CLASS X : CHAPTER - 1
REAL NUMBERS

IMPORTANT FORMULAS & CONCEPTS

EUCLID'S DIVISION LEMMA
Given positive integers a and b, there exist unique integers q and r satisfying a = bq + r, where $0 \le r < b$.
Here we call 'a' as dividend, 'b' as divisor, 'q' as quotient and 'r' as remainder.
$\therefore$ Dividend = (Divisor x Quotient) + Remainder
If in Euclid's lemma r = 0 then b would be HCF of 'a' and 'b'.

NATURAL NUMBERS
Counting numbers are called natural numbers i.e. 1, 2, 3, 4, 5, ……………. are natural numbers.

WHOLE NUMBERS
All counting numbers/natural numbers along with 0 are called whole numbers i.e. 0, 1, 2, 3, 4, 5 ……………. are whole numbers.

INTEGERS
All natural numbers, negative of natural numbers and 0, together are called integers. i.e. ………. – 3, – 2, – 1, 0, 1, 2, 3, 4, ………….. are integers.

ALGORITHM
An **algorithm** is a series of well defined steps which gives a procedure for solving a type of problem.

LEMMA
A **lemma** is a proven statement used for proving another statement.

EUCLID'S DIVISION ALGORITHM
Euclid's division algorithm is a technique to compute the Highest Common Factor (HCF) of two given positive integers. Recall that the HCF of two positive integers *a* and *b* is the largest positive integer *d* that divides both *a* and *b*.

To obtain the HCF of two positive integers, say c and d, with c > d, follow the steps below:
Step 1 : Apply Euclid's division lemma, to *c* and *d*. So, we find whole numbers, *q* and *r* such that $c = dq + r,\ 0 \le r < d$.
Step 2 : If $r = 0$, *d* is the HCF of *c* and *d*. If $r \ne 0$ apply the division lemma to *d* and *r*.
Step 3 : Continue the process till the remainder is zero. The divisor at this stage will be the required HCF.
This algorithm works because HCF (*c*, *d*) = HCF (*d*, *r*) where the symbol HCF (*c*, *d*) denotes the HCF of *c* and *d*, etc.

The Fundamental Theorem of Arithmetic
Every composite number can be expressed (factorised) as a product of primes, and this factorisation is unique, apart from the order in which the prime factors occur.

The prime factorisation of a natural number is unique, except for the order of its factors.

- HCF is the highest common factor also known as GCD i.e. greatest common divisor.
- LCM of two numbers is their least common multiple.
- Property of HCF and LCM of two positive integers 'a' and 'b':

- $HCF(a,b) \times LCM(a,b) = a \times b$
- $LCM(a,b) = \dfrac{a \times b}{HCF(a,b)}$
- $HCF(a,b) = \dfrac{a \times b}{LCM(a,b)}$

PRIME FACTORISATION METHOD TO FIND HCF AND LCM

HCF(a, b) = Product of the smallest power of each common prime factor in the numbers.
LCM(a, b) = Product of the greatest power of each prime factor, involved in the numbers.

RATIONAL NUMBERS

The number in the form of $\frac{p}{q}$ where 'p' and 'q' are integers and $q \neq 0$, e.g. $\frac{2}{3}, \frac{3}{5}, \frac{5}{7}, \ldots\ldots.$

Every rational number can be expressed in decimal form and the decimal form will be either terminating or non-terminating repeating. e.g. $\frac{5}{2} = 2.5$ (Terminating), $\frac{2}{3} = 0.66666....$ *or* $0.\overline{6}$ (Non-terminating repeating).

IRRATIONAL NUMBERS

The numbers which are not rational are called irrational numbers. e.g. $\sqrt{2}, \sqrt{3}, \sqrt{5}, etc$.

- *Let p be a prime number. If p divides a2, then p divides a, where a is a positive integer.*
- If p is a positive integer which is not a perfect square, then $\sqrt{m}$ is an irrational, e.g. $\sqrt{2}, \sqrt{5}, \sqrt{6}, \sqrt{8}, ...etc$.
- If p is prime, then $\sqrt{p}$ is also an irrational.

RATIONAL NUMBERS AND THEIR DECIMAL EXPANSIONS

- *Let x be a rational number whose decimal expansion terminates. Then x can be expressed in the form $\frac{p}{q}$ where p and q are coprime, and the prime factorisation of q is of the form 2^n5^m, where n, m are non-negative integers.*

- *Let $x = \frac{p}{q}$ be a rational number, such that the prime factorisation of q is of the form 2^n5^m, where n, m are non-negative integers. Then x has a decimal expansion which terminates.*
- *Let $x = \frac{p}{q}$ be a rational number, such that the prime factorisation of q is not of the form 2^n5^m, where n, m are non-negative integers. Then, x has a decimal expansion which is non-terminating repeating (recurring).*

- *The decimal form of irrational numbers is non-terminating and non-repeating.*
- *Those decimals which are non-terminating and non-repeating will be irrational numbers. e.g. 0.20200200020002……. is a non-terminating and non-repeating decimal, so it irrational.*

CLASS X : CHAPTER - 2
POLYNOMIALS

IMPORTANT FORMULAS & CONCEPTS

An algebraic expression of the form $p(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \ldots\ldots\ldots a_nx^n$, where $a \neq 0$, is called a polynomial in variable x of degree n.
Here, $a_0, a_1, a_2, a_3, \ldots\ldots, a_n$ are real numbers and each power of x is a non-negative integer.
e.g. $3x^2 - 5x + 2$ is a polynomial of degree 2.
$3\sqrt{x} + 2$ is not a polynomial.

- If $p(x)$ is a polynomial in x, the highest power of x in $p(x)$ is called **the degree of the polynomial** $p(x)$. For example, $4x + 2$ is a polynomial in the variable x of degree 1, $2y^2 - 3y + 4$ is a polynomial in the variable y of degree 2,

  - A polynomial of degree 0 is called a constant polynomial.
  - A polynomial $p(x) = ax + b$ of degree 1 is called a linear polynomial.
  - A polynomial $p(x) = ax^2 + bx + c$ of degree 2 is called a quadratic polynomial.
  - A polynomial $p(x) = ax^3 + bx^2 + cx + d$ of degree 3 is called a cubic polynomial.
  - A polynomial $p(x) = ax^4 + bx^3 + cx^2 + dx + e$ of degree 4 is called a bi-quadratic polynomial.

VALUE OF A POLYNOMIAL AT A GIVEN POINT x = k
If $p(x)$ is a polynomial in x, and if k is any real number, then the value obtained by replacing x by k in $p(x)$, is called **the value of $p(x)$ at $x = k$**, and is denoted by $p(k)$.

ZERO OF A POLYNOMIAL
A real number k is said to be a **zero of a polynomial $p(x)$**, if $p(k) = 0$.

- Geometrically, the zeroes of a polynomial $p(x)$ are precisely the x-coordinates of the points, where the graph of $y = p(x)$ intersects the x -axis.
- A quadratic polynomial can have at most 2 zeroes and a cubic polynomial can have at most 3 zeroes.
- In general, a polynomial of degree 'n' has at the most 'n' zeroes.

RELATIONSHIP BETWEEN ZEROES & COEFFICIENTS OF POLYNOMIALS

Type of Polynomial	General form	No. of zeroes	Relationship between zeroes and coefficients
Linear	$ax + b,\ a \neq 0$	1	$k = -\frac{b}{a}$, i.e. $k = -\frac{\text{Constant term}}{\text{Coefficient of x}}$
Quadratic	$ax^2 + bx + c,\ a \neq 0$	2	Sum of zeroes $(\alpha + \beta) = -\frac{\text{Coefficient of x}}{\text{Coefficient of } x^2} = -\frac{b}{a}$ Product of zeroes $(\alpha\beta) = \frac{\text{Constant term}}{\text{Coefficient of } x^2} = \frac{c}{a}$
Cubic	$ax^3 + bx^2 + cx + d$, $a \neq 0$	3	Sum of zeroes $(\alpha + \beta + \gamma) = -\frac{\text{Coefficient of } x^2}{\text{Coefficient of } x^3} = -\frac{b}{a}$ Product of sum of zeroes taken two at a time $(\alpha\beta + \beta\gamma + \gamma\alpha) = \frac{\text{Coefficient of x}}{\text{Coefficient of } x^3} = \frac{c}{a}$ Product of zeroes $(\alpha\beta\gamma) = -\frac{\text{Constant term}}{\text{Coefficient of } x^3} = -\frac{d}{a}$

- A quadratic polynomial whose zeroes are α and β is given by $p(x) = x^2 - (\alpha + \beta)x + \alpha\beta$
  i.e. x^2 – (Sum of zeroes)x + (Product of zeroes)

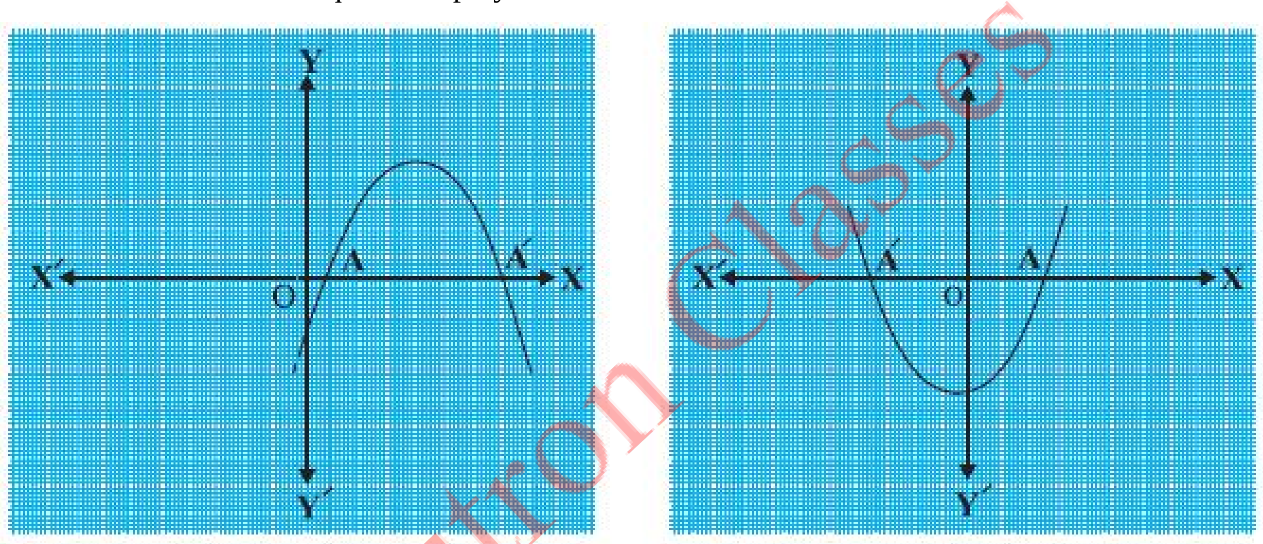
- A cubic polynomial whose zeroes are α, β *and* γ is given by
  $p(x) = x^3 - (\alpha + \beta + \gamma)x^2 + (\alpha\beta + \beta\gamma + \gamma\alpha)x - \alpha\beta\gamma$

The zeroes of a quadratic polynomial $ax^2 + bx + c$, $a \neq 0$, are precisely the *x*-coordinates of the points where the parabola representing $y = ax^2 + bx + c$ intersects the *x*-axis.

In fact, for any quadratic polynomial $ax^2 + bx + c$, $a \neq 0$, the graph of the corresponding equation $y = ax^2 + bx + c$ has one of the two shapes either open upwards like $\cup$ or open downwards like $\cap$ depending on whether $a > 0$ or $a < 0$. (These curves are called **parabolas**.)

