CLASS 9 CBSE FORMULAE SHEET

CHAPTER 1: NUMBER SYSTEM

1) Natural number (N) = {1,2,3,4….}
2) Whole number (W) = {0,1,2,3,4….}
3) Integers (Z) = {…-4,-3,-2,-1,0,1,2,3,4….}
4) Positive Numbers (Z_+) = {1,2,3,4….}
5) Negative Numbers (Z_-) = {-1,-2,-3,-4….}
6) Rational Numbers – When a number can be expressed in the form p/q where p and q are integers (q>0).
   Example: ½, 4/3, 5/7, etc.
7) Irrational Numbers – When a number cannot be expressed in the form p/q where p and q are integers (q>0). Example: $\sqrt{7}, \sqrt{2}, \sqrt{5},$ etc.
8) Real Numbers – All rational and irrational numbers make comprises the collection of real numbers and is denoted by R.
9) Laws of Exponents:
   - $a^m . a^n = a^{m+n}$
   - $a^m / a^n = a^{m+n}$
   - $(a^m)^n = a^{m.n}$
   - $a^{-m} = 1/a^m$
   - $a^0 = 1$

CHAPTER 2: POLYNOMIAL EXPRESSIONS

$S_{(x)} = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \ldots\ldots + a_1 x^1 + a_0$

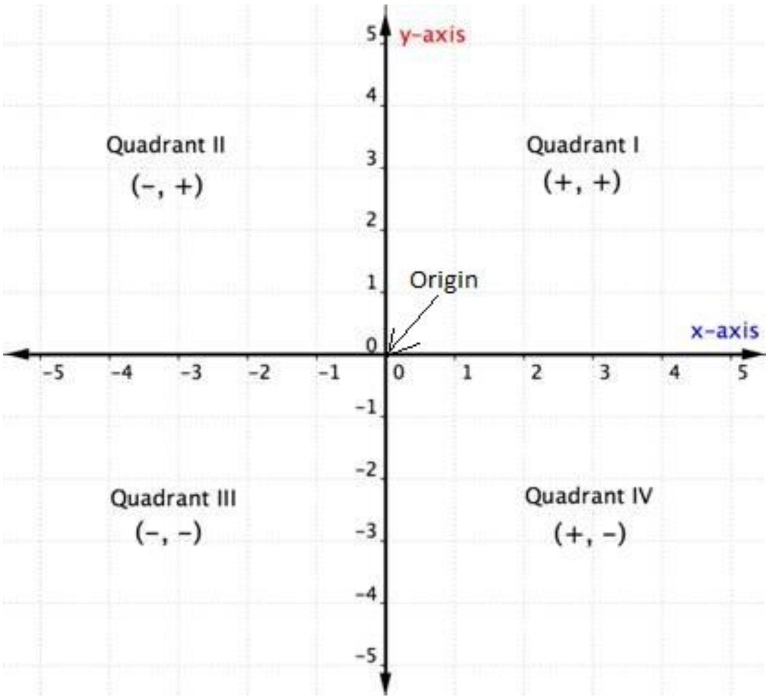
where, a_n, a_{n-1}, a_{n-2}, …. are constant and real numbers and $a_n \neq 0$.

1) a_n, a_{n-1}, a_{n-2}, …..a_1, a_0 are called the coefficients for x^n, x^{n-1}, x^{n-2},…….., a^1, a^0.
2) n is the degree of polynomial.
3) When a_n, a_{n-1}, a_{n-2}, ………, a_1, a_0 all are zero, it is known as zero polynomial.
4) Constant Polynomial: It is the polynomial with zero degree.
5) Algebraic expression consisting of one term is called monomial.
   Algebraic expression consisting of two terms is called binomial.
   Algebraic expression consisting of three terms is called trinomial.
6) Polynomial with one degree called linear polynomial, two degree as quadratic polynomial and three degree as cubic polynomial.
7) Important Strategies
   - Factor's theorem: If (x-a) is a factor of polynomial p(x), then p(a)=0 or if p(a)=0, (x-a) is the factor of the polynomial p(x).
   - Remainder's theorem: If p(x) is a polynomial of degree greater than or equal to 1 and p(x) is divided by the expression (x-a), then the remainder will be p(a).
   - Zeroes or the roots of the polynomial: It is a solution to the polynomial equation S(x)=0 i.e. a number "a" is said to be a zero of a polynomial if S(a)=0.

CHAPTER 3: COORDINATE GEOMETRY

1) To locate the position of a point in a plane, we require two perpendicular lines. One of them is horizontal, and the other is vertical.
2) The plane is known as the Cartesian or coordinate plane and the lines are called the coordinate axes.
3) The horizontal line is named as the *x* -axis, and the vertical line is the *y* - axis.
4) The coordinate axes divide the plane into four parts known as quadrants.
5) The point of intersection of the axes is called the origin.
6) The distance of a point from the *y* - axis is called its *x*-coordinate or **abscissa**, and the distance of the point from the *x*-axis is called its *y*-coordinate or **ordinate**.
7) If *x* is the abscissa of a point and *y* is the ordinate, then (*x*, *y*) are called the coordinates of the point.
8) The coordinates of a point on the *x*-axis are of the form (*x*, 0) and that of the point on the *y*-axis are (0, *y*).
9) The coordinates of the origin are (0, 0).
10) The coordinates of a point are of the form (+ , +) in the first quadrant, (–, +) in the second quadrant, (–, –) in the third quadrant and (+, –) in the fourth quadrant, where + denotes a positive real number and – denotes a negative real number.

