UNIT
05

LINEAR EQUATIONS AND INEQUALITIES

In this unit the students will be able to:

- Recall linear equation in one variable.
- Solve linear equation with rational coefficients.
- Reduce equations, involving radicals, to simple linear form and find their solutions.
- Define absolute value.
- Solve the equation, involving absolute value, in one variable.
- Define inequalities (>, <) and (≥, ≤).
- Recognize properties of inequalities (i.e. trichotomy, transitive, additive and multiplicative).
- Solve linear inequalities with rational coefficients.

We can use equations and formulae to model a variety of real life problems and situations. Business, industry, science, sports, travel, architecture and banking are some of the areas that really depend upon equations and inequalities to find the solutions to their problems. For example, consider the following problem taken from our daily life. Sarim and Raahim are football players in their school team.

If we want to compare their scores for the season, only one of the following statements will be true.

- Sarim scored less umber of goals than Raahim.
- Sarim scored the same number of goals as Raahim.
- Sarim scored more number of goals than Raahim.

Let x and y represent the number of goals scored by Sarim and Raahim respectively. We can compare their scores by using an inequality or an equation as given below.

$x < y$ or $x = y$ or $x > y$.

5.1 Linear Equations in One Variable

A **linear equation in one variable** is an equation that can be written in the standard form as $\mathbf{ax + b = 0}$ where a, b are real numbers and $a \neq 0$ e.g.
$2x + 3 = 0$, $5x + 3 = 5$

Key Fact

1. Exponent of the variable in linear equation is always 1. The equation $x^2 = 4$ is non-linear because exponent of the variable is not '1'.
2. Linear equations do not involve product of the variables. The equation $xy = 14$ is a non-linear equation.
3. Linear equation is also called **equation of degree one**.

5.1.1 To Find the Solution of Linear Equations

The **solution** of a linear equation in one variable is a replacement for the variable that makes the equation true.

A linear equation in one variable (in standard form) has exactly one solution. For the solution of such equations, we have to isolate the variable on either side of equal sign by a sequence of **equivalent equations.**

Key Fact

Two or more equations, which have the same solutions, are called equivalent equations. e.g. $2x + 3 = 4$ and $2x = 1$ are two **equivalent equations**.

We follow properties of equality i.e. addition, subtraction, multiplication and division properties while solving first degree linear equations.

Example 1: Solve the following equation for x.

$$-7x + 24 = 3$$

Solution:

$-7x + 24 = 3$ ⟵ original equation

$-7x + 24 - 24 = 3 - 24$ ⟵ subtract 24 from both sides

$-7x = -21$ ⟵ divide both sides by -7

$x = 3$

Check: To check this root, we replace the variable x by its value in the original equation and simplify both sides.

$-7x + 24 = 3$ ⟵ original equation

$-7(3) + 24 \overset{?}{=} 3$ ⟵ replace 'x' by 3

$-21 + 24 \overset{?}{=} 3$ ⟵ simplify L.H.S

$3 = 3$ ⟵ solution is checked

Thus, $x = 3$ is required root.

Point to Ponder!

While checking any solution, it is better to write a question mark over the equal sign just to indicate that we are not sure of the validity of the equation.

5.1.2 Solving Linear Equations Involving Fractions

The following examples illustrate this method.

Example 2: Solve $\frac{3x}{5} - \frac{1}{2} = \frac{x}{4} + 1$

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

LCM of 5, 2 and 4 = 20.

$$20 \times \frac{3x}{5} - 20 \times \frac{1}{2} = 20 \times \frac{x}{4} + 20$$
$$12x - 10 = 5x + 20$$
$$12x - 5x = 20 + 10$$
$$7x = 30$$
$$x = \frac{30}{7}$$

Thus, $x = \frac{30}{7}$ is the required root of the given equation.

Example 3: Solve $\frac{2x+3}{5} = \frac{3-4x}{8}$

Solution: $\frac{2x+3}{5} = \frac{3-4x}{8}$

By cross multiplication we get:

$$8(2x+3) = 5(3-4x)$$
$$16x + 24 = 15 - 20x$$
$$16x + 20x = 15 - 24$$
$$36x = -9$$
$$x = -\frac{9}{36} = -\frac{1}{4}$$

Thus, $x = -\frac{1}{4}$ is the root of given equation.