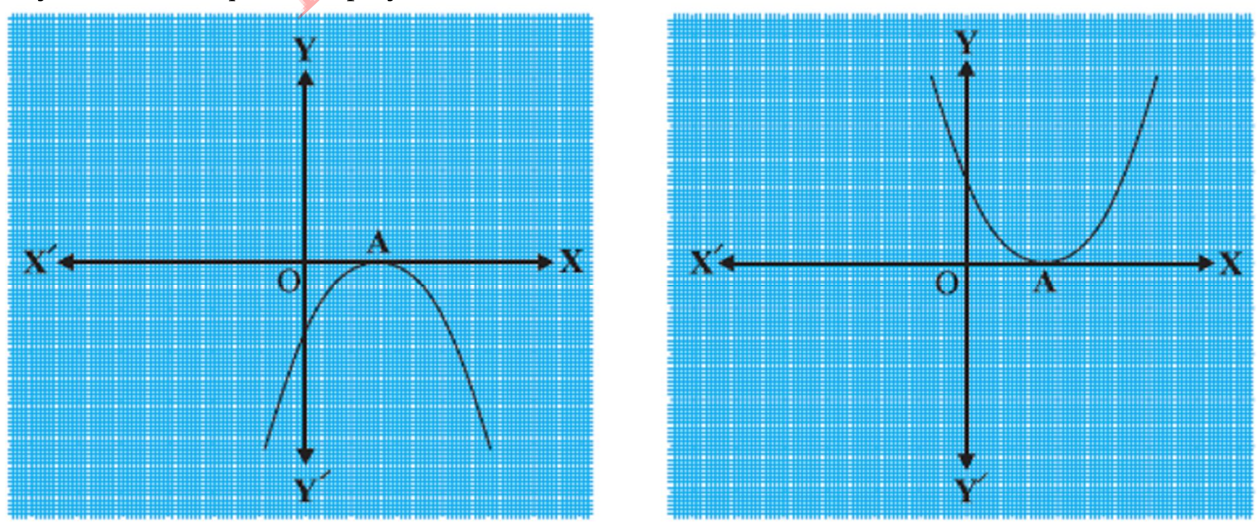
The following three cases can be happen about the graph of quadratic polynomial $ax^2 + bx + c$:

Case (i) : Here, the graph cuts *x*-axis at two distinct points A and A'. The *x*-coordinates of A and A' are the **two zeroes** of the quadratic polynomial $ax^2 + bx + c$ in this case



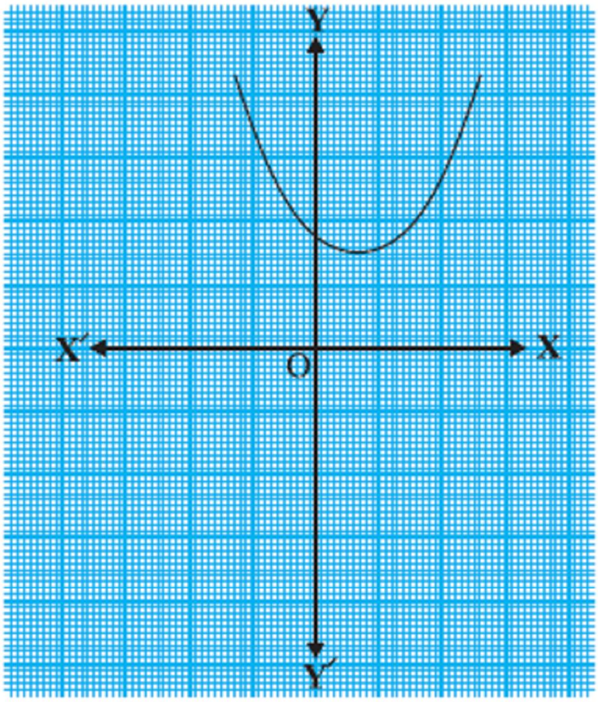
(i) $a > 0$ (ii) $a < 0$

Case (ii) : Here, the graph cuts the *x*-axis at exactly one point, i.e., at two coincident points. So, the two points A and A′ of Case (i) coincide here to become one point A. The *x*-coordinate of A is the **only zero** for the quadratic polynomial $ax^2 + bx + c$ in this case.

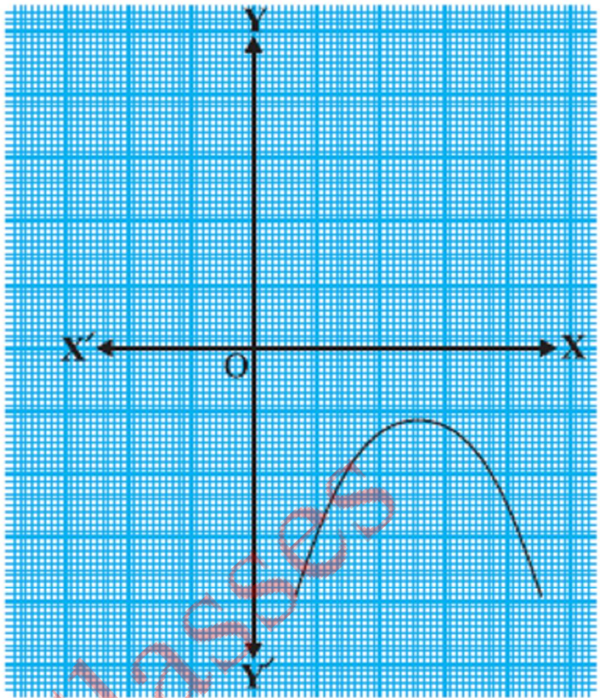


(i) $a > 0$ (ii) $a < 0$

Case (iii) : Here, the graph is either completely above the x-axis or completely below the x-axis. So, it does not cut the x-axis at any point. So, the quadratic polynomial $ax^2 + bx + c$ has **no zero** in this case.



(i)
a > 0



(ii)
a < 0

DIVISION ALGORITHM FOR POLYNOMIALS

If $p(x)$ and $g(x)$ are any two polynomials with $g(x) \neq 0$, then we can find polynomials $q(x)$ and $r(x)$ such that $p(x) = g(x) \times q(x) + r(x)$,
where $r(x) = 0$ or degree of $r(x)$ < degree of $g(x)$.

- ❖ If r(x) = 0, then g(x) is a factor of p(x).
- ❖ Dividend = Divisor × Quotient + Remainder

CLASS X : CHAPTER - 3
PAIR OF LINEAR EQUATIONS IN TWO VARIABLES

IMPORTANT FORMULAS & CONCEPTS

- An equation of the form ax + by + c = 0, where a, b and c are real numbers ($a \neq 0, b \neq 0$), is called a linear equation in two variables x and y.
- The numbers a and b are called the coefficients of the equation ax + by + c = 0 and the number c is called the constant of the equation ax + by + c = 0.

Two linear equations in the same two variables are called a pair of linear equations in two variables.
The most general form of a pair of linear equations is

$$a_1x + b_1y + c_1 = 0$$
$$a_2x + b_2y + c_2 = 0$$

where a_1, a_2, b_1, b_2, c_1, c_2 are real numbers, such that $a_1^2 + b_1^2 \neq 0$, $a_2^2 + b_2^2 \neq 0$.

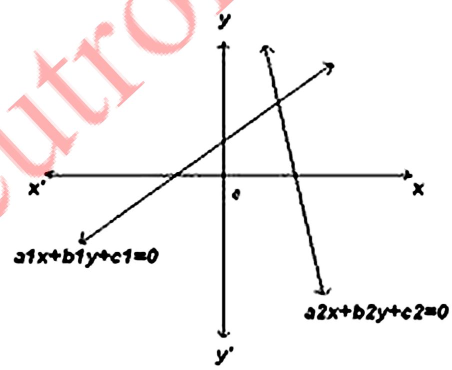
CONSISTENT SYSTEM
A system of simultaneous linear equations is said to be consistent, if it has at least one solution.

INCONSISTENT SYSTEM
A system of simultaneous linear equations is said to be inconsistent, if it has no solution.

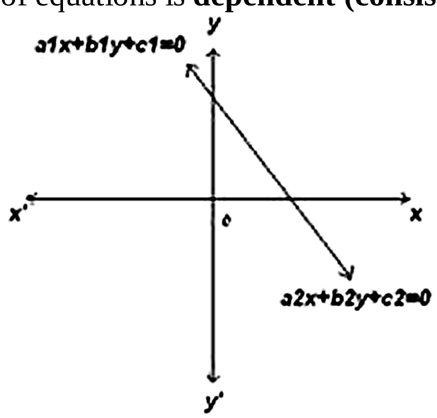
METHOD TO SOLVE A PAIR OF LINEAR EQUATION OF TWO VARIABLES
A pair of linear equations in two variables can be represented, and solved, by the:
(i) graphical method (ii) algebraic method

GRAPHICAL METHOD OF SOLUTION OF A PAIR OF LINEAR EQUATIONS
The graph of a pair of linear equations in two variables is represented by two lines.

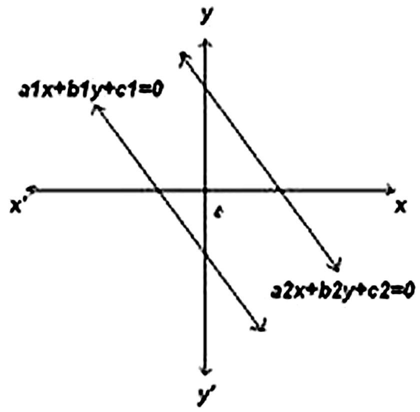
1. If the lines intersect at a point, then that point gives the unique solution of the two equations. In this case, the pair of equations is **consistent**.



2. If the lines coincide, then there are infinitely many solutions — each point on the line being a solution. In this case, the pair of equations is **dependent (consistent)**.



3. If the lines are parallel, then the pair of equations has no solution. In this case, the pair of equations is **inconsistent**.



Algebraic interpretation of pair of linear equations in two variables

The pair of linear equations represented by these lines $a_1x + b_1y + c_1 = 0$ and $a_2x + b_2y + c_2 = 0$

1. If $\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$ then the pair of linear equations has exactly one solution.
2. If $\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$ then the pair of linear equations has infinitely many solutions.
3. If $\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$ then the pair of linear equations has no solution.

S. No.	Pair of lines	Compare the ratios	Graphical representation	Algebraic interpretation
1	$a_1x + b_1y + c_1 = 0$ $a_2x + b_2y + c_2 = 0$	$\frac{a_1}{a_2} \neq \frac{b_1}{b_2}$	Intersecting lines	Unique solution (Exactly one solution)
2	$a_1x + b_1y + c_1 = 0$ $a_2x + b_2y + c_2 = 0$	$\frac{a_1}{a_2} = \frac{b_1}{b_2} = \frac{c_1}{c_2}$	Coincident lines	Infinitely many solutions
3	$a_1x + b_1y + c_1 = 0$ $a_2x + b_2y + c_2 = 0$	$\frac{a_1}{a_2} = \frac{b_1}{b_2} \neq \frac{c_1}{c_2}$	Parallel lines	No solution

ALGEBRAIC METHODS OF SOLVING A PAIR OF LINEAR EQUATIONS

Substitution Method

Following are the steps to solve the pair of linear equations by substitution method:

$a_1x + b_1y + c_1 = 0$ … (i) and

$a_2x + b_2y + c_2 = 0$ … (ii)

Step 1: We pick either of the equations and write one variable in terms of the other

$$y = -\frac{a_1}{b_1}x - \frac{c_1}{b_1} \quad \dots \text{(iii)}$$

Step 2: Substitute the value of x in equation (i) from equation (iii) obtained in step 1.

Step 3: Substituting this value of y in equation (iii) obtained in step 1, we get the values of x and y.