Quadrant	**x-coordinate**	**y-coordinate**
Ist quadrant	+	+
IInd quadrant	-	+
IIIrd quadrant	-	-
IVth quadrant	+	-



CHAPTER 4: LINEAR EQUATION IN TWO VARIABLES

An equation in the form ax+by+c=0, where a,b,c are real numbers, such that a,b≠0, is called linear equation in two variables.

1) A linear equation in two variables has infinitely many solutions.
2) The graph of every linear equation in two variables is a straight line.
3) $x = 0$ is the equation of the *y*-axis and $y = 0$ is the equation of the *x*-axis**.**
4) The graph of $x = a$ is a straight line parallel to the *y*-axis.
5) The graph of $y = a$ is a straight line parallel to the *x*-axis.
6) An equation of the type $y = mx$ represents a line passing through the origin.
7) Every point on the graph of a linear equation in two variables is a solution of the linear equation. Moreover, every solution of the linear equation is a point on the graph of the linear equation.

CHAPTER 5: EUCLID GEOMETRY

1) Who is Euclid?

A Greek mathematician, also known as father of geometry.

2) Definitions of Euclidian Geometry:
    - A point is that which has no part
    - A line has length without breadth

- The extremities of a line are points
- A straight line is one which lies evenly with points on itself
- A surface is that which has length and breadth only
- The edges of the surface are lines
  (The definition of line, plane, point explained by Euclid is not accepted by the mathematicians. Thus these terms are taken as undefined)

3) Axioms and postulates
   Axioms and postulates are assumptions which are obvious universal truths. They are not proved.

4) Theorems
   Theorems are statements which are proved, using definitions, axioms, previously proved statements and deductive reasoning.

5) Euclid's axioms:
   - Things which are equal to the same thing are equal to one another.
     If a=c and b=c, then a=b
   - If equals are added to equals the wholes are equal.
     a=b => a+c = b+c
   - If equals are subtracted to equals the wholes are equal.
     a=b => a-c = b-c
   - Things which coincide with one another are equal to one another.
   - The whole is greater than the part.
   - Things which are double of the same things are equal to one another.
   - Things which are halves of the same things are equal to one another.

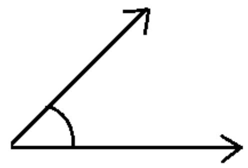
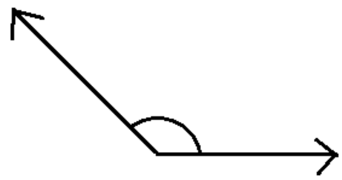
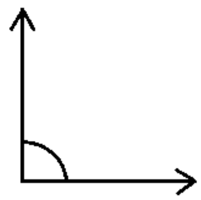
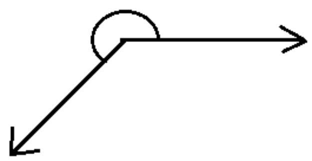
6) Euclid's postulates:
   - Postulate 1: A straight line may be drawn from any one point to any other point.
   - Postulate 2: A terminated line can be produced indefinitely.
   - Postulate 3: A circle can be drawn with any centre and any radius.
   - Postulate 4: All right angles are equal to one another.
   - Postulate 5: If a straight line falling on two straight lines makes the interior angles on the same side of it taken together less than two right angles, then the two straight lines, if produced indefinitely, meet on that side on which the sum of angles is less than two right angles.

7) Equivalent version of Euclid's 5^{th} Postulate:
   - "For every line *l* and for every point P not lying on *l*, there exists a unique line *m* passing through P and parallel to *l*."
   - Two distinct interesting lines cannot be parallel to the same line.

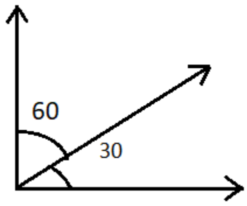
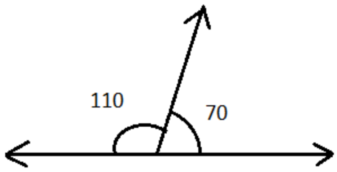
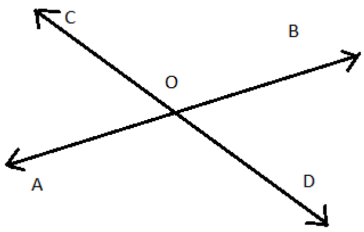
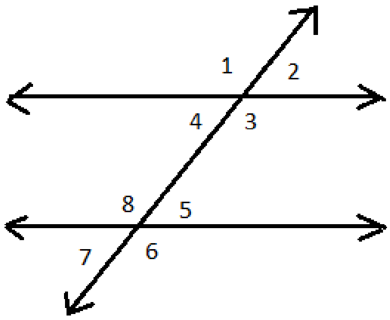
CHAPTER 6: LINES AND ANGLES

1) Definition of Angle: When two rays meet, having one endpoint, an angle is formed. The common endpoint is known as the vertex of the angle and the rays are the sides.

