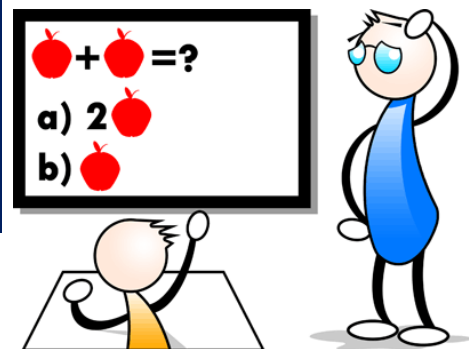
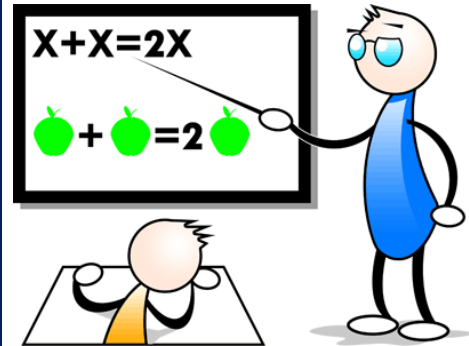


Grade 9 Mathematics

Unit 15 Equations

Reading material





By studying this lesson you will be able to

- Solve linear equations containing brackets.
- Solve linear equations containing fractions.
- Solve simultaneous linear equations when the coefficient of the unknown is equal in both equations.

Equation



$$x + 4 = 6$$

Algebraic expression



Number

$$2y + 3 = y + 8$$

Algebraic expression



Algebraic expression

Equation is a mathematical expression that contains an equal symbol. It may consist two algebraic expressions or algebraic expression with a constant.

Let's remind how we solve the equation in grade 7 and 8. We have to remove each term which are joined with the variable.

Take all of your variables on the same side of the equals sign and move all of the integers to the other side of the equal sign by doing the inverse mathematical operations. Any operation you do to the terms on one side of the equal sign, you must do the same to the terms on the other side of the equal sign.

Solving the linear equations.

$$2x + 3 = 11$$

$$2x + 3 \quad \boxed{-3} = 11 \quad \boxed{-3}$$

$$2x = 8$$

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

$$x = 4$$

- .Multiply x by two and add three . The answer is 11.
- Subtract three from both sides .
- Two times of x is equal with 8.
- Then divide both sides by two .
- The answer for x is 4.

$$\textcircled{2} \quad \frac{x}{3} - 2 = 4$$

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

$$\frac{x}{3} = 6$$

$$\frac{x}{3} \times 3 = 6 \times 3$$

$$\underline{\underline{x = 18}}$$

- Divide x by three and subtract two from it. The answer is 4.
- Add two to both sides of the equation .
- X divide by 3 is equal to 6.
- Multiply both sides by 3.
- The answer for x is 18.



$$\begin{aligned}
 3 \quad 5(y + 2) &= 25 \\
 5(y + 2) &= 25 \\
 5y + 10 &= 25 \\
 5y + 10 - 10 &= 25 - 10 \\
 5y &= 15 \\
 \frac{5y}{5} &= \frac{15}{5} \\
 \underline{\underline{y}} &= 3
 \end{aligned}$$

- Add 2 to y and multiply it by 5. The answer is 25.
- Multiply the terms inside the parenthesis by the number outside it.
- Then subtract 10 from both sides .
- Five times of y is 15.
- Then divide both sides by five .
- Answer is 3.

Method 2

$$\begin{aligned}
 5(y + 2) &= 25 \\
 \frac{5(y + 2)}{5} &= \frac{25}{5} \\
 y + 2 &= 5 \\
 y + 2 - 2 &= 5 - 2 \\
 \underline{\underline{y}} &= 3
 \end{aligned}$$

- Divide both sides by five .
- Then subtract two from both sides.
- Answer is three .

Solving linear equations with two types of brackets

There are several types of brackets that we use

Parentheses ()

Curly Brackets { }

Square Brackets []



When applying brackets , the usual practice is to

- First use parenthesis
- Then curly brackets
- Finally square brackets

The steps of removing brackets .

- First remove parenthesis
- Then curly brackets
- Finally square brackets .