Elimination Method

Following are the steps to solve the pair of linear equations by elimination method:

Step 1: First multiply both the equations by some suitable non-zero constants to make the coefficients of one variable (either x or y) numerically equal.

Step 2: Then add or subtract one equation from the other so that one variable gets eliminated.

- ❖ If you get an equation in one variable, go to Step 3.
- ❖ If in Step 2, we obtain a true statement involving no variable, then the original pair of equations has infinitely many solutions.

- If in Step 2, we obtain a false statement involving no variable, then the original pair of equations has no solution, i.e., it is inconsistent.

Step 3: Solve the equation in one variable (x or y) so obtained to get its value.
Step 4: Substitute this value of x (or y) in either of the original equations to get the value of the other variable.

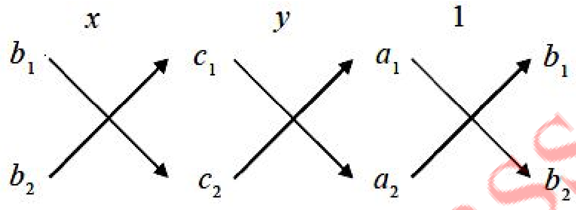
Cross - Multiplication Method
Let the pair of linear equations be:

$a_1x + b_1y + c_1 = 0$ … (1) and
$a_2x + b_2y + c_2 = 0$ … (2)

$$\frac{x}{b_1c_2 - b_2c_1} = \frac{y}{c_1a_2 - c_2a_1} = \frac{1}{a_1b_2 - a_2b_1} \quad \ldots\ldots\ldots\ldots (3)$$

$$\Rightarrow x = \frac{b_1c_2 - b_2c_1}{a_1b_2 - a_2b_1} \quad and \quad y = \frac{c_1a_2 - c_2a_1}{a_1b_2 - a_2b_1}$$

In remembering the above result, the following diagram may be helpful :



The arrows between the two numbers indicate that they are to be multiplied and the second product is to be subtracted from the first.

For solving a pair of linear equations by this method, we will follow the following steps :
Step 1 : Write the given equations in the form (1) and (2).
Step 2 : Taking the help of the diagram above, write Equations as given in (3).
Step 3 : Find *x* and *y*, provided $a_1b_2 - a_2b_1 \neq 0$
Step 2 above gives you an indication of why this method is called the **cross-multiplication method**.

CLASS X : CHAPTER - 4
QUADRATIC EQUATIONS

IMPORTANT FORMULAS & CONCEPTS

POLYNOMIALS

An algebraic expression of the form $p(x) = a_0 + a_1x + a_2x^2 + a_3x^3 + \ldots\ldots a_nx^n$, where $a \neq 0$, is called a polynomial in variable x of degree n.
Here, $a_0, a_1, a_2, a_3, \ldots, a_n$ are real numbers and each power of x is a non-negative integer.
e.g. $3x^2 - 5x + 2$ is a polynomial of degree 2.
$3\sqrt{x} + 2$ is not a polynomial.

- If $p(x)$ is a polynomial in x, the highest power of x in $p(x)$ is called **the degree of the polynomial** $p(x)$. For example, $4x + 2$ is a polynomial in the variable x of degree 1, $2y^2 - 3y + 4$ is a polynomial in the variable y of degree 2,

  - A polynomial of degree 0 is called a constant polynomial.
  - A polynomial $p(x) = ax + b$ of degree 1 is called a linear polynomial.
  - A polynomial $p(x) = ax^2 + bx + c$ of degree 2 is called a quadratic polynomial.
  - A polynomial $p(x) = ax^3 + bx^2 + cx + d$ of degree 3 is called a cubic polynomial.
  - A polynomial $p(x) = ax^4 + bx^3 + cx^2 + dx + e$ of degree 4 is called a bi-quadratic polynomial.

QUADRATIC EQUATION

A polynomial $p(x) = ax^2 + bx + c$ of degree 2 is called a quadratic polynomial, then $p(x) = 0$ is known as quadratic equation.
e.g. $2x^2 - 3x + 2 = 0$, $x^2 + 5x + 6 = 0$ are quadratic equations.

METHODS TO FIND THE SOLUTION OF QUADRATIC EQUATIONS

Three methods to find the solution of quadratic equation:

1. Factorisation method
2. Method of completing the square
3. Quadratic formula method

FACTORISATION METHOD

Steps to find the solution of given quadratic equation by factorisation

- Firstly, write the given quadratic equation in standard form $ax^2 + bx + c = 0$.
- Find two numbers α and β such that sum of α and β is equal to b and product of α and β is equal to ac.
- Write the middle term bx as $\alpha x + \beta x$ and factorise it by splitting the middle term and let factors are (x + p) and (x + q) i.e. $ax^2 + bx + c = 0 \Rightarrow (x + p)(x + q) = 0$
- Now equate reach factor to zero and find the values of x.
- These values of x are the required roots/solutions of the given quadratic equation.

METHOD OF COMPLETING THE SQUARE

Steps to find the solution of given quadratic equation by Method of completing the square:

- Firstly, write the given quadratic equation in standard form $ax^2 + bx + c = 0$.
- Make coefficient of x^2 unity by dividing all by a then we get

  $$x^2 + \frac{b}{a}x + \frac{c}{a} = 0$$

- Shift the constant on RHS and add square of half of the coefficient of x i.e. $\left(\frac{b}{2a}\right)^2$ on both sides.

$$x^2+\frac{b}{a}x=-\frac{c}{a}\Rightarrow x^2+2\left(\frac{b}{2a}\right)x+\left(\frac{b}{2a}\right)^2=-\frac{c}{a}+\left(\frac{b}{2a}\right)^2$$

- Write LHS as the perfect square of a binomial expression and simplify RHS.

$$\left(x+\frac{b}{2a}\right)^2=\frac{b^2-4ac}{4a^2}$$

- Take square root on both sides

$$x+\frac{b}{2a}=\pm\sqrt{\frac{b^2-4ac}{4a^2}}$$

- Find the value of x by shifting the constant term on RHS i.e. $x=\pm\sqrt{\frac{b^2-4ac}{4a^2}}-\frac{b}{2a}$

QUADRATIC FORMULA METHOD

Steps to find the solution of given quadratic equation by quadratic formula method:

- Firstly, write the given quadratic equation in standard form $ax^2 + bx + c = 0$.
- Write the values of a, b and c by comparing the given equation with standard form.
- Find discriminant $D = b^2 - 4ac$. If value of D is negative, then is no real solution i.e. solution does not exist. If value of $D \geq 0$, then solution exists follow the next step.
- Put the value of a, b and D in quadratic formula $x=\frac{-b\pm\sqrt{D}}{2a}$ and get the required roots/solutions.

NATURE OF ROOTS

The roots of the quadratic equation $ax^2 + bx + c = 0$ by quadratic formula are given by

$$x=\frac{-b\pm\sqrt{b^2-4ac}}{2a}=\frac{-b\pm\sqrt{D}}{2a}$$

where D = b^2-4ac is called discriminant. The nature of roots depends upon the value of discriminant D. There are three cases –

Case – I

When $D > 0$ i.e. $b^2-4ac > 0$, then the quadratic equation has two distinct roots.

i.e. $x=\frac{-b+\sqrt{D}}{2a}$ *and* $\frac{-b-\sqrt{D}}{2a}$

Case – II

When D = 0, then the quadratic equation has two equal real roots.

i.e. $x=\frac{-b}{2a}$ *and* $\frac{-b}{2a}$

Case – III

When D < 0 then there is no real roots exist.

CLASS X : CHAPTER - 5
ARITHMETIC PROGRESSION (AP)

IMPORTANT FORMULAS & CONCEPTS

SEQUENCE

An arrangement of numbers in a definite order according to some rule is called a sequence. In other words, a pattern of numbers in which succeeding terms are obtained from the preceding term by adding/subtracting a fixed number or by multiplying with/dividing by a fixed number, is called sequence or list of numbers.

e.g. 1,2,3,4,5

A sequence is said to be finite or infinite accordingly it has finite or infinite number of terms. The various numbers occurring in a sequence are called its terms.

ARITHMETIC PROGRESSION (AP).

An **arithmetic progression** is a list of numbers in which each term is obtained by adding a fixed number to the preceding term except the first term.

This fixed number is called the common difference of the AP. It can be positive, negative or zero.

Let us denote the first term of an AP by a_1, second term by a_2, . . ., nth term by a_n and the common difference by d. Then the AP becomes $a_1, a_2, a_3, . . ., a_n$.

So, $a_2 - a_1 = a_3 - a_2 = . . . = a_n - a_{n-1} = d$.

The general form of an arithmetic progression is given by

$$a, a + d, a + 2d, a + 3d, . . .$$

where a is the first term and d the common difference.

***n*th Term of an AP**

Let $a_1, a_2, a_3, . . .$ be an AP whose first term a_1 is a and the common difference is d.

Then,

the **second term** $a_2 = a + d = a + \mathbf{(2 - 1)}\, d$

the **third** term $a_3 = a_2 + d = (a + d) + d = a + 2d = a + \mathbf{(3 - 1)}\, d$

the **fourth** term $a_4 = a_3 + d = (a + 2d) + d = a + 3d = a + \mathbf{(4 - 1)}\, d$

. . . .

. . . .

Looking at the pattern, we can say that the ***n*th** term $a_n = a + (n - 1)\, d$.

So, **the *n*th term a_n of the AP with first term a and common difference d is given by**

$$a_n = a + (n - 1)\, d.$$

a_n is also called the **general term of the AP**. If there are m terms in the AP, then a_m represents the **last term which is sometimes also denoted by *l***.

***n*th Term from the end of an AP**

Let the last term of an AP be ‘l’ and the common difference of an AP is ‘d’ then the nth term from the end of an AP is given by

$$l_n = l - (n - 1)\, d.$$

Sum of First *n* Terms of an AP

The sum of the first *n* terms of an AP is given by

$$S_n = \frac{n}{2}[2a + (n-1)d]$$

where a = first term, d = common difference and n = number of terms.

Also, it can be written as

$$S_n = \frac{n}{2}[a + a_n]$$

where a_n = nth terms
or

$$S_n = \frac{n}{2}[a + l]$$

where l = last term
This form of the result is useful when the first and the last terms of an AP are given and the common difference is not given..

Sum of first *n* positive integers is given by $S_n = \frac{n(n+1)}{2}$

Problems based on finding a_n if S_n is given.
Find the nth term of the AP, follow the steps:

- Consider the given sum of first n terms as S_n.
- Find the value of S_1 and S_2 by substituting the value of n as 1 and 2.
- The value of S_1 is a_1 i.e. a = first term and $S_2 - S_1 = a_2$
- Find the value of $a_2 - a_1 = d$, common difference.
- By using the value of a and d, Write AP.

Problems based on finding S_n if a_n is given.
Find the sum of n term of an AP, follow the steps:

- Consider the nth term of an AP as a_n.
- Find the value of a_1 and a_2 by substituting the value of n as 1 and 2.
- The value of a_1 is a = first term.
- Find the value of $a_2 - a_1 = d$, common difference.
- By using the value of a and d, Write AP.
- By using Sn formula, simplify the expression after substituting the value of a and d.

Arithmetic Mean
If a, b and c are in AP, then 'b' is known as arithmetic mean between 'a' and 'c'

$b = \frac{a+c}{2}$ i.e. AM between 'a' and 'c' is $\frac{a+c}{2}$.