2) Types of angles:

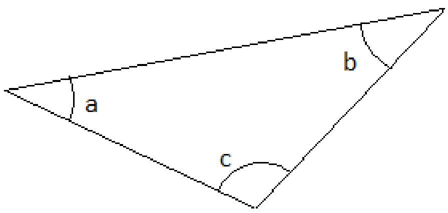
Angle type	Figure
Acute Angle 0< θ< 90°	
Obtuse angle 90°< θ< 180°	
Right Angle θ =90°	
Reflex Angle 180°< θ< 360°	
Straight Angle θ = 180°	

S.No.	Terms	Descriptions

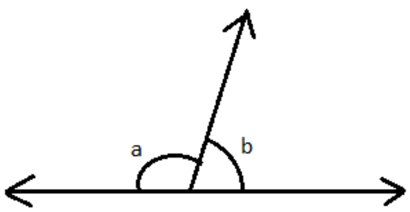
1	Complimentary angles	Two angles whose sum equal to 90° 
2	Supplementary angles	Two angles whose sum is equal to 180° 
3	Vertically opposite angles	If two lines intersect with each other, then vertically opposite angles are equal. 
4	Transversal across the parallel lines	If the transversal intersects two parallel lines  a. Each pair of corresponding angles are equal. $\angle 1 = \angle 8, \angle 2 = \angle 5$, $\angle 4 = \angle 7, \angle 3 = \angle 6$ b. Each pair of alternate interior angles are equal. $\angle 4 = \angle 5$ $\angle 3 = \angle 8$ c. Each pair of interior angles on the same side of the transversal is supplimentary. $\angle 4 + \angle 8 = 180°$ $\angle 3 + \angle 5 = 180°$

5	Theorem on transversal across the lines	If a transversal intersect two lines such that either a. Any one pair of corresponding angles are equal b. Any one pair of alternate interior angles are equal c. Any one pair of interior angles on the same side of the transversal is supplementary Then the two lines are parallel.
6	Parallel lines note	Lines which are parallel to a given line are parallel to each other.

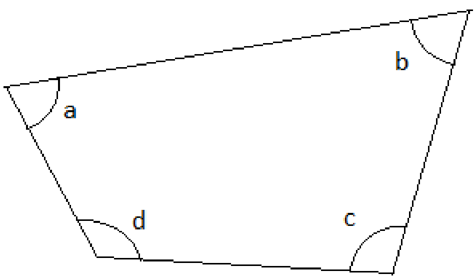
3) Angle Rules



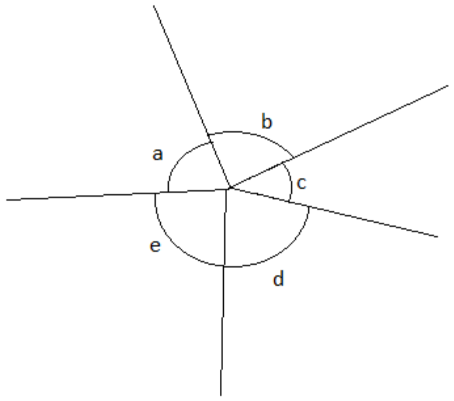
Angles in a triangle add up to 180.
So a+b+c = 180°



Angles on a straight line add up to 180°. So,
a+b = 180°



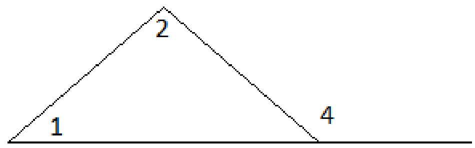
Angles in a quadrilateral add up to 360°. So,
a+b+c+d = 360°



Angles around a point add up to 360°.
So,
a+b+c+d+e = 360°

If the side of the triangle is produced, the exterior angle formed is equal to the sum of the opposite interior angle.

$$\angle 4 = \angle 1 + \angle 2$$



4) Axioms:
   - Axiom 1: *If a ray stands on a line, then the sum of two adjacent angles so formed is 180°.*
   - Axiom 2: *If the sum of two adjacent angles 180°, then the non-common arms of the angles form a line.* This axiom is also known as Linear Pair Axiom.
   - Axiom 3: *If a transversal intersects two parallel lines, then each pair of corresponding angles is equal.*
   - Axiom 4: *if a transversal intersects two lines such that a pair of corresponding angles is equal, then the two lines are parallel to each other.*

5) Theorems:
   - Theorem 1: If two lines intersect each other, then the vertically opposite angles are equal.
   - Theorem 2: If a transversal intersects two parallel lines, then each pair of alternate interior angles is equal.
   - Theorem 3: If a transversal intersects two lines such that a pair of alternate interior angles is equal, then the two lines are parallel.
   - Theorem 4: If a transversal intersects two parallel lines, then each pair of interior angles on the same side of the transversal is supplementary.
   - Theorem 5: If a transversal intersects two lines such that a pair of interior angles on the same side of the transversal is supplementary, then the two lines are parallel.
   - Theorem 6: Lines which are parallel to the same line are parallel to each other.

- Theorem 7: The sum of the angles of the triangles is 180°.
- Theorem 8: If a side of a triangle is produced, then the exterior angle so formed is equal to the sum of the two interior apposite angles.

