 years Kiran will be 5 times as old as she is now. What is her present age?

Solution: Suppose that present age of Kiran is 'x' years

According to given condition, after 20 years

The age of Kiran = $5x$ years

It implies $(x + 20) = 5x$

$20 = 5x - x$

$20 = 4x$

Dividing both sides by 4

$x = 5$

Hence, the present age of Kiran is 5 years.

6. Asad's father is 42 years old. He is 12 years older than twice of Asad's age. Find the Asad's age.

Solution: Suppose that Asad's age is 'x' years

According to given condition ,

Asad's father age = $2x + 12$ years = 42 years

$2x = 42 - 12$

$2x = 30$

Dividing both sides by 2

$x = 15$

Hence, Asad's age is 15 years.

7. The sum of two consecutive numbers is 37. Find the numbers.

Solution: Suppose that one number is x and other is $x + 1$.

According to given condition

$x + x + 1 = 37$

$2x + 1 = 37$

Subtracting 1 from both sides

$2x + 1 - 1 = 37 - 1$

$2x = 36$

Dividing both sides by 2

$x = 18$

One number = $x = 18$ and other number is $x + 1$ i.e. $18 + 1 = 19$

Hence, one number is 18 and other number is 19.

8. A man is 40 years older than his son. After 12 years the man will be three times as old as his son. Find their present ages.

Solution: Suppose that age of son is 'x' years

So, age of the man = $x + 40$ years

According to given condition, after 12 years

The age of son = $x + 12$ years

The age of the man = $3(x + 12) = x + 40 + 12$

$3x + 36 = x + 40 + 12$

$3x + 36 = x + 52$

Subtract x from both sides

$3x + 36 - x = x + 52 - x$

$2x + 36 = 52$

Subtract 36 from both sides

$2x + 36 - 36 = 52 - 36$

$2x = 16$

Dividing both sides by 2

$x = 8$

The age of son = x + 12 years
= 8 + 12 years
= 20 years

The age of the man = $3(x + 12)$
= $3(8 + 12)$
= $3 \times 20 = 60$ years

Hence, the present ages of the man and his son are 60 years and 20 years respectively.

9. In a cricket match, Imran Farhat and Abdul Razzaq enhanced 69 runs in the score of Pakistan. If the score of Abdul Razzaq is double than the score of Imran Farhat. Find that how many runs Abdul Razzaq requires to complete his half century.

Solution: Suppose that scores of Imran Farhat are 'x'.

So, scores of Abdul Razzaq = $2x$

According to given condition,

$x + 2x = 69$

$3x = 69$

Dividing both sides by 3

$x = 23$

It means, scores of Imran Farhat are 23 and scores of Abdul Razzaq are $2 \times 23 = 46$ scores. Half century means 50 runs.

Hence, Abdul Razzaq require 4 runs to complete half century.

Review Exercise 7

1. Encircle the correct option.

(i) $4x + 3 - 2x$ is an:

(a) equation (b) expression (c) quantity (d) none of these

(ii) $4x + 3 = 2x$ is an:

(a) equation (b) expression (c) quantity (d) none of these

(iii) The linear equation $4x + 3 = 2x$ has solution:

(a) $-\frac{2}{3}$ (b) $-\frac{3}{2}$ (c) -3 (d) 4

(iv) $3x + 8 = 0$ is:

(a) a second degree equation (b) a first degree equation

(c) a quadratic equation (d) not an equation

(v) An expression for the statement "a number increased by 9" is:

(a) $9x$ (b) $\frac{x}{9}$ (c) $x + 9$ (d) $x - 9$

(vi) An equation for the statement "The sum of three consecutive numbers is 18" is:

(a) $x+(x+1)+(x+2)=18$ (b) $x+y+x=18$ (c) $x+x+x=18$ (d) $(x)(x+1)(x+2)=18$

(vii) Age of mother is double the age of her child and mother's age is 56 years. The age of the son will be:

(a) 112 years (b) 18 years (c) 28 years (d) 38 years

(viii) What is the root of the equation: $\frac{x}{2}-1=3$

(a) 2 (b) 4 (c) 6 (d) 8

(ix) What is the solution of the equation: $\frac{x}{3}-\frac{x}{2}=1$

(a) 2 (b) 3 (c) -6 (d) 6

(x) What is 4 in 5^4?