Example 4: Solve $0.7(x-1) - 0.5x = 1.1$

Solution:

$$0.7(x-1) - 0.5x = 1.1$$
$$0.7x - 0.7 - 0.5x = 1.1$$
$$0.2x - 0.7 = 1.1$$
$$0.2x = 1.8$$
$$2x = 18$$
$$x = 9$$

Check: Replace x by its value in the original equation.

$$0.7(9-1) - 0.5(9) \stackrel{?}{=} 1.1$$
$$5.6 - 4.5 \stackrel{?}{=} 1.1$$
$$1.1 = 1.1$$

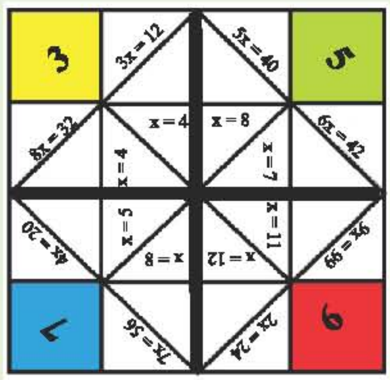
Thus, $x = 9$ is the required solution of the given equation.

Historya Mystery

Finding solution of equations has been a principal aim of mathematics for thousands of years. However, the equal sign did not occur in any text until 1557.

Funmatics

Help students to make such a cootie catcher to play with friends for reinforcement of solution of linear equations.



EXERCISE 5.1

Solve the following linear equations in one variable.

1. $5x - 2 - x = 4 - 3x - 27$

2. $4a - 3(5a - 14) = 5(7 + a) - 9$

3. $7(2 - 5x) + 27 = 18x - 3(8 - 4x)$

4. $\frac{5x}{4} + \frac{1}{2} = 0$

5. $\frac{x-2}{2} + \frac{x+10}{9} = 5$

6. $\frac{4(x+2)}{3} - \frac{6(x-7)}{7} = 12$

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

8. $\frac{y+1}{3} + \frac{y+1}{2} = 2 - \frac{y+3}{2}$

9. $\frac{1}{5}(x-8) + \frac{4+x}{7} = 7 - \frac{23-x}{5}$

10. $\frac{1}{2y} - \frac{1}{6} = \frac{1}{4y} - 1 - \frac{1}{y}$; $y \neq 0$

11. $4 - 0.3(1 - x) = 7$

12. $0.5x = 6.3 - 0.2x$

13. $1.3x - 0.2 = 0.3x - 1.5$

5.2 Linear Equations Involving Radicals

5.2.1 Radical Equations

An equation in which the unknown letter (variable) appears under a radical sign is called a **radical equation.**

Examples: $\sqrt{x+1} = 7$, $\sqrt{x} = 9$, $\sqrt{x+2} = 5$, $\sqrt{2x-3} = \sqrt{x+5}$

Key Fact

- If two numbers are equal, then their squares are also equal i.e. if $x = y$ then $x^2 = y^2$
- If the squares of two numbers are equal, the numbers may or may not be equal. e.g. $(-5)^2 = (5)^2$ but $-5 \neq 5$

5.2.2 To Solve a Radical Equation

I. Arrange the terms such that a term with a radical sign is by itself on one side of the equation.

II. Square both sides of the equation.

III. Solve the resulting linear equation for corresponding variable.

IV. Check the solution in the original equation.

Example 5: Solve $\sqrt{x}+3=7$

Solution:
$$\sqrt{x}+3 = 7$$
$$\sqrt{x} = 4$$
$$(\sqrt{x})^2 = (4)^2$$
$$x = 16$$

Check: Replace x by 16 in the original equation.
$$\sqrt{16}+3 \stackrel{?}{=} 7$$
$$4+3=7$$
$$7=7 \longleftarrow \text{solution is checked}$$

Hence, $x = 16$ is required solution.

Key Fact

The equation in which after isolating the radical term, if radical term is equal to a negative number, such equation has no solution in real numbers.

While squaring both sides of a radical equation it is possible to get an extra root called extraneous root that does not satisfy the original equation. Therefore, it is necessary to check every root by substituting it into the original equation. Consider the following example for such case.