6) <u>Zero degree angle:</u> A zero degree angle appears as a straight line that travels from the point of inception to the right or positive side of a number line**.** If the line travels both left and right from the point of inception, it is considered a 180 degree angle or straight angle**.**

CHAPTER 7: TRIANGLES

1) What is meant by Congruence?
Two geometric figures are said to be congruence if they are exactly same size and shape. Symbol used to denote congruency is ≅.
Two angles are congruent if they are equal.
Two circles are congruent if they have equal radii.
Teo squares are congruent if they have equal sides.

2) Triangle Congruence
   - Two triangles are congruent if three sides and three angles of one triangle is congruent to the corresponding sides and angles of the other
   - Corresponding sides are equal
     AB=DE , BC=EF , AC=DF
   - Corresponding angles are equal

$$\angle A = \angle D$$
$$\angle B = \angle E$$
$$\angle C = \angle F$$

   - We write this as

$$\Delta ABC \cong \Delta DEF$$

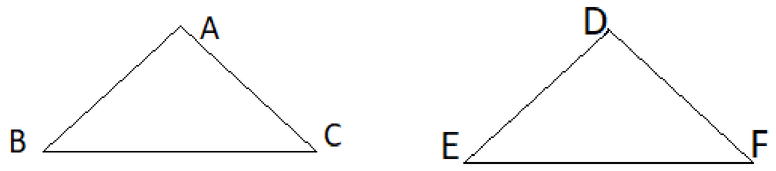
   - The above six equalities are between the corresponding parts of the two congruent triangles. In short form this is called C.P.C.T.
   - We should keep the letters in correct order on both sides.

3) Inequalities in triangles
   - Ina triangle the angle opposite to longer side is larger.
   - In a triangle, side opposite to larger angle is larger.
   - The sum of any two sides of the triangle is greater than the third side.
     In triangle ABC,
     AB + BC > AC

4) Different criterion for congruence of the triangles

i. Side Angle Side (SAS) congruence

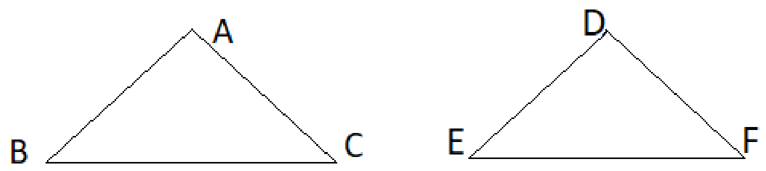
- Two triangles are congruent if the two sides and included angles of one triangle is equal to the two sides and included angle.
- It is an axiom as it cannot be proved so it is an accepted truth.
- ASS and SSA type two triangles may not be congruent always.



If the following condition holds:
AB = DE , BC = EF, $\angle B = \angle E$
Then,
$\Delta ABC \cong \Delta DEF$

ii. Angle Side Angle (ASA) congruence

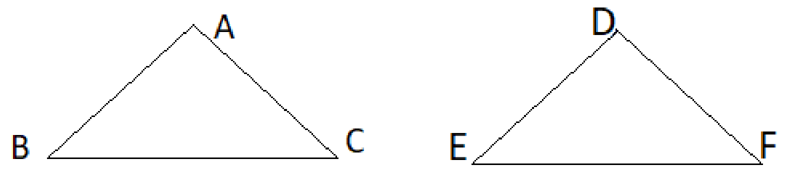
- Two triangles are congruent if the two angles and included side of one triangle is equal to the corresponding angles and side.
- It is a theorem and can be proved



If the following condition holds:
BC = EF , $\angle B = \angle E$, $\angle C = \angle F$
Then,
$\Delta ABC \cong \Delta DEF$

iii. Angle-Angle-Side (AAS) congruence

- Two triangles are congruent if two pair of angles and any one side of one triangle is equal to the corresponding angles and side.
- It is a theorem and can be proved.



If the following condition holds:

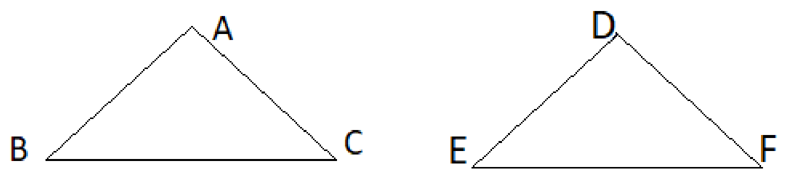
BC = EF , $\angle A = \angle D$, $\angle C = \angle F$

Then,

$\Delta ABC \cong \Delta DEF$

iv. Side-Side-Side (SSS) congruence

- Two triangles are congruent if the three sides of one triangle is equal to the three sides of the another.



If the following condition holds:

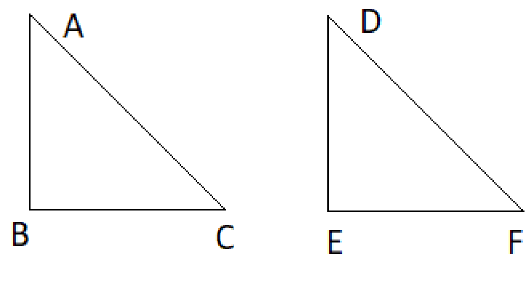
BC = EF , AB = DE , DF = AC

Then,

$\Delta ABC \cong \Delta DEF$

v. Right angle-Hypotenuse-Side (RHS) congruence

- Two right triangles are congruent if the hypotenuse and a side of the one triangle are equal to corresponding hypotenuse and side of the another.