(a) base (b) exponent (c) coefficient (d) variable

2. Solve the following linear equations and also verify the solution.

(i) $4x-2x-20=8x-15$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$4x-2x-20=8x-15$$
$$2x-20=8x-15$$

Add 20 on both sides.

$$2x-20+20=8x-15+20$$

Same integers with opposite signs cancel each other.

$$2x=8x+5$$

Subtract $8x$ from both sides

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

Same integers with opposite signs cancel each other.

$$-6x=5$$

Divide both sides by -6.

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

Hence, the solution of given equation is $-\frac{5}{6}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x=-\frac{5}{6}$ use it into $4x-2x-20=8x-15$

$$4\left(-\frac{5}{6}\right)-2\left(-\frac{5}{6}\right)-20=8\left(-\frac{5}{6}\right)-15$$
$$-\frac{20}{6}+\frac{10}{6}-20=-\frac{40}{6}-15$$
$$\frac{-20+10-120}{6}=\frac{-40-90}{6}$$
$$-\frac{130}{6}=-\frac{130}{6}$$

Both sides are same, it shows the solution is exact.

(ii) $\frac{2x+7}{7}=\frac{2x+1}{2}$

Solution: To solve this type of expression take LCM of denominators. LCM of 7 and 2 is 14.

Now, multiply both fractions by 14.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

$$\frac{2x+7}{\cancel{7}}\times\cancel{14}^{2}=\frac{2x+1}{\cancel{2}}\times\cancel{14}^{7}$$

$$(2x+7)\times 2=(2x+1)\times 7$$

$$(2\times 2x)+(2\times 7)=(7\times 2x)+(7\times 1)$$

$$4x+14=14x+7$$

Subtract 14 from both sides.

$$4x+14-14=14x+7-14$$

$$4x=14x-7$$

Subtract $14x$ from both sides.

$$4x-14x=14x-7-14x$$

$$-10x=-7$$

Divide both sides by -10.

$$x=\frac{7}{10}$$

Here, $x=\frac{7}{10}$ use it into $\frac{2x+7}{7}=\frac{2x+1}{2}$

$$\frac{2\left(\frac{7}{10}\right)+7}{7}=\frac{2\left(\frac{7}{10}\right)+1}{2}$$

$$\frac{\left(\frac{7}{5}\right)+7}{7}=\frac{\left(\frac{7}{5}\right)+1}{2}$$

$$\frac{\left(\frac{7+35}{5}\right)}{7}=\frac{\left(\frac{7+5}{5}\right)}{2}$$

$$\frac{\left(\frac{42}{5}\right)}{7}=\frac{\left(\frac{12}{5}\right)}{2}$$

$$\frac{\cancel{42}^{6}}{5\times\cancel{7}}=\frac{\cancel{12}^{6}}{5\times\cancel{2}}$$

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

Both sides are same, it shows the solution is exact.

(iii) $\frac{8x}{2}-4=6$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

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

Add 4 on both sides.

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

Same integers with opposite signs cancel each other.

$$\frac{8x}{2}=10$$

Multiply both sides by 2.

$$\frac{8x}{\cancel{2}}\times\cancel{2}=10\times 2$$

$$8x=20$$

Divide both sides by 8

$$\frac{\cancel{8}x}{\cancel{8}}=\frac{\cancel{20}^{5}}{\cancel{8}_{2}}$$

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

Hence, the solution of given equation is $\frac{5}{2}$.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x=\frac{5}{2}$ use it into $\frac{8x}{2}-4=6$

$$\frac{\cancel{8}^{4}\left(\frac{5}{\cancel{2}}\right)}{2}-4=6$$

$$\frac{20}{2}-4=6$$

$$10-4=6$$

$$6=6$$

Both sides are same, it shows the solution is exact.