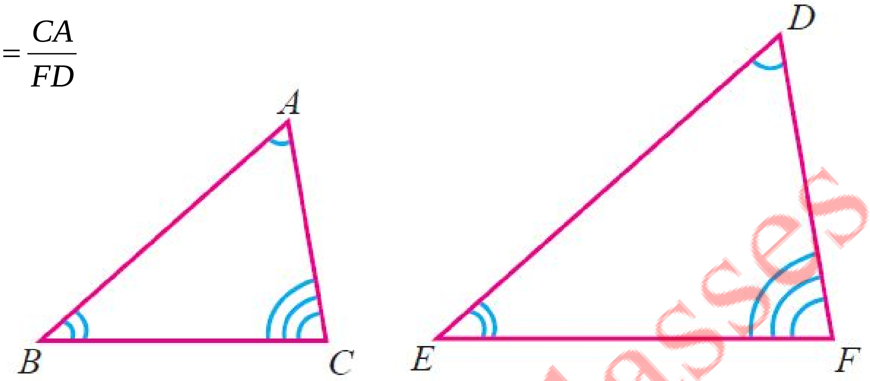
CLASS X : CHAPTER - 6
TRIANGLES

IMPORTANT FORMULAS & CONCEPTS

All those objects which have the same shape but different sizes are called similar objects.
Two triangles are similar if
(i) their corresponding angles are equal (or)
(ii) their corresponding sides have lengths in the same ratio (or proportional)

Two triangles ΔABC and ΔDEF are similar if
$(i) \angle A = \angle D, \angle B = \angle E, \angle C = \angle F$

$(ii) \frac{AB}{DE} = \frac{BC}{EF} = \frac{CA}{FD}$



Basic Proportionality theorem or Thales Theorem
If a straight line is drawn parallel to one side of a triangle intersecting the other two sides, then it divides the two sides in the same ratio.

If in a ΔABC, a straight line DE parallel to BC, intersects AB at D and AC at E, then

$(i) \frac{AB}{AD} = \frac{AC}{AE} \quad (ii) \frac{AB}{DB} = \frac{AC}{EC}$

Converse of Basic Proportionality Theorem (Converse of Thales Theorem)
If a straight line divides any two sides of a triangle in the same ratio, then the line must be parallel to the third side.

Angle Bisector Theorem
The internal (external) bisector of an angle of a triangle divides the opposite side internally (externally) in the ratio of the corresponding sides containing the angle.

Converse of Angle Bisector Theorem
If a straight line through one vertex of a triangle divides the opposite side internally (externally) in the ratio of the other two sides, then the line bisects the angle internally (externally) at the vertex.

Criteria for similarity of triangles
The following three criteria are sufficient to prove that two triangles are similar.

(i) AAA(Angle-Angle-Angle) similarity criterion
If in two triangles, corresponding angles are equal, then their corresponding sides are in the same ratio (or proportion) and hence the two triangles are similar.
Remark: If two angles of one triangle are respectively equal to two angles of another triangle, then the two triangles are similar.

(ii) SSS (Side-Side-Side) similarity criterion for Two Triangles

In two triangles, if the sides of one triangle are proportional (in the same ratio) to the sides of the other triangle, then their corresponding angles are equal and hence the two triangles are similar.

(iii) SAS (Side-Angle-Side) similarity criterion for Two Triangles

If one angle of a triangle is equal to one angle of the other triangle and if the corresponding sides including these angles are proportional, then the two triangles are similar.

Areas of Similar Triangles

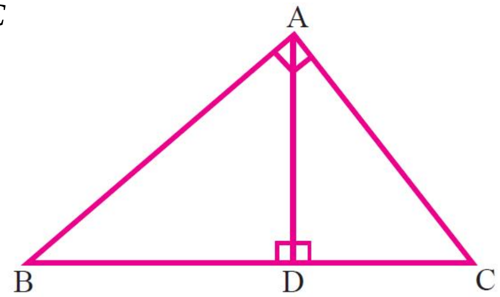
The ratio of the areas of two similar triangles is equal to the ratio of the squares of their corresponding sides.

If a perpendicular is drawn from the vertex of a right angled triangle to its hypotenuse, then the triangles on each side of the perpendicular are similar to the whole triangle.

Here, (a) $\Delta DBA + \Delta ABC$

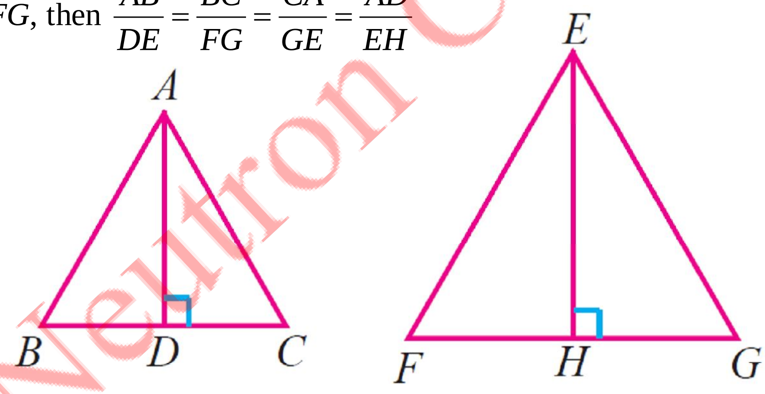
(b) $\Delta DAC + \Delta ABC$

(c) $\Delta DBA + \Delta DAC$



If two triangles are similar, then the ratio of the corresponding sides is equal to the ratio of their corresponding altitudes.

i.e., if $\Delta ABC + \Delta EFG$, then $\frac{AB}{DE}=\frac{BC}{FG}=\frac{CA}{GE}=\frac{AD}{EH}$



If two triangles are similar, then the ratio of the corresponding sides is equal to the ratio of the corresponding perimeters.

If $\Delta ABC + \Delta EFG$, then $\frac{AB}{DE}=\frac{BC}{FG}=\frac{CA}{GE}=\frac{AB+BC+CA}{DE+FG+GE}$

Pythagoras theorem (Baudhayan theorem)

In a right angled triangle, the square of the hypotenuse is equal to the sum of the squares of the other two sides.

Converse of Pythagoras theorem

In a triangle, if the square of one side is equal to the sum of the squares of the other two sides, then the angle opposite to the first side is a right angle.

CLASS X : CHAPTER - 7
COORDINATE GEOMETRY

IMPORTANT FORMULAS & CONCEPTS

Points to remember

- The distance of a point from the *y*-axis is called its ***x*-coordinate**, or **abscissa**.
- The distance of a point from the *x*-axis is called its ***y*-coordinate**, or **ordinate**.
- The coordinates of a point on the *x*-axis are of the form (*x*, 0).
- The coordinates of a point on the *y*-axis are of the form (0, *y*).

Distance Formula

The distance between any two points A(x_1, y_1) and B(x_2, y_2) is given by

$$AB = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

$$or \quad AB = \sqrt{(\text{difference of abscissae})^2 + (\text{difference of ordinates})^2}$$

Distance of a point from origin

The distance of a point P(x, y) from origin O is given by OP = $\sqrt{x^2 + y^2}$

Problems based on geometrical figure

To show that a given figure is a

- Parallelogram – prove that the opposite sides are equal
- Rectangle – prove that the opposite sides are equal and the diagonals are equal.
- Parallelogram but not rectangle – prove that the opposite sides are equal and the diagonals are not equal.
- Rhombus – prove that the four sides are equal
- Square – prove that the four sides are equal and the diagonals are equal.
- Rhombus but not square – prove that the four sides are equal and the diagonals are not equal.
- Isosceles triangle – prove any two sides are equal.
- Equilateral triangle – prove that all three sides are equal.
- Right triangle – prove that sides of triangle satisfies Pythagoras theorem.

Section formula

The coordinates of the point P(*x*, *y*) which divides the line segment joining the points A(x_1, y_1) and B(x_2, y_2), internally, in the ratio $m_1 : m_2$ are

$$\left(\frac{m_1 x_2 + m_2 x_1}{m_1 + m_2}, \frac{m_1 y_2 + m_2 y_1}{m_1 + m_2} \right)$$

This is known as the **section formula**.

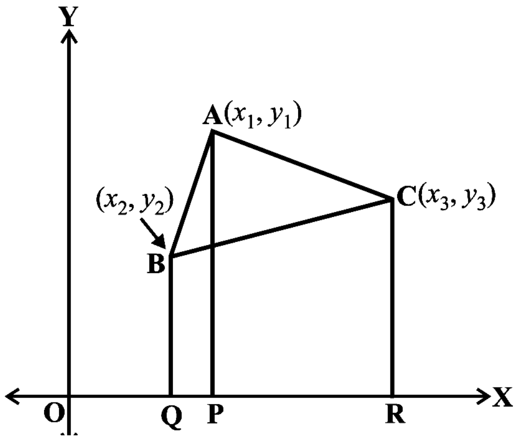
Mid-point formula

The coordinates of the point P(*x*, *y*) which is the midpoint of the line segment joining the points A(x_1, y_1) and B(x_2, y_2), are $\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

Area of a Triangle

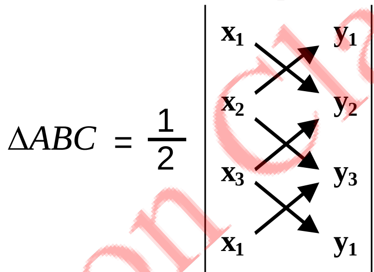
If A(x_1, y_1), B(x_2, y_2) and C(x_3, y_3) are the vertices of a ΔABC, then the area of ΔABC is given by

$$Area\ \ of\ \ \Delta ABC = \frac{1}{2}[x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)]$$



Trick to remember the formula

The formula of area of a triangle can be learn with the help of following arrow diagram:



Find the sum of products of numbers at the ends of the lines pointing downwards and then subtract the sum of products of numbers at the ends of the line pointing upwards, multiply the difference by $\frac{1}{2}$. .e. $Area\ \ of\ \ \Delta ABC = \frac{1}{2}[(x_1y_2 + x_2y_3 + x_3y_1) - (x_1y_3 + x_3y_2 + x_2y_1]$

CLASS X: CHAPTER - 8
INTRODUCTION TO TRIGONOMETRY

IMPORTANT FORMULAS & CONCEPTS

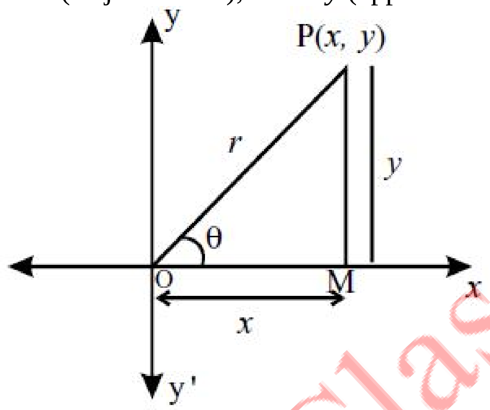
The word 'trigonometry' is derived from the Greek words 'tri' (meaning three), 'gon' (meaning sides) and 'metron' (meaning measure). In fact, **trigonometry** is the study of relationships between the sides and angles of a triangle.

Trigonometric Ratios (T - Ratios) of an acute angle of a right triangle

In XOY-plane, let a revolving line OP starting from OX, trace out $\angle XOP = \theta$.

From P (x, y) draw PM $\perp$ to OX.