If the following condition holds:

AC = DF , BC = EF

Then,

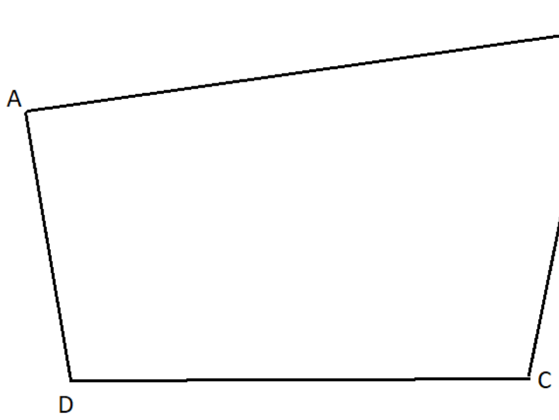
$\Delta ABC \cong \Delta DEF$

5) Some important points on triangles

Terms	Description
Orthocenter	The point of intersection of the three altitudes of the triangle
Equilateral	A triangle whose all sides are equal and all angles are 60°
Median	A line segment joining the corner of the triangle to the midpoint of the opposite side of the triangle.
Altitude	A line segment from the corner of a triangle and perpendicular to the opposite side of the triangle.
Isosceles	A triangle whose two sides are equal.
Centroid	The point of intersection of the three medians of a triangle.
Incentre	The point of intersection of all the three angle bisectors of a triangle
Circumcenter	The point of intersection of all the three perpendicular bisectors of the three sides of the triangle.
Scalene triangle	A triangle having no two equal sides and no two equal angles.
Right triangle	A right triangle has one angle equal to 90°
Obtuse triangle	A triangle whose one angle is obtuse and other two angles are acute angles.
Acute triangle	A triangle whose all the three angles are acute triangles.

CHAPTER 8: QUADRILATERALS

1) What do you mean by Quadrilaterals?
   A quadrilateral is a geometrical figure formed by four line-segments determined by four distinct coplanar points of which no three are co-linear and the line-segments intersects only at the end points.



For ABCD to be a quadrilateral, following conditions are required:

I)The four points A, B, C, D must be distinct and coplanar.

II) No three points are co-linear

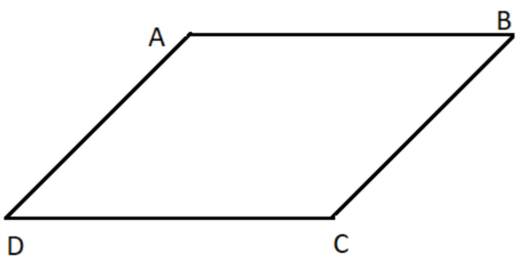
III)Line segments, AB, BC, CD and DA intersects at their end points only.

Basically, a quadrilateral is a four-sided polygon with four angles. There are various types of quadrilaterals; most commonly used quadrilaterals are parallelogram, rhombus, square, rectangle, trapezium.

2) Angle properties of Quadrilateral
   - Sum of all interior angles is 360°.
   - Sum of all exterior angles is 360°.

3) Types of Quadrilaterals

I. PARALLELOGRAM

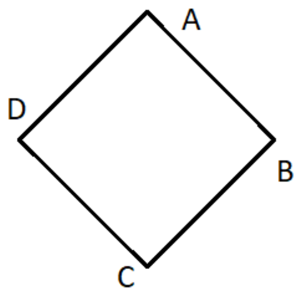


A quadrilateral which has both pairs of opposite sides parallel is called a parallelogram.

Properties of a parallelogram are as follows:

- Opposite sides of a parallelogram are equal.
- Opposite angles of a parallelogram are equal.
- Diagonals of a parallelogram bisect each other.
- Diagonals of a parallelogram divide into two congruent triangles.

II. RHOMBUS

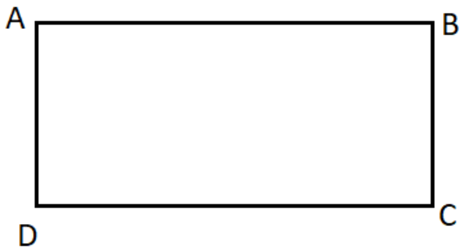


Rhombus is a parallelogram in which any pair of adjacent sides is equal.

Properties of a rhombus:

- All sides of rhomb us are equal.
- The opposite angles of a rhombus are equal.
- The diagonals of a rhombus bisect each other at right angles.

III. RECTANGLE

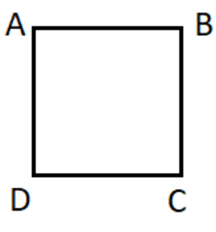


A parallelogram in which all the four angles are right angles is called a rectangle.

Properties of rectangle:

- Opposite sides of a rectangle are equal.
- Each angle of a rectangle is a right-angle.
- Diagonals of a rectangle are equal.
- Diagonals of a rectangle bisect each other.

IV. SQUARE

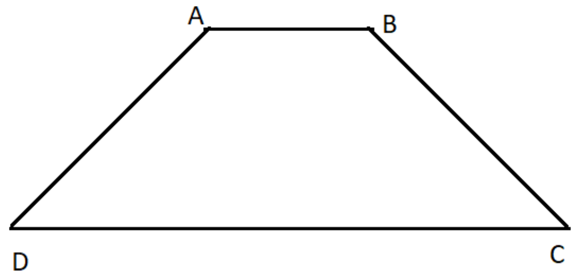


A quadrilateral all of whose sides are equal and all of whose angles are right angles.