(iv) $5.2x + 2.7 = 4.8x + 1.1$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$5.2x + 2.7 = 4.8x + 1.1$$

Subtract 2.7 from both sides.

$$5.2x + 2.7 - 2.7 = 4.8x + 1.1 - 2.7$$

Same integers with opposite signs cancel each other.

$$5.2x = 4.8x - 1.6$$

Subtract $4.8x$ from both sides

$$5.2x - 4.8x = 4.8x - 1.6 - 4.8x$$

Same integers with opposite signs cancel each other.

$$0.4x = -1.6$$

Divide both sides by 0.4.

$$\frac{0.4x}{0.4} = -\frac{1.6}{0.4}$$

$$x = -\frac{16}{4}$$

$$x = -4$$

Hence, the solution of given equation is -4.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = -4$ use it into $5.2x + 2.7 = 4.8x + 1.1$

$$5.2(-4) + 2.7 = 4.8(-4) + 1.1$$

$$-20.8 + 2.7 = -19.2 + 1.1$$

$$-18.1 = -18.1$$

Both sides are same, it shows the solution is exact.

(v) $\frac{x}{2} + 8 = 20$

Solution: To solve the given algebraic equation we have to find the value of 'x'.

$$\frac{x}{2} + 8 = 20$$

Subtract 8 from both sides.

$$\frac{x}{2} + 8 - 8 = 20 - 8$$

Same integers with opposite signs cancel each other.

$$\frac{x}{2} = 12$$

Multiply both sides by 2.

$$\frac{x}{2} \times 2 = 12 \times 2$$

$$x = 24$$

Hence, the solution of given equation is 24.

Verification: To verify the given solution we have to put the value of variable in the equation and identify that both sides are equal or not.

Here, $x = 24$ use it into $\frac{x}{2} + 8 = 20$

$$\frac{24}{2} + 8 = 20$$

$$12 + 8 = 20$$

$$20 = 20$$

Both sides are same, it shows the solution is exact.

3. Majid is twice as old as his sister Asma. Sum of their ages is 18. Find age of Asma.

Solution: Suppose that Asma's age is 'x' years so, Majid's age will be $2x$.

According to given condition

$$2x + x = 18$$

$$3x = 18$$

Dividing both sides by 3

$$x = 6$$

Asma's age is 'x' years it means 6 years and Majid's age is $2x$ means 12 years.

Hence, Asma's age is 6 years.

4. Sum of two odd numbers is 36. Find the numbers if there difference is 2.

Solution: Suppose that odd numbers are '$2n+1$' and $2n+3$

According to given condition

$$2n+1 + 2n+3 = 36$$

$$4n + 4 = 36$$

Subtracting 4 from both sides

$$4n + 4 - 4 = 36 - 4$$

$$4n = 32$$

Dividing both sides by 4

$$n = 8$$

So, $2n + 1 = 2(8) + 1 = 16 + 1 = 17$ and $2n + 3 = 2(8) + 3 = 16 + 3 = 19$

Hence, the required odd numbers are 17 and 19.

5. The length of a rectangle is three times of its width. If perimeter of the rectangle is 80 metres, then find its length and width.

Solution: Suppose that width of rectangle is 'x' so, the length will be $3x$.

As we know that,

Perimeter of rectangle = 2 (Length + Width)

According to given condition

$$2 \text{ (Length + Width)} = 80 \ m$$

$$2 (3x + x) = 80 \ m$$

$$2 (4x) = 80 \ m$$

$$8x = 80 \ m$$

Dividing both sides by 8

$$x = 10 \ m$$

So, Width = $x = 10 \ m$ and Length = $3x = 3(10) = 30 \ m$

Hence, the length and width of the rectangle are 30 m and 10 m.