Example 6: Solve $4+2\sqrt{3y+1}=3$

Solution:
$$4+2\sqrt{3y+1} = 3$$
$$2\sqrt{3y+1} = -1 \text{ ....(i)}$$
$$(2\sqrt{3y+1})^2 = (-1)^2$$
$$4(3y+1) = 1$$
$$12y+4 = 1$$
$$12y = -3$$
$$y = -\frac{1}{4}$$

Check:
$$4+2\sqrt{3(-\frac{1}{4})+1} \stackrel{?}{=} 3$$
$$4+2\sqrt{\frac{-3}{4}+1} \stackrel{?}{=} 3$$
$$4+2\sqrt{\frac{1}{4}} \stackrel{?}{=} 3$$
$$4+1 \stackrel{?}{=} 3$$
$$5 \neq 3$$

Thus, $y=-\frac{1}{4}$ is an extraneous root and solution set is ϕ.

Note: In example 6, there is no need to solve the equation after step (i). We can directly say that equation has no solution.

EXERCISE 5.2

Reduce the following radical equations into simple linear equations then find their solution. In case of extraneous solution, write ϕ for the solution set.

1. $\sqrt{2x}=4$
2. $\sqrt{x-3}=2$
3. $\sqrt{x-5}=3$
4. $\sqrt{2x+1}=9$
5. $\sqrt{5x-4}=14$
6. $\sqrt{3x-5}=-10$
7. $\sqrt{y+4}-3=2$
8. $5-\sqrt{2x-1}=0$

9. $\sqrt{y+1}-12=-10$

10. $\sqrt{5t-2}=\sqrt{3t+4}$

11. $\sqrt{9-2x}=\sqrt{5x-12}$

12. $12-\sqrt{y+1}=14$

13. $4\sqrt{z}+8=40$

14. $\sqrt{\frac{a+6}{a+2}}=\sqrt{\frac{a+2}{a-1}}$

15. $\sqrt{\frac{z}{z+3}}=\sqrt{\frac{z+2}{z+6}}$

16. $\sqrt{5x-4}=\sqrt{7x+2}$

5.3 Equations Involving Absolute Value

5.3.1 Defining an Absolute Value

The **absolute value** of a number is its distance from 0 on the number line. If x is any point on the number line then its distance from 0 is denoted by $|x|$. The two vertical bars are called **absolute value bars.** Since distance between any two points is always a positive number or zero, thus the absolute value of a number is always a positive number or zero e.g. distance from 0 to 5 or from 0 to – 5 is 5 units on the number line.

Thus, $|5| = 5$ and $|-5| = 5$

The absolute value of a real number x, written as $|x|$, is defined as

- $|x| = x$, if $x \geq 0$
- $|x| = -x$ if $x < 0$ e.g. $|9| = 9$ or $|-3| = -(-3) = 3$

5.3.2 Solution of Absolute Value Equations

An equation that contains a variable inside the absolute value bars is called an **absolute value equation.**

e.g. $|x| + 1 = 5$, $|x-3| = 4$

To solve the equations involving absolute value, we apply the basic definition of absolute value.

Example 7: Solve the equation $|x| = 8$.

Solution: To solve such equation we have to consider both the possible values of the number with absolute value.

Thus, if $|x| = 8$ then $x = 8$ or $x = -8$.

The solution set is $\{-8, 8\}$.

Example 8: Solve the equation $|x| = -6$.

Solution There is no real number x such that $|x| = -6$. So, this equation has no solution. Hence the solution set is ϕ.

Conclusions

An absolute value equation of the form $|ax+b| = c$, where a, b and c are real numbers, $a \neq 0$ and $c > 0$ is equivalent to two equations:

$$ax+b=c \quad \text{or} \quad ax+b=-c.$$

For the required solution set of the given absolute value equation, we solve both the equations separately.

Example 9: Solve the equation:

$$|2x+5| = 11, \text{ where } x \in R.$$

Solution:

Step-I: Remove the absolute value bars and write two equations as

$$2x+5=11 \quad \text{or} \quad 2x+5=-11$$

Step-II: Now solve both the equations for x.