Properties of square:

- All the sides of a square are equal
- Each of the angles is right angle
- The diagonals of the square bisect each other at right angles.
- Diagonals of square are equal

V. TRAPEZIUM



A quadrilateral which has one pair of opposite sides parallel is called trapezium.

4) Theorems:

I. Theorem 1: A diagonal of a parallelogram divides it into two congruent triangles.

II. Theorem 2: In a parallelogram opposite sides are equal.

III. Theorem 3: If each pair of opposite sides of a quadrilateral is equal then it is a parallelogram.

IV. Theorem 4: In a parallelogram opposite angles are equal.

V. Theorem 5: If in a quadrilateral, each pair of opposite angles is equal, then it is a parallelogram.

VI. Theorem 6: The diagonals of a parallelogram bisect each other.

VII. Theorem 7: If the diagonals of a quadrilateral bisect each other, then it is a parallelogram.

VIII. Theorem 8: A quadrilateral is a parallelogram if a pair of opposite sides is equal and parallel.

IX. Theorem 9: a) The line-segment joining the mid-points of two sides of a triangle is parallel to third side. It is also known as the **mid-point theorem**.

b) The line drawn through the mid-point of a side of a triangle, parallel to another side bisects the third side.

5) Salient Features about quadrilaterals:

- A square is always a parallelogram
- A square is always a rectangle
- A rhombus can be a square
- A rectangle has four right angles

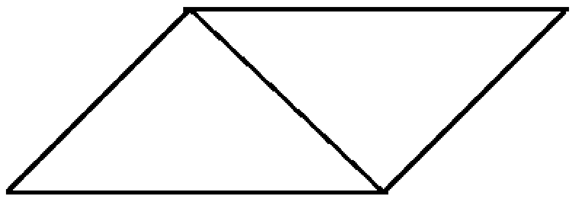
CHAPTER 9: AREA OF PARALLELOGRAMS AND TRIANGLES

1) Area of figure: Area of a figure is a number associated with the part of the plane enclosed by that figure.

2) Properties of Area:
a) Two congruent figures have same area.

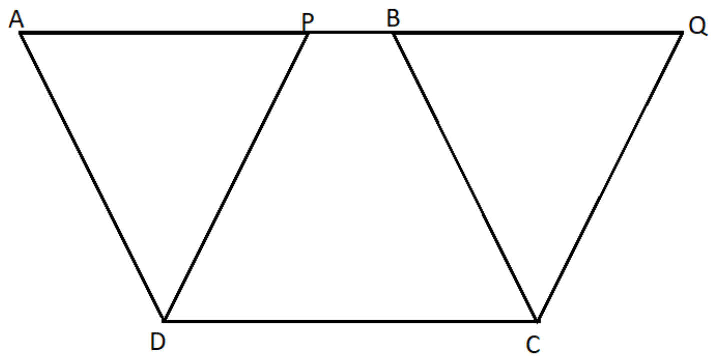
b) If two figures have same area, they are not necessarily congruent.
c) If a planar region formed by a figure T is made up of two non-overlapping planar regions formed by figures P and Q, then ar (T) = ar (P) + ar (Q), where ar (X) denotes the area of figure X.

3) Two figures are said to be on the same base and between the same parallels, if they have a common base and the vertices, opposite to the common base of each figure lies on a line parallel to the base.



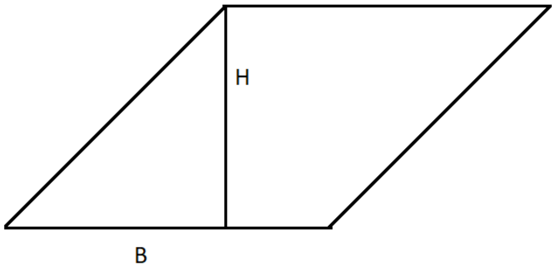
In the above figure triangle and parallelogram are on the same base between same parallel.

4) Parallelograms on the same base (or equal bases) and between the same parallels are equal in area.



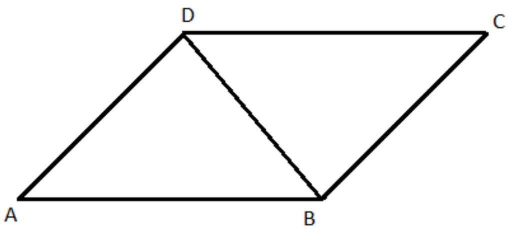
Area of parallelogram ABCD = Area of parallelogram PBCQ

5) Area of parallelogram is equal to the base multiplied by height.



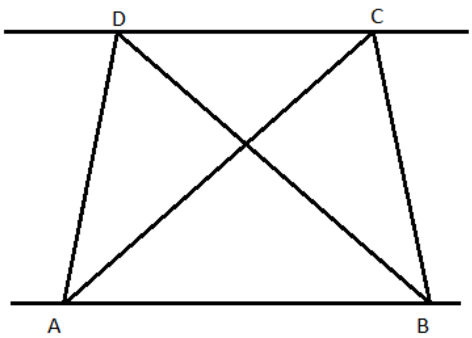
Area of Parallelogram = height × base

6) Triangles and parallelograms:
   - If a parallelogram and triangle are on the same base and between the same parallels, then the area of the triangle is half the area of the parallelogram.