In right angled triangle OMP. OM = x (Adjacent side); PM = y (opposite side); OP = r (hypotenuse).



$$\sin\theta = \frac{\text{Opposite side}}{\text{Hypotenuse}} = \frac{y}{r} \qquad \operatorname{cosec}\theta = \frac{\text{Hypotenuse}}{\text{Opposite side}} = \frac{r}{y}$$

$$\cos\theta = \frac{\text{Adjacent Side}}{\text{Hypotenuse}} = \frac{x}{r} \qquad \sec\theta = \frac{\text{Hypotenuse}}{\text{Adjacent Side}} = \frac{r}{x}$$

$$\tan\theta = \frac{\text{Opposite side}}{\text{Adjacent Side}} = \frac{y}{x} \qquad \cot\theta = \frac{\text{Adjacent Side}}{\text{Opposite side}} = \frac{x}{y}$$

Reciprocal Relations

$$\sin\theta = \frac{1}{\operatorname{cosec}\theta} \qquad \operatorname{cosec}\theta = \frac{1}{\sin\theta}$$

$$\cos\theta = \frac{1}{\sec\theta} \qquad \sec\theta = \frac{1}{\cos\theta}$$

$$\tan\theta = \frac{1}{\cot\theta} \qquad \cot\theta = \frac{1}{\tan\theta}$$

Quotient Relations

$$\tan\theta = \frac{\sin\theta}{\cos\theta} \quad \textit{and} \quad \cot\theta = \frac{\cos\theta}{\sin\theta}$$

- **Remark 1 :** sin q is read as the "sine of angle q" and it should never be interpreted as the product of 'sin' and 'q'
- **Remark 2 : Notation :** $(\sin\theta)^2$ is written as $\sin^2\theta$ (read "sin square q'') Similarly $(\sin\theta)^n$ is written as $\sin^n\theta$ (read ''sin nth power q''), n being a positive integer.
- **Note :** $(\sin\theta)^2$ should not be written as $\sin\theta^2$ or as $\sin^2\theta^2$
- **Remark 3 :** Trigonometric ratios depend only on the value of θ and are independent of the lengths of the sides of the right angled triangle.

Trigonometric ratios of Complementary angles.

$\sin(90-\theta) = \cos\theta$	$\cos(90-\theta) = \sin\theta$
$\tan(90-\theta) = \cot\theta$	$\cot(90-\theta) = \tan\theta$
$\sec(90-\theta) = \operatorname{cosec}\theta$	$\operatorname{cosec}(90-\theta) = \sec\theta$.

Trigonometric ratios for angle of measure.
0^0, 30^0, 45^0, 60^0 and 90^0 in tabular form.

$\angle$A	0^0	30^0	45^0	60^0	90^0
sinA	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cosA	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tanA	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
cosecA	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
secA	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
cotA	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

TRIGONOMETRIC IDENTITIES

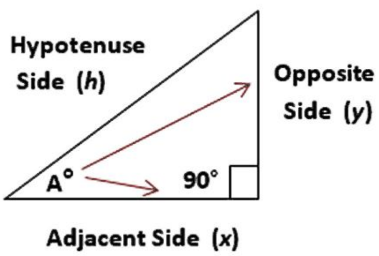
An equation involving trigonometric ratios of an angle is said to be a trigonometric identity if it is satisfied for all values of θ for which the given trigonometric ratios are defined.

Identity (1) : $\sin^2\theta + \cos^2\theta = 1$
$\Rightarrow \sin^2\theta = 1 - \cos^2\theta$ and $\cos^2\theta = 1 - \sin^2\theta$.

Identity (2) : $\sec^2\theta = 1 + \tan^2\theta$
$\Rightarrow \sec^2\theta - \tan^2\theta = 1$ and $\tan^2\theta = \sec^2\theta - 1$.

Identity (3) : $\operatorname{cosec}^2\theta = 1 + \cot^2\theta$
$\Rightarrow \operatorname{cosec}^2\theta - \cot^2\theta = 1$ and $\cot^2\theta = \operatorname{cosec}^2\theta - 1$.

SOME TIPS

Right Triangle	SOH-CAH-TOA Method	Coordinate System Method
	SOH: $\text{sine}(A) = \sin(A) = \frac{\text{Opposite}}{\text{Hypotenuse}}$ CAH: $\text{cosine}(A) = \cos(A) = \frac{\text{Adjacent}}{\text{Hypotenuse}}$ TOA: $\text{tangent}(A) = \tan(A) = \frac{\text{Opposite}}{\text{Adjacent}}$ $\text{cosecant}(A) = \csc(A) = \frac{1}{\sin(A)} = \frac{\text{Hypotenuse}}{\text{Opposite}}$ $\text{secant}(A) = \sec(A) = \frac{1}{\cos(A)} = \frac{\text{Hypotenuse}}{\text{Adjacent}}$ $\text{cotangent}(A) = \cot(A) = \frac{1}{\tan(A)} = \frac{\text{Adjacent}}{\text{Opposite}}$	$\sin(A) = \frac{y}{h}$ $\cos(A) = \frac{x}{h}$ $\tan(A) = \frac{y}{x}$ $\csc(A) = \frac{1}{\sin(A)} = \frac{h}{y}$ $\sec(A) = \frac{1}{\cos(A)} = \frac{h}{x}$ $\cot(A) = \frac{1}{\tan(A)} = \frac{x}{y}$

Each trigonometric function in terms of the other five.

in terms of	$\sin\theta$	$\cos\theta$	$\tan\theta$	$\csc\theta$	$\sec\theta$	$\cot\theta$
$\sin\theta =$	$\sin\theta$	$\pm\sqrt{1-\cos^2\theta}$	$\pm\frac{\tan\theta}{\sqrt{1+\tan^2\theta}}$	$\frac{1}{\csc\theta}$	$\pm\frac{\sqrt{\sec^2\theta-1}}{\sec\theta}$	$\pm\frac{1}{\sqrt{1+\cot^2\theta}}$
$\cos\theta =$	$\pm\sqrt{1-\sin^2\theta}$	$\cos\theta$	$\pm\frac{1}{\sqrt{1+\tan^2\theta}}$	$\pm\frac{\sqrt{\csc^2\theta-1}}{\csc\theta}$	$\frac{1}{\sec\theta}$	$\pm\frac{\cot\theta}{\sqrt{1+\cot^2\theta}}$
$\tan\theta =$	$\pm\frac{\sin\theta}{\sqrt{1-\sin^2\theta}}$	$\pm\frac{\sqrt{1-\cos^2\theta}}{\cos\theta}$	$\tan\theta$	$\pm\frac{1}{\sqrt{\csc^2\theta-1}}$	$\pm\sqrt{\sec^2\theta-1}$	$\frac{1}{\cot\theta}$
$\csc\theta =$	$\frac{1}{\sin\theta}$	$\pm\frac{1}{\sqrt{1-\cos^2\theta}}$	$\pm\frac{\sqrt{1+\tan^2\theta}}{\tan\theta}$	$\csc\theta$	$\pm\frac{\sec\theta}{\sqrt{\sec^2\theta-1}}$	$\pm\sqrt{1+\cot^2\theta}$
$\sec\theta =$	$\pm\frac{1}{\sqrt{1-\sin^2\theta}}$	$\frac{1}{\cos\theta}$	$\pm\sqrt{1+\tan^2\theta}$	$\pm\frac{\csc\theta}{\sqrt{\csc^2\theta-1}}$	$\sec\theta$	$\pm\frac{\sqrt{1+\cot^2\theta}}{\cot\theta}$
$\cot\theta =$	$\pm\frac{\sqrt{1-\sin^2\theta}}{\sin\theta}$	$\pm\frac{\cos\theta}{\sqrt{1-\cos^2\theta}}$	$\frac{1}{\tan\theta}$	$\pm\sqrt{\csc^2\theta-1}$	$\pm\frac{1}{\sqrt{\sec^2\theta-1}}$	$\cot\theta$

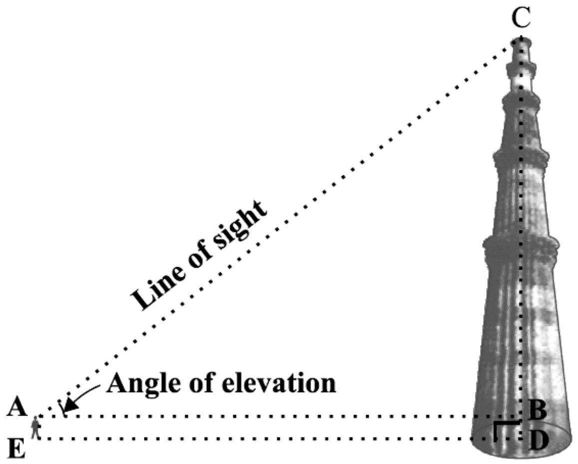
Note: $\csc\theta$ **is same as** $\cos ec\theta$ **.**

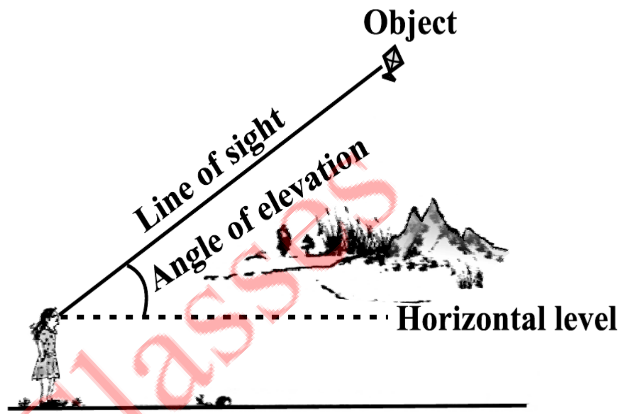
CLASS X : CHAPTER - 9
SOME APPLICATIONS TO TRIGONOMETRY

IMPORTANT FORMULAS & CONCEPTS

ANGLE OF ELEVATION

In the below figure, the line AC drawn from the eye of the student to the top of the minar is called the *line of sight*. The student is looking at the top of the minar. The angle BAC, so formed by the line of sight with the horizontal, is called the *angle of elevation* of the top of the minar from the eye of the student. Thus, the **line of sight** is the line drawn from the eye of an observer to the point in the object viewed by the observer.

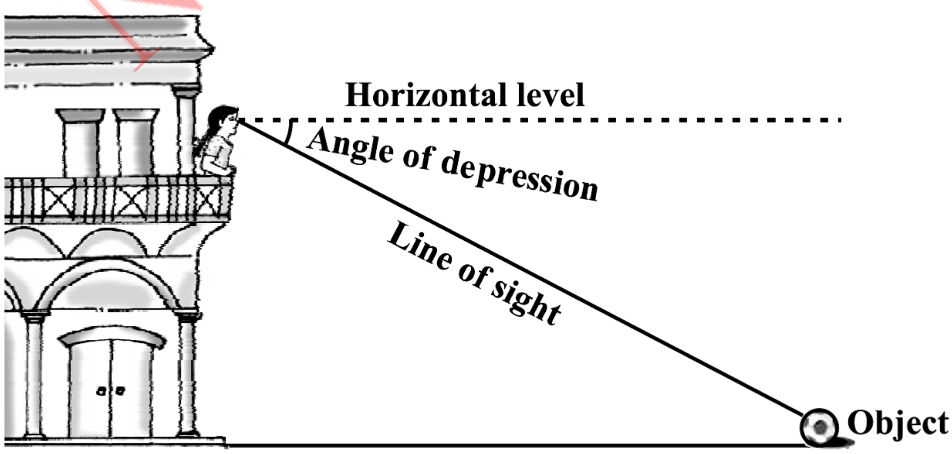




The **angle of elevation** of the point viewed is the angle formed by the line of sight with the horizontal when the point being viewed is above the horizontal level, i.e., the case when we raise our head to look at the object

ANGLE OF DEPRESSION

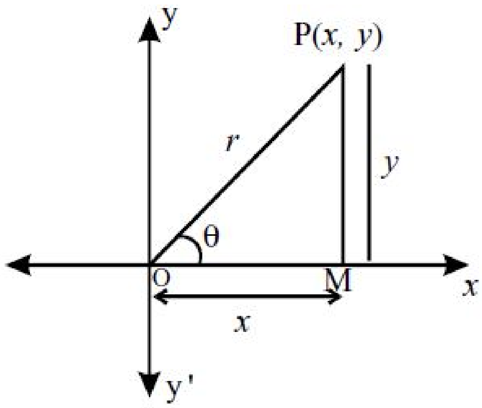
In the below figure, the girl sitting on the balcony is *looking down* at a flower pot placed on a stair of the temple. In this case, the line of sight is *below* the horizontal level. The angle so formed by the line of sight with the horizontal is called the *angle of depression*. Thus, the **angle of depression** of a point on the object being viewed is the angle formed by the line of sight with the horizontal when the point is below the horizontal level, i.e., the case when we lower our head to look at the point being viewed



Trigonometric Ratios (T - Ratios) of an acute angle of a right triangle

In XOY-plane, let a revolving line OP starting from OX, trace out $\angle XOP = \theta$. From P (x, y) draw PM $\perp$ to OX.