$2x+5 = 11$	$2x+5 = -11$
$2x = 11-5$	$2x = -11-5$
$2x = 6$	$2x = -16$
$x = 3$	$x = -8$

Step-III: Hence 3 and –8 are roots of the absolute value equations. Thus, the solution set is $\{3, -8\}$

- The equation $|x| = k$ and $k > 0$ has two solutions k and – k.
- The equation $|x| = 0$ has one solution, namely $x = 0$.
- The equation $|x| = k$ and $k < 0$ has no solution and the solution set in this case is ϕ.

Example 10: Solve the absolute value equation.

$$\frac{|10-x|}{5} = \frac{|2x-5|}{2}, \quad \text{where } x \in R$$

Solution: Before we remove the absolute value bars, try to isolate the absolute value expressions on either side as

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

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

$$\left|\frac{10-x}{2x-5}\right| = \frac{5}{2} \longleftarrow \because \frac{|a|}{|b|} = \left|\frac{a}{b}\right|$$

$\frac{10-x}{2x-5} = \frac{5}{2}$	or	$\frac{-10x}{2x-5} = -\frac{5}{2}$
$\frac{10-x}{2x-5} = \frac{5}{2}$		$\frac{10-x}{2x-5} = -\frac{5}{2}$
$2(10-x) = 5(2x-5)$		$2(10-x) = -5(2x-5)$

Key Fact

- $|ab| = |a|\,|b|$
- $\frac{|a|}{|b|} = \left|\frac{a}{b}\right|$
- $|a| + |a| = 2\,|a|$

$$20-2x = 10x-25 \qquad\qquad 20-2x = -10x+25$$
$$-12x = -45 \qquad\qquad 8x = 5$$
$$x = \frac{45}{12}=\frac{15}{4} \qquad\qquad x = \frac{5}{8}$$

Thus, the solution set is $\left\{\frac{15}{4}, \frac{5}{8}\right\}$.

Example 11: Solve the following absolute value equaiton.

$$|a-1| = |2a-3|, \quad a \in R$$

Solution:

By removing the absolute value bars we get two equations as:

$$a-1 = 2a-3 \quad \text{or} \quad a-1 = -(2a-3)$$
$$-a = -2 \qquad\qquad a-1 = -2a+3$$
$$a = 2 \qquad\qquad 3a = 4$$
$$a = \frac{4}{3}$$

The solution set is $\left\{2, \frac{4}{3}\right\}$.

EXERCISE 5.3

Solve the following absolute value equations, where $x, y, z \in R$.

1. $|x| = \frac{5}{3}$
2. $|x+2| = 6$
3. $|5y-1| = 9$
4. $|x+1| = 2$
5. $|6-3y| = 0$
6. $3|z-2| - 4 = -2$
7. $|2x-1| = 5$
8. $|3x+2| = 7$
9. $\frac{|4x|}{3} = 12$
10. $|5x| + 10 = 5$
11. $\frac{|1-2y|}{4} = 3$
12. $\frac{|x+1|}{2} = \frac{|2x-1|}{3}$
13. $|5x-3| = |x+7|$
14. $|z+3| - 3 = 5 - |z+3|$

5.4 Linear Inequalities (or Inequations) in one Variable

5.4.1 Defining an Inequality

There are many ways in which two expressions may be unequal. The following symbols express some inequalities.

Inequality Symbols

- $<$ is less than e.g. $-5 < 7$
- $>$ is greater than e.g. $10 > -3$
- $\leq$ is less than or equal to e.g. $7 \leq 7$
- $\geq$ is greater than or equal to e.g. $5 \geq 1$
- $\neq$ is not equal to e.g. $3 \neq 5$

History a Mystery

The symbols for "is less than" and "is greater than" were introduced by Thomas Harriot around 1630. Before that ⊏ and ⊐ were used for < and > respectively.

A statement that "two algebraic expressions are not equal" is called an "**inequality**" or "**inequation.**"

A **linear inequality in one variable** is an inequality (inequation) that can be written in the standard form of $ax + b < 0$ (or $ax + b > 0$) where a and b are real numbers and $a \neq 0$.

Examples: $x \leq 3$, $x \geq -2$, $x - 5 < -10$, $5y - 7 < 3y + 9$, $-5 > -7$, $-3 \neq x + 1$

Remark: Above mentioned definition is also valid for the symbols $\leq$ and $\geq$.
Some examples of linear inequations are $4x + 3 \geq 0$, $y > -7$, $8(x - 2) \leq 3 - 5x$ and $x + 3 < -5$

An inequality written with the symbols < or > is called a **strict inequality.**

5.4.2 Solution of Linear Inequalities (in one variable)

The definitions of **solution** and **solution set** for inequalities are same as for equations.