Area of triangle ADB = $\frac{1}{2}$ × Area of
parallelogram ABCD

   - Triangles on the same base (or equal bases) and between the same parallels are equal in area.



Area of triangle ABD = Area
of triangle ACB

7) Area of triangle = $\frac{1}{2}$ × base × height.

CHAPTER 10: CIRCLES

1.A circle is the collection of all points in a plane, which are equidistant from a fixed point in
the plane.
2. Equal chords of a circle (or of congruent circles) subtend equal angles at the centre.
3. If the angles subtended by two chords of a circle (or of congruent circles) at the centre
(corresponding centres) are equal, the chords are equal.
4. The perpendicular from the centre of a circle to a chord bisects the chord.

5. The line drawn through the centre of a circle to bisect a chord is perpendicular to the chord.
6. There is one and only one circle passing through three non-collinear points.
7. Equal chords of a circle (or of congruent circles) are equidistant from the centre (or
corresponding centres).
8. Chords equidistant from the centre (or corresponding centres) of a circle (or of congruent
circles) are equal.
9. 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.
10. Congruent arcs of a circle subtend equal angles at the centre.
11. 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.
12. Angles in the same segment of a circle are equal.
13. Angle in a semicircle is a right angle.
14. 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.
15. The sum of either pair of opposite angles of a cyclic quadrilateral is 180°.
16. If sum of a pair of opposite angles of a quadrilateral is 180°, the quadrilateral is cyclic.

CHAPTER 12: HERON'S FORMULA

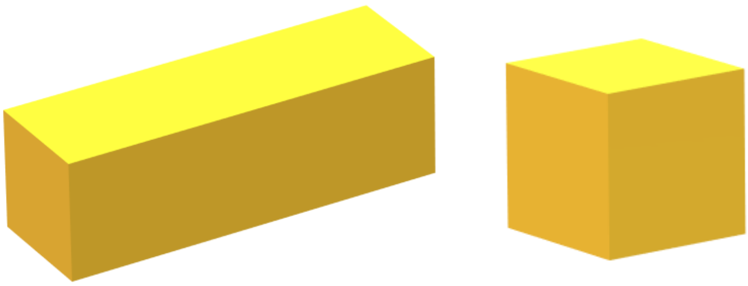
1) Perimeter and area of different figures

Shape	**Perimeter/height**	**Area**
Right angled triangle Base=b, Height =h, Hypotenuse = d	P = b+h+d Height = h	$A = \frac{1}{2}bh$
Isosceles Right angled triangle Equal side = a	$P = 2a - a\sqrt{2}$ Height = a	$A = \frac{1}{2}a^2$
Any triangle of side a,b,c	P=a+b+c	$A = 2\sqrt{s(s-a)(s-b)(s-c)}$ Where $s = \frac{a+b+c}{2}$ This is called Heron's formula.
Square Side=a	P = 4a	$A = a^2$
Rectangle of length and breadth L and B respectively	P = 2L+2B	$A = L \times B$
Parallelogram	P = 2a+2b	A = Base x Height

Two sides are given as a and b		
Rhombus Diagonal d_1 and d_2 are given	$P = 2\sqrt{(d_1^2 + d_2^2)}$	$A = \frac{d_1 d_2}{2}$
Quadrilateral a) All the sides are given a,b,c,d b) Both the diagonal are perpendicular to each other c) When a diagonal and perpendicular to diagonal are given	P = a+b+c+d	$A = \sqrt{(s-a)(s-b)(s-c)(s-d)}$ Where $s = \frac{a+b+c}{2}$ $A = \frac{d_1 d_2}{2}$ where d_1 and d_2 are diagonals $A = \frac{1}{2}dh_1 + \frac{1}{2}dh_2$

CHAPTER 13: Surface Area and Volume

1) Surface Area and Volume of Cube and Cuboid



Type	Measurement
Surface Area of Cuboid of length L, breadth B and height H	2(LB + BH + LH)
Lateral surface area of the cuboid	2(L + B)H
Diagonal of the cuboid	$\sqrt{L^2 + B^2 + H^2}$
Volume of the cuboid	LBH
Length of all 12 edges of the cuboid	4(L + B + H)
Surface area of the cube of side L	$6L^2$
Lateral surface area of the cube	$4L^2$
Diagonal of the cube	$L\sqrt{3}$
Volume of the cube	L^3

2) Surface area and volume of right circular cylinder

Radius(r) - The radius of the circular base is called the radius of the cylinder.

Height(h) - The length of the axis of the cylinder is called the height of the cylinder.

Lateral surface(L) – The curved surface between the two base of the right circular cylinder is called the lateral surface.