In right angled triangle OMP. OM = x (Adjacent side); PM = y (opposite side); OP = r (hypotenuse).



$\sin\theta = \frac{\text{Opposite Side}}{\text{Hypotenuse}} = \frac{y}{r}$, $\cos\theta = \frac{\text{Adjacent Side}}{\text{Hypotenuse}} = \frac{x}{r}$, $\tan\theta = \frac{\text{Opposite Side}}{\text{Adjacent Side}} = \frac{y}{x}$

$\operatorname{cosec}\theta = \frac{\text{Hypotenuse}}{\text{Opposite Side}} = \frac{r}{y}$, $\sec\theta = \frac{\text{Hypotenuse}}{\text{Adjacent Side}} = \frac{r}{x}$, $\cot\theta = \frac{\text{Adjacent Side}}{\text{Opposite Side}} = \frac{x}{y}$

Reciprocal Relations

$\operatorname{cosec}\theta = \frac{1}{\sin\theta}$**,** $\sec\theta = \frac{1}{\cos\theta}$ **and** $\cot\theta = \frac{1}{\tan\theta}$

Quotient Relations

$\tan\theta = \frac{\sin\theta}{\cos\theta}$ and $\cot\theta = \frac{\cos\theta}{\sin\theta}$

Trigonometric ratios of Complementary angles.

sin (90 – θ) = cos θ
cos (90 – θ) = sin θ
tan (90 – θ) = cot θ
cot (90 – θ) = tan θ
sec (90 – θ) = cosec θ
cosec (90 – θ) = sec θ.

Trigonometric ratios for angle of measure.
0^0, 30^0, 45^0, 60^0 and 90^0 in tabular form.

∠A	0^0	30^0	45^0	60^0	90^0
sinA	0	$\frac{1}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{\sqrt{3}}{2}$	1
cosA	1	$\frac{\sqrt{3}}{2}$	$\frac{1}{\sqrt{2}}$	$\frac{1}{2}$	0
tanA	0	$\frac{1}{\sqrt{3}}$	1	$\sqrt{3}$	Not defined
cosecA	Not defined	2	$\sqrt{2}$	$\frac{2}{\sqrt{3}}$	1
secA	1	$\frac{2}{\sqrt{3}}$	$\sqrt{2}$	2	Not defined
cotA	Not defined	$\sqrt{3}$	1	$\frac{1}{\sqrt{3}}$	0

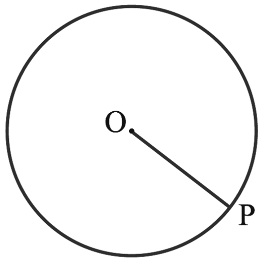
CLASS X : CHAPTER - 10
CIRCLES

IMPORTANT FORMULAS & CONCEPTS

Circle

The collection of all the points in a plane, which are at a fixed distance from a fixed point in the plane, is called a circle.

- The fixed point is called the *centre* of the circle and the fixed distance is called the *radius* of the circle. In the below figure, O is the centre and the length OP is the radius of the circle.



- The line segment joining the centre and any point on the circle is also called a *radius* of the circle.

- A circle divides the plane on which it lies into three parts. They are: (i) inside the circle, which is also called the *interior* of the circle; (ii) the *circle* and (iii) outside the circle, which is also called the *exterior* of the circle. The circle and its interior make up the *circular region*.

- The chord is the line segment having its two end points lying on the circumference of the circle.

- The chord, which passes through the centre of the circle, is called a *diameter* of the circle.

- A *diameter is the longest chord and all diameters have the same length, which is equal to two times the radius.*

- A piece of a circle between two points is called an *arc*.

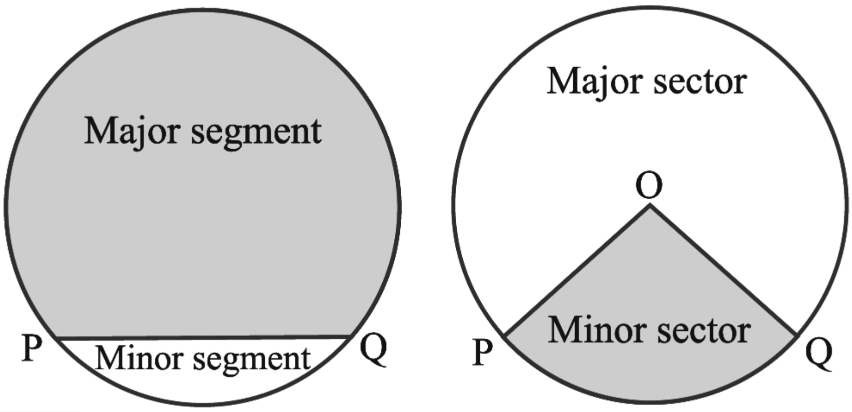
- The longer one is called the *major arc* PQ and the shorter one is called the *minor arc* PQ.

- The length of the complete circle is called its *circumference*.

- The region between a chord and either of its arcs is called a *segment* of the circular region or simply a *segment* of the circle. There are two types of segments also, which are the *major segment* and the *minor segment*.

- The region between an arc and the two radii, joining the centre to the end points of the arc is called a *sector*. The minor arc corresponds to the *minor sector* and the major arc corresponds to the *major sector*.

- In the below figure, the region OPQ is the minor sector and remaining part of the circular region is the major sector. When two arcs are equal, that is, each is a semicircle, then both segments and both sectors become the same and each is known as a *semicircular region*.



Points to Remember :

- A circle is a collection of all the points in a plane, which are equidistant from a fixed point in the plane.
- Equal chords of a circle (or of congruent circles) subtend equal angles at the centre.
- If the angles subtended by two chords of a circle (or of congruent circles) at the centre (corresponding centre) are equal, the chords are equal.
- The perpendicular from the centre of a circle to a chord bisects the chord.
- The line drawn through the centre of a circle to bisect a chord is perpendicular to the chord.
- There is one and only one circle passing through three non-collinear points.
- Equal chords of a circle (or of congruent circles) are equidistant from the centre (or corresponding centres).
- Chords equidistant from the centre (or corresponding centres) of a circle (or of congruent circles) are equal.
- If two arcs of a circle are congruent, then their corresponding chords are equal and conversely, if two chords of a circle are equal, then their corresponding arcs (minor, major) are congruent.
- Congruent arcs of a circle subtend equal angles at the centre.
- The angle subtended by an arc at the centre is double the angle subtended by it at any point on the remaining part of the circle.
- Angles in the same segment of a circle are equal.\
- Angle in a semicircle is a right angle.
- If a line segment joining two points subtends equal angles at two other points lying on the same side of the line containing the line segment, the four points lie on a circle.
- The sum of either pair of opposite angles of a cyclic quadrilateral is 180°.
- If the sum of a pair of opposite angles of a quadrilateral is 180°, then the quadrilateral is cyclic.

Secant to a Circle

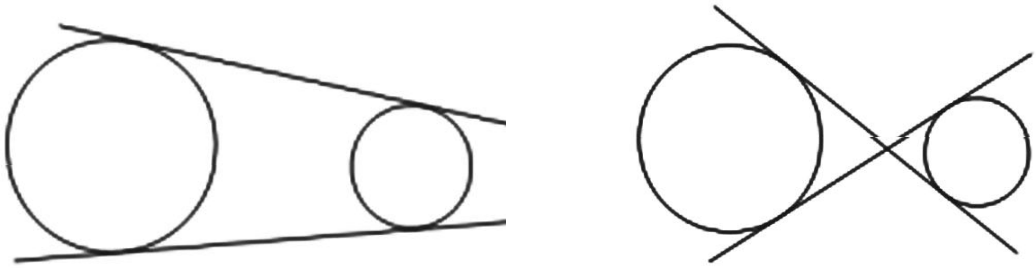
A secant to a circle is a line that intersects the circle at exactly two points.

Tangent to a Circle

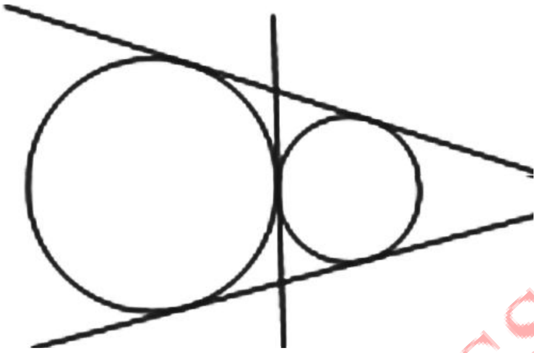
A tangent to a circle is a line that intersects the circle at only one point.

Given two circles, there are lines that are tangents to both of them at the same time.

☞ If the circles are separate (do not intersect), there are four possible common tangents:

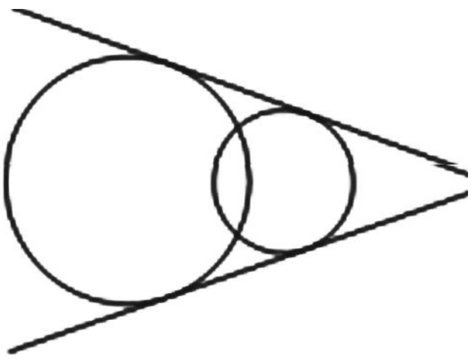


☞ If the two circles touch at just one point, there are three possible tangent lines that are common to both:

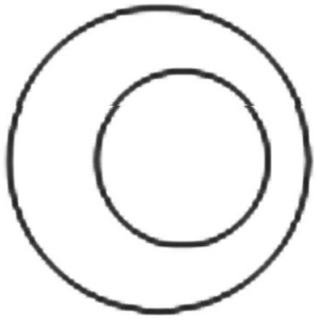


☞ If the two circles touch at just one point, with one inside the other, there is just one line that is a tangent to both:

☞ If the circles overlap - i.e. intersect at two points, there are two tangents that are common to both:



☞ If the circles lie one inside the other, there are no tangents that are common to both. A tangent to the inner circle would be a secant of the outer circle.



- The tangent to a circle is perpendicular to the radius through the point of contact.
- *The lengths of tangents drawn from an external point to a circle are equal*.
- The centre lies on the bisector of the angle between the two tangents.
- “If a line in the plane of a circle is perpendicular to the radius at its endpoint on the circle, then the line is tangent to the circle”.

CLASS X : CHAPTER - 11
CONSTRUCTONS

IMPORTANT CONCEPTS

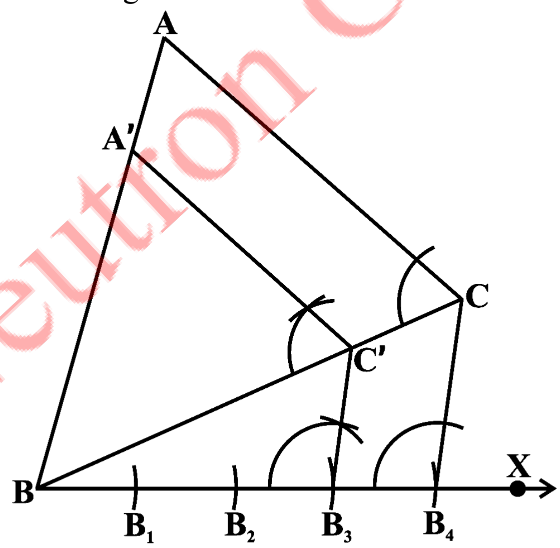
To construct a triangle similar to a given triangle as per given scale factor.