A **solution** of an inequality is a replacement for the variable that makes the inequality true. **Solution set** of an inequality is the set of all real numbers that satisfy the inequality.

Procedure:
The procedure for solving a linear inequality in one variable is almost identical to that for solving a linear equation. Here, also to isolate the variable, we use "**properties of inequalities**". These properties are similar to the properties of equality but there is one important difference that **when both sides of an inequality are multiplied or divided by a negative number then direction of the inequality symbol is reversed.** e.g.

original inequality ⟵ $-2 < 5$
$(-3)(-2) > (-3)(5)$ ⟵ multiplying both sides by -3 and reversing inequality symbol
$6 > -15$ ⟵ simplest form

Two or more inequalities that have the same solution set are called **equivalent inequalities** e.g. $x + 5 < 8$ and $x < 3$ are two equivalent inequalities.

Example 12: Solve the following inequality.
$8x + 9 < 6x - 7$, where $x \in R$.

Solution:
$$8x + 9 < 6x - 7$$
$$8x - 6x < -7 - 9$$
$$2x < -16$$
$$x < -8$$

Check Point
In example 13 if $x \in Z$, then what will be the solution set?

The solution contais all real numbers less than – 8.
Check the solution by replacing x with any number less than – 8, for example – 9, as

$$8(-9) + 9 < 6(-9) - 7$$
$$-72 + 9 < -54 - 7$$
$$-63 < -61 \leftarrow \text{true statement}$$

Thus the solution set is $\{x \mid x \in R \wedge x < -8\}$.

Point to Ponder!

- $5 \geq 1$ is true because $5 > 1$ is true.
- $7 \leq 7$ is true because $7 = 7$ is true.

Example 13: Solve the inequality.

$$3(-4 + 5y) \leq -8(1 - 2y) + 6, x \in R$$

Solution:

$$3(-4 + 5y) \leq -8(1 - 2y) + 6$$
$$-12 + 15y \leq -8 + 16y + 6$$
$$-12 + 15y \leq 16y - 2$$
$$-y \leq 10$$
$$y \geq -10$$

$\therefore$ Solution Set = $\{x \mid x \in R \wedge y \geq -10\}$

Example 14: Solve. $\frac{1}{2}x + 3 \geq \frac{1}{4}x + 2, x \in R$

Solution:

$$\frac{1}{2}x + 3 \geq \frac{1}{4}x + 2$$
$$4(\frac{1}{2}x + 3) \geq 4(\frac{1}{4}x + 2) \leftarrow \text{multiply both sides by LCM of denominators}$$
$$2x + 12 \geq x + 8$$
$$x + 12 \geq 8$$
$$x \geq -4$$

The solution set is $\{x \mid x \in R \wedge x \geq -4\}$.

Compound Inequalities

Two inequalities that are joined by the word **"and"** or the word **"or"** are called compound inequalities e.g. $2x < 6$ and $3x + 2 > -4$, $3x + 5 > 7$ or $4x - 1 < 3$

5.4.3 Solution of Compound Inequalities Joined with 'or'

When two inequalities are joined with connective word **'or'**, it is necessary to solve each inequality separately. The solution set of the compound inequality will be the union of both the solution sets i.e., the solution set will satisfy either one or both the inequalities.

Key Fact

A compound inequality containing or is true if at least one of its inequality is true.

Example 15: Solve the following.

$$2x + 3 > 7 \quad \text{or} \quad 4x - 1 < 3; \quad x \in R$$

Solution: We will solve both the inequalities for x separately.

$$2x + 3 > 7 \quad \text{or} \quad 4x - 1 < 3$$
$$2x > 4 \quad \text{or} \quad 4x < 4$$
$$x > 2 \quad \text{or} \quad x < 1$$

$\{x \mid x \in R \wedge x > 2\}$ or $\{x \mid x \in R \wedge x < 1\}$

Now the union of both the solution sets is

$\{x \mid x \in R \wedge x > 2 \text{ or } x < 1\}$

Hence, the solution set of the given compound inequality contains all real numbers greater than 2 or less than 1.