Type	Measurement
Curved or lateral surface area of the cylinder	$2\pi rh$
Total surface area of the cylinder	$2\pi r(h + r)$
Volume of the cylinder	$\pi r^2 h$

3) Surface area and volume of right circular cone

Radius(r) - The radius of the circular base is called the radius of the cone

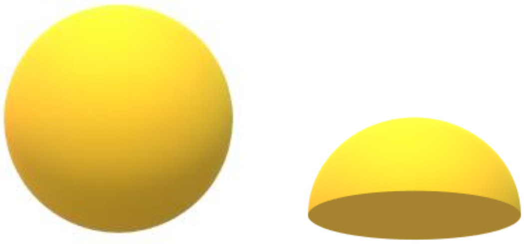
Height(h) - The length of the line joining the vertex to the centre of base is called the height of cone

Slant height(L) – The length of the segment joining the vertex to any point on the circular edge of the base is called the slant height of the cone.

Lateral surface area – The curved surface joining the base and uppermost point of a right circular cone is called Lateral surface.

Type	Measurement
Curved or lateral surface of cone	πrL
Total surface area of cone	$\pi r(L + r)$
Volume of cone	$\frac{1}{3}\pi r^2 h$

4) Surface area and volume of sphere and hemisphere



Sphere – A sphere can also be considered as a solid obtained on rotating a circle about its diameter.
Hemisphere – A plane through the centre of the sphere divides the sphere into two equal parts, each of which is called a hemisphere.
Radius – The radius of the circle by which it is formed.
Spherical shell – The difference of two solid concentric spheres is called a spherical shell.
Lateral surface area – Total surface area of the sphere
Lateral surface area of hemisphere – it is the curved surface area except the circular base.

Type	Measurement
Surface area of sphere	$4\pi r^2$
Volume of sphere	$\frac{4}{3}\pi r^3$
Curved surface area of hemisphere	$2\pi r^2$
Total surface area of hemisphere.	$3\pi r^2$
Volume of hemisphere	$\frac{2}{3}\pi r^3$
Volume of the spherical shell whose outer and inner radii and 'R' and 'r' respectively	$\frac{4}{3}\pi(R^3 - r^3)$

CHAPTER 14: STATISTICS

1) Define the term statistics.
   Statistics is a broad mathematical concept which studies ways to collect, summarize, and draw conclusions from data.

2) Define the term Data.
   A systematic record of facts or different values of quantity is called data. Data can be of two kinds. One is Primary Data. Another one is Secondary Data.
   Primary data: The data collected by researcher with a specific purpose is called primary data. It is known as raw data (data without fabrication and not tailored data). Primary data can be sourced from personal investigation, through questionnaire, through local sources etc.
   Secondary data: The data gathered from a source where it already exists is called secondary data. Data which has already been collected by

someone, may be sorted, tabulated and has undergone a statistical treatment. It is fabricated or tailored data.
Salient Features of Data:

- Statistics deals with collection, presentation, analysis and interpretation of numerical data.
- Arranging data in an order to study their salient features is called presentation of data.
- Data arranged in ascending or descending order is called arrayed data or an array.
- The difference between the maximum and the minimum values of the observation is called the **range of the data.**
- Table that shows the frequency of different values in the given data is called the **frequency distribution table.**
- A frequency distribution table that shows the frequency of each individual value in the given data is called an ungrouped frequency distribution table.
- Class mark of a class is the mid value of the two limits of that class.
- A frequency distribution in which the upper limit of one class differs from the lower limit of the succeeding class is called an Inclusive or discontinuous frequency.
- A frequency distribution in which the upper limit of one class coincides with the lower limit of the succeeding class is called an Exclusive or discontinuous frequency.

3) Bar Graph: It is a pictorial representation of data in which rectangular bars of uniform width are drawn with equal spacing between them on one axis usually the x-axis. The value of the variables will be on the y-axis.

4) Histogram: It is a set of adjacent rectangles whose areas are proportional to the frequencies of a given continuous frequency distribution.

5) Mean: The mean value of a variable is defined as the sum of all the values of the variable divided by the number of values.

$$\overline{x} = \frac{a_1 + a_2 + a_3 + a_4}{4} = \frac{\sum a_i}{n}$$

6) Median**:** The median of a set of data values is the middle value of the data set when it has been arranged in ascending order.

- Median is calculated as

$\frac{1}{2}(n+1)\ observation$

Where n is an odd number.

- Median is calculated as

$\left(\frac{n}{2}\right)th\ \ and\ \ \left(\frac{n}{2}+1\right)th$ observations.
Where, n is an even number.

7) Mode: Mode of a statistical data set is the value of that variable which has the maximum frequency.

CHAPTER 15: PROBABILITY

1) Empirical or experimental probability:
Probability of events, calculated based on experiments.

Empirical probability = $\frac{No.of\ trials\ which\ expected\ outcome}{Total\ no.of\ trials}$

Suppose, a coin is tossed 50times. We get 39times head and 11times tails. So, the probability of getting head is calculated as,
P= $\frac{39}{50}$ = 0.78

Empirical probability depends on experiment and will get different values based on experiment.

2) Important points on Events:
If the event A, B, and C covers the entire possible outcome in the experiment then,
P(A) + P(B) + P(C) = 1

3) What is an Impossible event?
The probability of an event (U) which is impossible to occur is 0. Such an event is called an Impossible event.
P(U) = 0

4) Sure or Certain event:
The probability of an event (X) which is certain to occur is 1. P(X) = 1

5) **Probability of an event will always be**
0 ≤ P(E) ≤ 1

6) Impossible event: If an event is never going to happen then we can describe the probability as an impossible event. For example, the probability of rolling a 7 on an ordinary dice would be impossible.