Solving linear equations with two types of brackets.

$$2 \{4 (x-3) - 5\} = 6$$

$$2 \{4 (x-3) - 5\} = 6$$

$$2 \{4x -12 -5\} = 6$$

$$2 \{4x -17\} = 6$$

$$8x - 34 = 6$$

$$8x - 34 +34 = 6+ 34$$

$$8x = 40$$

$$\frac{8x}{8} = \frac{40}{8}$$

$$x = 5$$

$$x = 5$$

- First multiply each terms in the parentheses by 4.
- Then solve the like terms in side the brackets.
- Then multiply the terms inside the curly bracket by 2.
- Then add 34 to both side of the equation.
- Then divide both side by 8.
- Answer for x is 5.

$$2 \quad 5 \{ x + 2(x + 1) \} - 21 = 49$$

$$5 \{ x + 2(x + 1) \} - 21 = 49$$

$$5 \{ x + 2x + 2 \} - 21 = 49$$

$$5 \{ 3x + 2 \} - 21 = 49$$

$$15x + 10 - 21 = 49$$

$$15x - 11 = 49$$

$$15x - 11 + 11 = 49 + 11$$

$$15x = 60$$

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

$$x = 4$$

- Let's multiply the terms in the parentheses by 2 which is outside of parentheses.
- Let's simplify the like terms in side the curly brackets.
- ☐ Then multiply the terms inside the curly brackets by 5.
- ☐ Then simplify the like terms in left hand side.
- ☐ Add 11 to both side of the equation
- ☐ Then divide both side by 15.
- ☐ the answer for x is 4.

Method 2

$$\begin{aligned}
 \textcircled{2} \quad 5 \{ x + 2(x + 1) \} - 21 &= 49 \\
 5 \{ x + 2(x + 1) \} - 21 + 21 &= 49 + 21 \\
 5 \{ x + 2(x + 1) \} &= 70 \\
 \frac{5 \{ x + 2(x + 1) \}}{5} &= \frac{70}{5} \\
 x + 2(x + 1) &= 14 \\
 x + 2x + 2 &= 14 \\
 3x + 2 &= 14 \\
 3x + 2 - 2 &= 14 - 2 \\
 3x &= 12 \\
 \frac{3x}{3} &= \frac{12}{3} \\
 \underline{\underline{x}} &= \underline{\underline{4}}
 \end{aligned}$$

- Let's add 21 to both side to remove -21.
- Then divide both sides by 5.
- Multiply the terms in the parentheses by 2, the number which is outside the parentheses.
- Then simplify the like terms.
- Then subtract two from both side.
- Divide both sides by 3.
- Answer is 4.

Solving linear equation containing fractions

$$\begin{aligned}
 \textcircled{1} \quad \frac{a+3}{2} &= 5 \\
 \frac{(a+3)}{2} \times 2 &= 5 \times 2 \\
 a + 3 &= 10 \\
 a + 3 - 3 &= 10 - 3 \\
 \underline{\underline{a}} &= 7
 \end{aligned}$$

- When solving the equations with fractions, first we have to remove the terms in the denominators.
- So multiply both sides by 2.
- Then subtract 3 from both sides.
- Answer for x is 7.

$$\begin{aligned}
 \textcircled{2} \quad \frac{3y}{4} + \frac{y}{4} &= 8 \\
 \frac{3y}{4} \times 4 + \frac{y}{4} \times 4 &= 8 \times 4 \\
 3y + y &= 32 \\
 4y &= 32 \\
 \frac{4y}{4} &= \frac{32}{4} \\
 \underline{\underline{y}} &= 8
 \end{aligned}$$

- Here the denominators are equal.
- So multiply each term by the denominator.
- Then denominator is removed.
- So multiply each term by 4.
- Then simplify like terms.
- Divide both sides by 4.
- Answer for y is 8.

$$3 \quad 6 \left(\frac{x}{2} + 3 \right) = 33$$

$$6 \left(\frac{x}{2} + 3 \right) = 33$$

$$6 \times \frac{x}{2} + 6 \times 3 = 33$$

$$3x + 18 = 33$$

$$3x + 18 - 18 = 33 - 18$$

$$3x = 15$$

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

$$\underline{\underline{x = 5}}$$

- First multiply each term in the brackets by the number outside of the bracket.
- When 6 is divided by 2, answer is 3.
- Then subtract 18 from both sides.
- Then divide both sides by 3.
- Answer for x is 5.

$$\begin{aligned}
 4 \quad \frac{x+4}{2} - \frac{x-2}{3} &= 4 \\
 6 \frac{(x+4)}{2} - 6 \frac{(x-2)}{3} &= 4 \times 6 \\
 \overset{\curvearrowright}{3(x+4)} - \overset{\curvearrowright}{2(x-2)} &= 24 \\
 3x + 12 - 2x + 4 &= 24 \\
 x + 16 &= 24 \\
 x + 16 - 16 &= 24 - 16 \\
 \underline{\underline{x}} &= \underline{\underline{8}}
 \end{aligned}$$

Here the denominators of the fractions are different.