5.4.4 Solution of Compound Inequalities Joined with 'and'

When two inequalities are joined with the connective word **'and'** then the solution set of the compound inequality will be the intersection of both the solution sets i.e. the solution set contains all the solutions that satisfy both of the inequalities.

Example 16: Solve the compound inequality.

$x - 5 \geq -1$ and $x + 3 \leq 10, x \in R$

Solution: Solve both the inequalities for 'x'.

$x - 5 \geq -1$ and $x + 3 \leq 10$

$x \geq 4$ and $x \leq 7$

$\{x \mid x \in R \wedge x \geq 4\}$ and $\{x \mid x \in R \wedge x \leq 7\}$

Intersection of two solution sets is $\{x \mid x \in R \wedge 4 \leq x \leq 7\}$

i.e. Solution set consists of all real numbers that are greater than or equal to 4 and less than or equal to 7.

Key Fact

- Two inequalities $-6 < 5x + 3$ and $5x + 3 < 5$ can be written in combined form as $-6 < 5x + 3 < 5$.
- There is no short way to write a compound inequality containing 'or'.
- Compound inequality containing **and** is true if its both inequalities are true.

Example 17: The sum of two times a number x and 3 is between 5 and 17. Between what two numbers is the given number x?

Solution: Expression 'sum of 2 times a number x and 3' can be written as $2x + 3$. Then given compound inequality is '$5 < 2x + 3 < 17$'.

Now we solve this compound inequality.

$5 < 2x + 3 < 17$

$5 - 3 < 2x < 17 - 3$ ⟵ subtracting 3 from each part

$2 < 2x < 14$

$1 < x < 7$ ⟵ dividing each part by 2

Thus, x lies in between 1 and 7.

Math Play Ground

a. Take students to the play ground.
b. Give each student a paper strip with some equation or inequality written on.
c. Spread solutions of all students in the play ground.
d. Ask them to find the respective answers as a game of treasure hunt.

EXERCISE 5.4

1.(a) Check whether the given value of each variable satisfies the inequality.

i) $5y-12>0;\quad y=3$ ii) $4-2x\le 9;\quad x=-3$

iii) $5-2x>-4x+5;\quad x=4$ v) $3(z+4)\le 6;\quad z=-2$

v) $5(x-2)\ge 9x-3(2x-4);\quad x=11$

(b) In the following cases, write each solution in the set notation form.

i) $2\le x\le 5$, where $x\in N$ ii) $y<7$, where $y\in N$

iii) $z\le -3$, where $z\in R$ iv) $x\le 4$, where $x\in W$

v) $-4<x<\frac{-3}{2}$, where $x\in R$

Solve the following inequalities.

2. $3x-2<7,\ x\in N$
3. $6x-5\le 35-2x,\ x\in W$
4. $16-5y<4(y-1)-7,\ y\in R$
5. $10-(7-y)\ge 3y-9,\ y\in R$

Solve the following compound inequalities, where $x\in R$ (6-10).

6. $5-3x<11$ or $2x+3<-9$
7. $2x+3\le 9$ and $x-5>-6$
8. $1\le 7-3x\le 22$
9. $3x+21<1-x$ or $3x+8>3-2x$
10. $1-5x>16$ and $3-\frac{3x}{2}\le 9$
11. The sum of five times a number x and 10 is less than –35 or greater than –5. What real numbers does x represent?
12. Two times a number decreased by 5 is greater than or equal to the number increased by 8. Find the possible values for the number.

KEY POINTS

- An equation that can be written in the standard form $ax+b=0$ where $a, b\in R$ and $a\ne 0$ is called a linear equation in one variable.
- A solution of a linear equation in one variable is a number replacement for the variable that makes it true.
- Two or more linear equations with the same solutions are called equivalent equations.
- To solve a linear equation with fractions, multiply all the terms by the least common multiple of all denominators to clear the fractions.
- Root of a linear equation that does not satisfy the original equation is called an "extraneous root" of that equation.
- A linear equation in which the variable appears under the radical sign is called a radical equation.
- An equation that contains an absolute value symbol is called an absolute value equation.