Example 1 - Construct a triangle similar to a given triangle ABC with its sides equal to $\frac{3}{4}$ of the corresponding sides of the triangle ABC (i.e., of scale factor $\frac{3}{4}$).

Steps of Construction :

- Draw any ray BX making an acute angle with BC on the side opposite to the vertex A.
- Locate 4 (the greater of 3 and 4 in $\frac{3}{4}$) points B_1, B_2, B_3 and B_4 on BX so that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4$.
- Join B_4C and draw a line through B3 (the 3rd point, 3 being smaller of 3 and 4 in $\frac{3}{4}$) parallel to B_4C to intersect BC at C′.
- Draw a line through C′ parallel to the line CA to intersect BA at A′ (see below figure).

  Then, Δ A′BC′ is the required triangle.

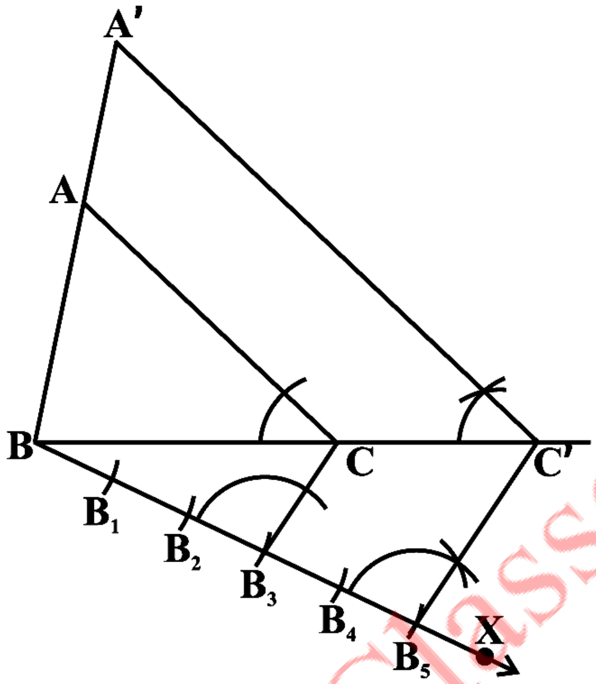


Example 2 : Construct a triangle similar to a given triangle ABC with its sides equal to $\frac{5}{3}$ of the corresponding sides of the triangle ABC (i.e., of scale factor $\frac{5}{3}$).

Steps of Construction :

- Draw any ray BX making an acute angle with BC on the side opposite to the vertex A.
- Locate 5 points (the greater of 5 and 3 in $\frac{5}{3}$) B1, B2, B3, B4 and B5 on BX so that $BB_1 = B_1B_2 = B_2B_3 = B_3B_4 = B_4B_5$.

- Join B_3(the 3rd point, 3 being smaller of 3 and 5 in $\frac{5}{3}$) to C and draw a line through B_5 parallel to B_3C, intersecting the extended line segment BC at C′.
- Draw a line through C′ parallel to CA intersecting the extended line segment BA at A′ (see the below figure).
  Then A′BC′ is the required triangle.



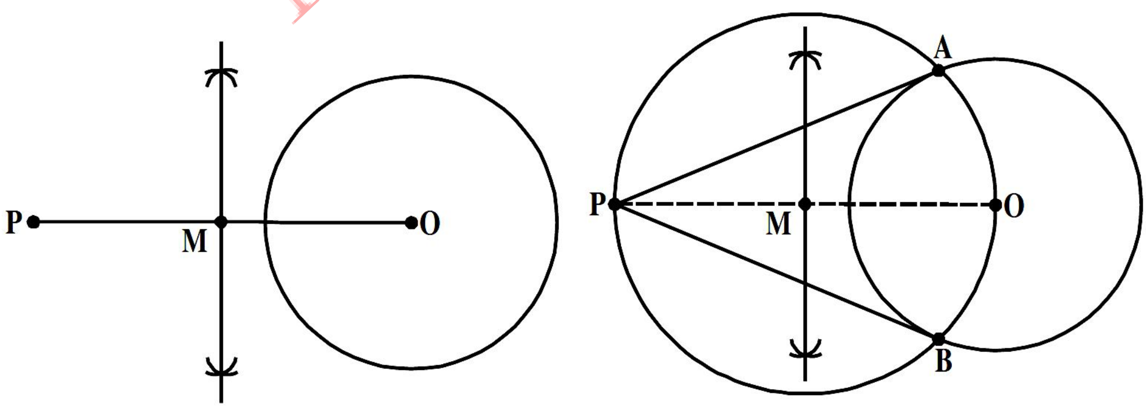
To construct the tangents to a circle from a point outside it.

Given : We are given a circle with centre 'O' and a point P outside it. We have to construct two tangents from P to the circle.

Steps of construction :

- Join PO and draw a perpendicular bisector of it. Let M be the midpoint of PO.
- Taking M as centre and PM or MO as radius, draw a circle. Let it intersect the given circle at the points A and B.
- Join PA and PB.

Then PA and PB are the required two tangents.

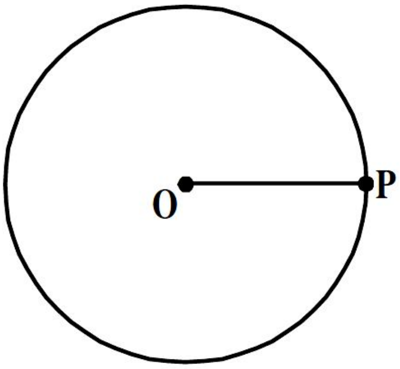


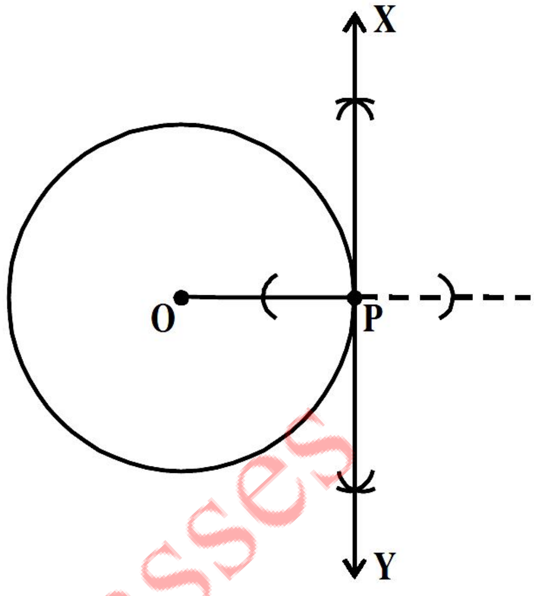
To Construct a tangent to a circle at a given point when the centre of the circle is known.

We have a circle with centre 'O' and a point P anywhere on its circumference. Then we have to construct a tangent through P.

Steps of Construction :

- Draw a circle with centre 'O' and mark a point 'P' anywhere on it. Join OP.
- Draw a perpendicular line through the point P and name it as XY, as shown in the figure.
- XY is the required tangent to the given circle passing through P.





CLASS X : CHAPTER - 12
AREAS RELATED TO CIRCLES

IMPORTANT FORMULAS & CONCEPTS

Perimeter and Area of a Circle

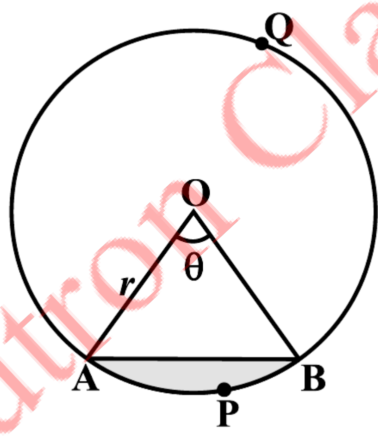
Perimeter/circumference of a circle $= \pi \times$ diameter
$= \pi \times 2r$ (where r is the radius of the circle)
$= 2\pi r$

Area of a circle $= \pi r^2$, where $\pi = \frac{22}{7}$

Areas of Sector and Segment of a Circle

Area of the sector of angle θ $= \frac{\theta}{360^0} \times \pi r^2$, where r is the radius of the circle and θ the angle of the sector in degrees

length of an arc of a sector of angle θ $= \frac{\theta}{360^0} \times 2\pi r$, where r is the radius of the circle and θ the angle of the sector in degrees



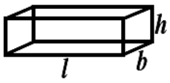
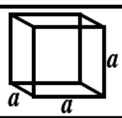
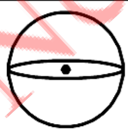
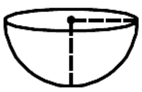
Area of the segment APB = Area of the sector OAPB – Area of Δ OAB

$= \frac{\theta}{360^0} \times \pi r^2 -$ area of Δ OAB

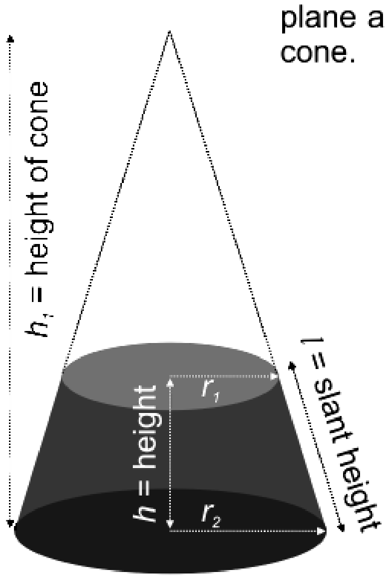
- ☞ Area of the major sector OAQB $= \pi r^2$ – Area of the minor sector OAPB
- ☞ Area of major segment AQB $= \pi r^2$ – Area of the minor segment APB
- ☞ Area of segment of a circle = Area of the corresponding sector – Area of the corresponding triangle

CLASS X : CHAPTER - 13
SURFACE AREAS AND VOLUMES

IMPORTANT FORMULAS & CONCEPTS

S. No.	Name of the solid	Figure	Lateral / Curved surface area	Total surface area	Volume	Nomen-clature
1.	Cuboid		$2h(l+b)$	$2(lb+bh+hl)$	lbh	l:length b:breadth h:height
2.	Cube		$4a^2$	$6a^2$	a^3	a:side of the cube
3.	Right prism		Perimeter of base $\times$ height	Lateral surface area+2(area of the end surface)	area of base $\times$ height	-
4.	Regular circular Cylinder		$2\pi rh$	$2\pi r(r+h)$	$\pi r^2 h$	r:radius of the base h:height
5.	Right pyramid		$\frac{1}{2}$ (perimeter of base) $\times$ slant height	Lateral surfaces area+area of the base	$\frac{1}{3}$ area of the base $\times$ height	-
6.	Right circular cone		πrl	$\pi r(l+r)$	$\frac{1}{3}\pi r^2 h$	r:radius of the base h:height l:slant height
7.	Sphere		$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$	r:radius
8.	Hemisphere		$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$	r:radius

Frustum of a Cone - If a right circular cone is cut off by a plane parallel to its base, then the portion of the cone between the cutting plane and the base of the cone is called a frustum of a cone.



Slant Height of Frustum (l)	$\sqrt{h^2 + (r_1 - r_2)^2}$
Lateral Surface Area	$\pi(r_1 + r_2)l$
Total Surface Area	$\pi\{(r_1 + r_2)l + r_1^2 + r_2^2\}$
Volume	$\frac{\pi}{3}(r_1^2 + r_1 r_2 + r_2^2)h$
Height of cone of which the frustum is part of (h_1)	$\frac{hr_1}{(r_1 - r_2)}$

CLASS X: CHAPTER - 14
STATISTICS

IMPORTANT FORMULAS & CONCEPTS

In many real-life situations, it is helpful to describe data by a single number that is most representative of the entire collection of numbers. Such a number is called a **measure of central tendency.** The most commonly used measures are as follows.