- So take the L.C.M. of the denominators and multiply each term by the L.C.M. of the denominators.
- The L.C.M. of the denominators is 6. (2×3).
- So multiply each term by 6.
- Then we obtain an equation without denominators.
- Then multiply each bracket by the numbers out side of the brackets.
- Then simplify the like terms.
- Subtract 16 from both sides.
- Answer is 8.

Solving the simultaneous equations

The linear equation has one variable .

$$X + 4 = 5$$

Unknown term (variable)



The simultaneous equations have two variables .

$$x + y = 5$$

$$x - y = 5$$

So here x and y are unknown terms .

Let's find the values for unknown terms in a pair of simultaneous equations .

The following table shows several different pairs of values of x and y which satisfy the equation . Here x and y are not unique .

$$(i) x + y = 7$$

x	y	$x+y$
1	6	7
2	5	7
3		
4		
5		

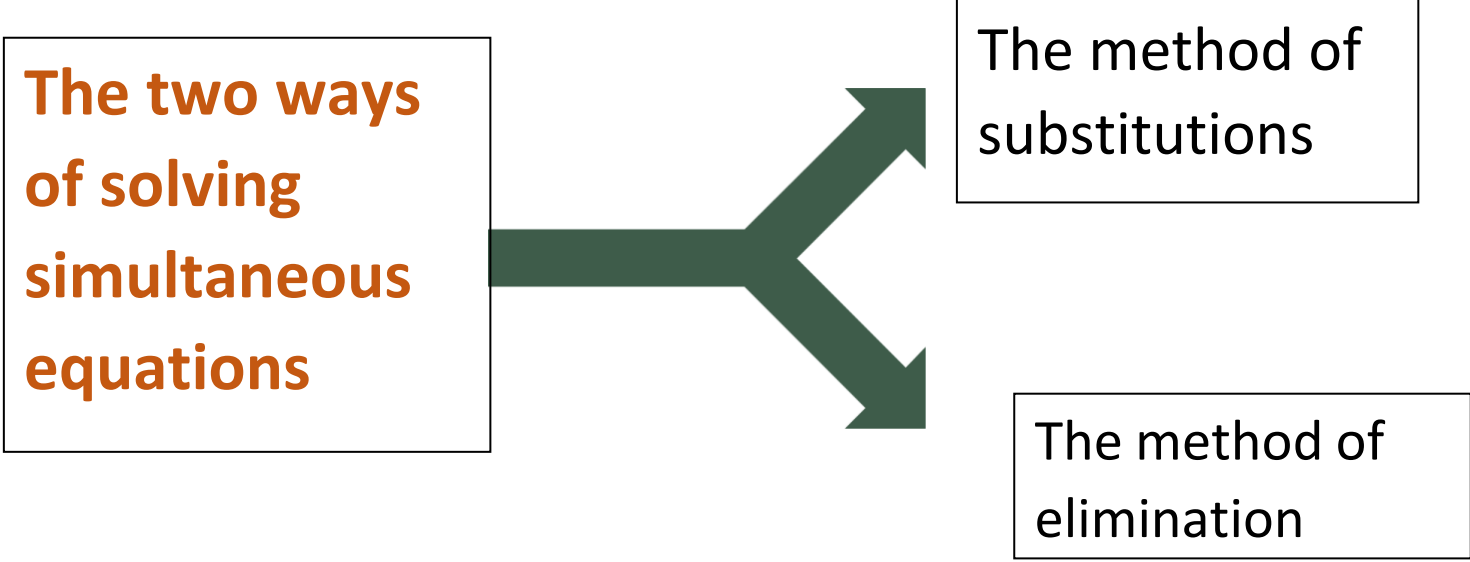
$$(ii) x - y = 1$$

x	y	$x-y$
6	5	1
5	4	1
4		
3		
2		

There are many pairs of values of x and y which satisfy the equation.