- If x is a real number then $|x| = x$ if $x \geq 0$ and $|x| = -x$ if $x < 0$.
- If two equations have the same absolute value, then they are either equal or opposite.
- A statement that two algebraic expressions are not equal is called an inequality.
- An equality that can be written in the standard form of $ax + b < 0$ where a and b are real numbers and $a \neq 0$ is called a linear inequality.
- A solution set is the set of all solutions of an inequality.
- Two or more inequalities, which have the same solution sets are called equivalent inequalities
- A compound inequality is a relation containing two simple inequalities connected with the words '**and**' or '**or**'.

MISCELLANEOUS EXERCISE 5

1. Encircle the correct option in the following. absolutely correct.

(i). Which one is the standard form of linear equation?
(a) $ax^2 + b = 0$ (b) $ax + b = -c$ (c) $ax + b > 0$ (d) $ax + b = 0$

(ii). The exponent of the variable in linear equation is?
(a) 1 (b) 2 (c) –1 (d) 0

(iii). Which one is the linear equation in one variable?
(a) $ax + y = 0$ (b) $xy + 3 = 0$ (c) $2x + 3 = 0$ (d) $2x^2 + 3 = 0$

(iv). Which one is the solution of $12x + 17 = 65$?
(a) 48 (b) $\frac{82}{12}$ (c) 4 (d) $\frac{65}{12}$

(v). What number must be subtracted from the right side of $7x = 30$ so that 4 is a solution of the resulting equation?
(a) 7 (b) 2 (c) 4 (d) –2

(vi). Which property of equality will be applied to solve the equation $-2x = \frac{2}{5}$?
(a) Addition (b) Subtraction
(c) Division (d) Addition and subtraction

(vii). Which one is the solution set of $5|x| = 25$?
(a) $\{-25, 25\}$ (b) $\{-25\}$ (c) $\{5\}$ (d) $\{-5, 5\}$

(viii). Which is the solution set of $|x| + 7 = 3$?
(a) $\{-4\}$ (b) $\{4, -4\}$ (c) $\{\ \}$ (d) $\{-7, -3\}$

(ix). Which one is the solution set of $\sqrt{5x} = -10$?
(a) $\{\ \}$ (b) $\{-20\}$ (c) $\{20\}$ (d) $\{-2\}$

(x). Which one is the solution set of $\sqrt{3x+1} = 5$?
(a) 25 (b) 8 (c) 24 (d) $\frac{26}{3}$

(xi). Which one is the solution of $\frac{4}{x}-\frac{2}{x}=5$?

(a) -1 (b) $\frac{2}{5}$ (c) $\frac{5}{2}$ (d) zero

(xii). Which one is a strict inequality?

(a) $x+3 \neq 0$ (b) $12x > 5$ (c) $2y-3 \leq 0$ (d) $4x+5 \geq 0$

(xiii). What should be value of 'k' if $x < y$ shows $kx > ky$?

(a) $k=0$ (b) $k>0$ (c) $k<0$ (d) $k \geq 0$

(xiv). Which one is the compound relation?

(a) $1+2x<4+x$ (b) $4x+3>5\frac{3}{5}$ (c) $x+y>5\frac{1}{2}$ (d) $x \leq 0$

(xv). Which one is the solution of $3-\frac{1}{2}x \geq 0$?

(a) $x \geq -6$ (b) $x \leq 6$ (c) $x \geq 6$ (d) $x \leq -6$

(xvi). Which one is the solution of $2(x+6) \leq 3(x+4)$?

(a) $x \leq 0$ (b) $x \geq 0$ (c) $x \leq 24$ (d) $x \geq 24$

Solve the following.

2. $\frac{2x-11}{12}=\frac{2x+10}{12}-\left(\frac{28-2x}{4}-\frac{1}{4}\right)$

3. $\sqrt{a-\frac{1}{2}}=\sqrt{\frac{2a}{5}+\frac{2}{5}}$

4. $\frac{\sqrt{5x-4}-4}{10}=-1$

5. $5-|5y+1|=-9$

6. $\frac{3}{4}x-1 \geq x+1, x \in R$

7. $4(2y+3)-(6y-1)>10,\ y \in R$

8. $\frac{3}{2}x \leq -3$ or $\frac{2}{3}x \geq 4,\ x \in R$

9. The difference between three times a number y and 18 is less than 12 or greater than 39. What real numbers do y represent?

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