1. The **mean,** or **average,** of 'n' numbers is the sum of the numbers divided by n.
2. The **median** of 'n' numbers is the middle number when the numbers are written in order. If n is even, the median is the average of the two middle numbers.
3. The **mode** of 'n' numbers is the number that occurs most frequently. If two numbers tie for most frequent occurrence, the collection has two modes and is called **bimodal.**

MEAN OF GROUPED DATA

Direct method

Mean, $\bar{x} = \dfrac{\sum f_i x_i}{\sum f_i}$

Assume mean method or Short-cut method

Mean, $\bar{x} = A + \dfrac{\sum f_i d_i}{\sum f_i}$ where $d_i = x_i - A$

Step Deviation method

Mean, $\bar{x} = A + \dfrac{\sum f_i u_i}{\sum f_i} \times h$ where $u = \dfrac{x_i - A}{h}$

MODE OF GROUPED DATA

$$Mode = l + \left(\frac{f_1 - f_0}{2f_1 - f_0 - f_2} \right) \times h$$

where l = lower limit of the modal class,
h = size of the class interval (assuming all class sizes to be equal),
f_1 = frequency of the modal class,
f_0 = frequency of the class preceding the modal class,
f_2 = frequency of the class succeeding the modal class.

- **Cumulative Frequency:** The cumulative frequency of a class is the frequency obtained by adding the frequencies of all the classes preceeding the given class.

MEDIAN OF GROUPED DATA

$$Median = l + \left(\frac{\frac{n}{2} - cf}{f} \right) \times h$$

where l = lower limit of median class,
n = number of observations,
cf = cumulative frequency of class preceding the median class,
f = frequency of median class,
h = class size (assuming class size to be equal).

EMPIRICAL FORMULA
3Median = Mode + 2 Mean

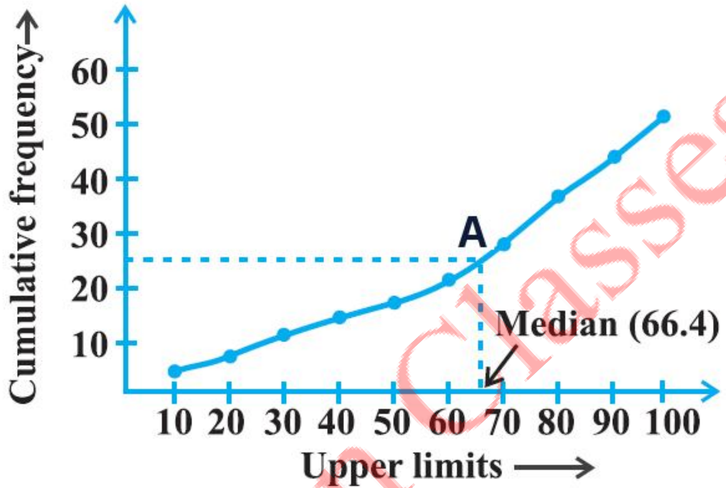
❖ Cumulative frequency curve is also known as 'Ogive'.

There are three methods of drawing ogive:

1. LESS THAN METHOD

Steps involved in calculating median using less than Ogive approach-

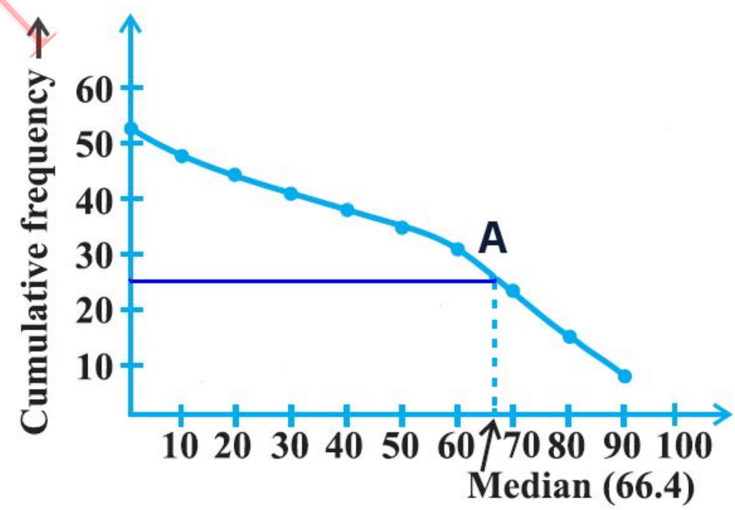
- Convert the series into a 'less than ' cumulative frequency distribution.
- Let N be the total number of students who's data is given. N will also be the cumulative frequency of the last interval. Find the $(N/2)^{th}$ itemand mark it on the y-axis.
- Draw a perpendicular from that point to the right to cut the Ogive curve at point A.
- From point A where the Ogive curve is cut, draw a perpendicular on the x-axis. The point at which it touches the x-axis will be the median value of the series as shown in the graph.



2. MORE THAN METHOD

Steps involved in calculating median using more than Ogive approach-

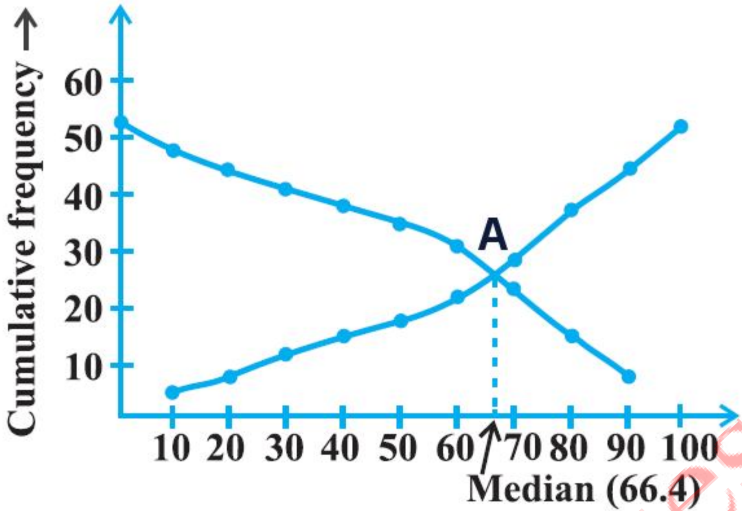
- Convert the series into a 'more than ' cumulative frequency distribution.
- Let N be the total number of students who's data is given. N will also be the cumulative frequency of the last interval. Find the $(N/2)^{th}$ item and mark it on the y-axis.
- Draw a perpendicular from that point to the right to cut the Ogive curve at point A.
- From point A where the Ogive curve is cut, draw a perpendicular on the x-axis. The point at which it touches the x-axis will be the median value of the series as shown in the graph.



3. LESS THAN AND MORE THAN OGIVE METHOD

Another way of graphical determination of median is through simultaneous graphic presentation of both the less than and more than Ogives.

- ➢ Mark the point A where the Ogive curves cut each other.
- ➢ Draw a perpendicular from A on the x-axis. The corresponding value on the x-axis would be the median value.



- ❖ The median of grouped data can be obtained graphically as the *x*-coordinate of the point of intersection of the two ogives for this data.

CLASS X : CHAPTER - 15
PROBABILITY

IMPORTANT FORMULAS & CONCEPTS

PROBABILITY

Experimental or empirical probability P(E) of an event E is

$$P(E) = \frac{\text{Number of trials in which the event happened}}{\text{Total number of trials}}$$

The theoretical probability (also called classical probability) of an event A, written as P(A), is defined as

$$P(A) = \frac{\text{Number of outcomes favourable to A}}{\text{Number of all possible outcomes of the experiment}}$$

Two or more events of an experiment, where occurrence of an event prevents occurrences of all other events, are called **Mutually Exclusive Events.**

COMPLIMENTARY EVENTS AND PROBABILITY

We denote the event 'not E' by E . This is called the **complement** event of event E.

So, P(E) + P(not E) = 1

i.e., $P(E) + P(\overline{E}) = 1$, which gives us $P(\overline{E}) = 1 - P(E)$.

In general, it is true that for an event E, $P(\overline{E}) = 1 - P(E)$

- The probability of an event which is impossible to occur is 0. Such an event is called an **impossible event**.

- The probability of an event which is sure (or certain) to occur is 1. Such an event is called a **sure event** or a **certain event**.

- The probability of an event E is a number P(E) such that $0 \leq P(E) \leq 1$

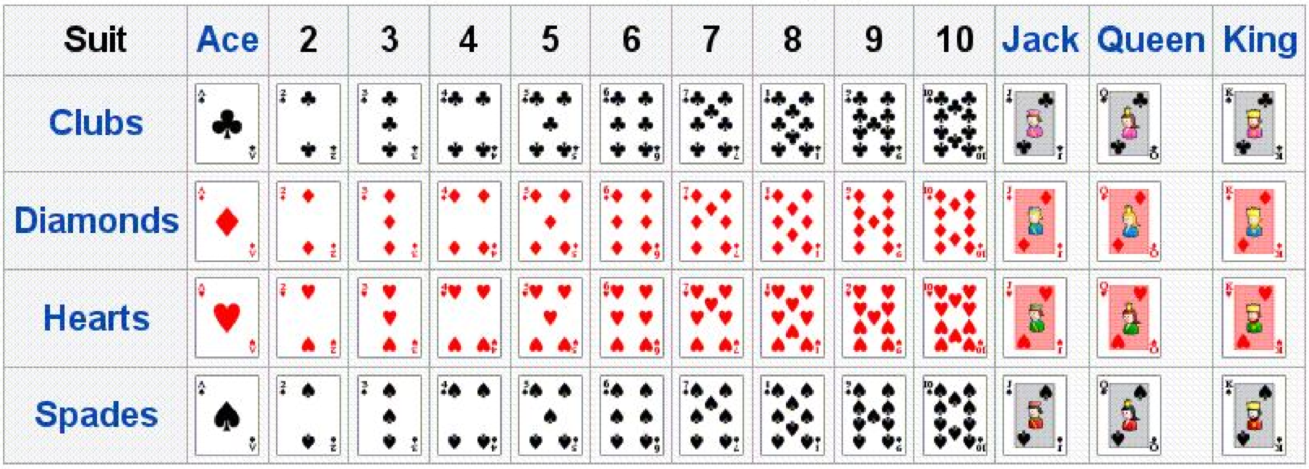
- An event having only one outcome is called an elementary event. The sum of the probabilities of all the elementary events of an experiment is 1.

DECK OF CARDS AND PROBABILITY

A deck of playing cards consists of 52 cards which are divided into 4 suits of 13 cards each. They are black spades (♠) red hearts (♥), red diamonds (♦) and black clubs (♣).

The cards in each suit are Ace, King, Queen, Jack, 10, 9, 8, 7, 6, 5, 4, 3 and 2. Kings, Queens and Jacks are called face cards.

Example set of 52 poker playing cards



Suit	Ace	2	3	4	5	6	7	8	9	10	Jack	Queen	King
Clubs													
Diamonds													
Hearts													
Spades													

Equally likely events : Two or more events are said to be equally likely if each one of them has an equal chance of occurrence.

Mutually Exclusive events : Two or more events are mutually exclusive if the occurrence of each event prevents the every other event.

Complementary events : Consider an event has few outcomes. Event of all other outcomes in the sample survey which are not in the favourable event is called Complementary event.

Exhaustive events : All the events are exhaustive events if their union is the sample space.

Sure events : The sample space of a random experiment is called sure or certain event as any one of its elements will surely occur in any trail of the experiment.

Impossible event : An event which will occur on any account is called an impossible event.