By observing Tables 1 and 2 , you can see that there is only one pair of values of x and y which satisfies both $x + y = 7$ and $x - y = 1$. This pair is $x = 4$ and $y = 3$

**The two ways
of solving
simultaneous
equations**



The method of
substitutions

The method of
elimination

Let's solve this pair of simultaneous equation

$$m + n = 5$$

$$m - n = 1$$

$$m + n = 5 \longrightarrow \boxed{1}$$

$$m - n = 1 \longrightarrow \boxed{2}$$

By making "m" the subject of equation 2, we can write it as

$$m = 1 + n$$

By Substituting this expression for "m" in the equation 1, we obtained

$$m + n = 5$$

$$1 + n + n = 5$$

$$1 + 2n = 5$$

$$1 - 1 + 2n = 5 - 1$$

$$2n = 4$$

$$n / 2 = 4 / 2$$

$$n = 2$$

We now find the value of m by substituting $n=2$ in 1st equation

$$m + n = 5$$

$$m + 2 = 5$$

$$m + 2 - 2 = 5 - 2$$

$$m = 3$$

So,

$$n = 2 \text{ and}$$

$$m = 3$$

Solving the simultaneous equations using the method of elimination .

Simply .

$$2a + b = 13$$

$$a - b = 2$$

$$2a + b = 13 \quad \longrightarrow \quad \boxed{1}$$

$$a - b = 2 \quad \longrightarrow \quad \boxed{2}$$

First, observe that “+b” is there in the equation 1 and “-b” is in the equation 2.

By adding both equations, we can remove one unknown term.

$$\textcircled{1} + \textcircled{2}$$

$$2a + b + a - b = 13 + 2$$

$$3a = 15$$

$$\frac{3a}{3} = \frac{15}{3}$$

$$a = 5$$

By substituting $a=5$, in **1**

$$2a + b = 13$$

$$2 \times 5 + b = 13$$

$$10 + b = 13$$

$$10 - 10 + b = 13 - 10$$

$$b = 3$$

$$\therefore a = 5, b = 3$$

Simply

$$3a + b = 5$$

$$a + b = 3$$

$$\begin{array}{r} 3a + b = 5 \longrightarrow \boxed{1} \\ a + b = 3 \longrightarrow \boxed{2} \end{array}$$

$$\textcircled{1} - \textcircled{2}$$

$$3a + b - (a + b) = 5 - 3$$

$$3a + b - a - b = 2$$

$$2a = 2$$

$$a = 1$$

By substituting $a=1$ to the 2nd equation .

$$a + b = 3$$

$$1 + b = 3$$

$$1 - 1 + b = 3 - 1$$

$$b = 2$$

So,

$$a = 1 \text{ and } b = 2$$

Let's solve the following problems using simultaneous equations

Two books and a pen cost Rs.70. A book and a pen cost Rs.40. Taking the price of a book as Rs. x and the price of a pen as Rs. y , construct a pair of simultaneous equations and find the price of a book and a pen separately .

Price of a book = x

Price of a pen = y

Cost of two books and a pen = $2x + y$

$$2x + y = 70$$

Cost of a book and a pen = $x + y$

$$x + y = 40$$

$$2x + y = 70 \longrightarrow \boxed{1}$$

$$x + y = 40 \longrightarrow \boxed{2}$$

$$\textcircled{1} - \textcircled{2}$$

$$2x + y - (x + y) = 70 - 40$$

$$2x + y - x - y = 30$$

$$x = 30$$

By substituting $x = 30$ in 2nd equation .

$$x + y = 40$$

$$30 + y = 40$$

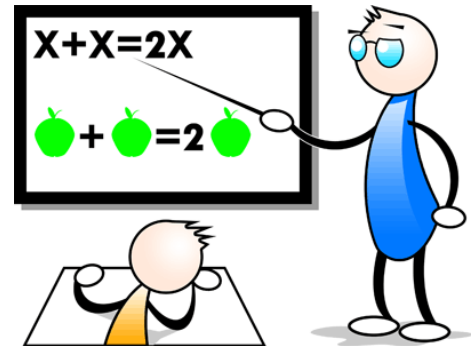
$$30 - 30 + y = 40 - 30$$

$$Y = 10$$

- **So the price of a book is Rs. 30 and the price of a pen is Rs.10.**

Grade 9 Mathematics

Unit 15 Equations



Mathematics Equation

