NAME OF SHAPE

Triangle
Figure enclosed 3 sides as AB, BC, CA and \( \angle A, \angle B, \angle C \) angles
Here, note that sum total of angles (or) sum of total sides will be 180 degrees

(a) Equilateral Triangle
Figure enclosed 3 equal sides as "a" and each angle equal to 60 degrees.

(b) Isosceles Triangle
Figure has any 2 equal sides among 3 sides and altitude(h) drawn to non-equal side to bisects it.

(c) Scalene Triangle
Figure has 3 unequal sides

If Any one angle among 3 angles makes 90 degree, then it is known as Right angled triangle. Here \( \angle C = 90 \) degrees

2D - SHAPE

FORMULAS

1. Area = \( \frac{1}{2} \times \text{base} \times \text{height} \)
2. If \( s = a+b+c/2 \) known, then
   Area = \( \sqrt{s(s-a)(s-b)(s-c)} \)
   \( s = \text{semi-perimeter} \)
3. Perimeter (P) = 2s = a+b+c

1. Area = \( \sqrt{3/4} a^2 \)
   (or) \( \sqrt{\frac{3}{4}} \)
2. Height = \( \sqrt{\frac{3}{2}} \) a
3. Perimeter = 3a

1. Area = \( \frac{b}{4} \sqrt{4a^2 - b^2} \)
2. Height = \( \frac{1}{2} \sqrt{4a^2 - b^2} \)
3. Perimeter = 2a + b

1. Area = \( \sqrt{s(s-a)(s-b)(s-c)} \)
2. Perimeter = a + b + c

1. Area = \( \frac{1}{2} \times \text{base} \times \text{height} \)
2. Perimeter = p + b + h
3. \( h^2 = p^2 + b^2 \)
4. \( h = \sqrt{p^2 + b^2} \)
**Quadrilaterals**

**(a) Square**
If parallelogram has its 4 sides are equal is known as Square

1. Area = side x side = a^2 
   (or) = 1/2 d^2 
   (Here d= diagonal of square)
2. diagonal (d) = \sqrt{2}a
   If Area(A) given, then d=\sqrt{2}A
   If Perimeter (P) given, then 
   d= P/2 \sqrt{2}
3. Perimeter (P)= 4 x side 
   =4 a
   If Area(A) given, then 
   P = \sqrt{16 x A} 
   = 2 \sqrt{2} \ d

**(b) Rectangle**
If parallelogram has its opposite sides are equal and each angles makes 90 degrees known as Rectangle

1. Area = length x breadth 
   = l x b
2. Perimeter (P) = 2 (l+b)
3. Diagonal (d)=\sqrt{l^2 + b^2}

**(c) Parallelogram**
If a quadrilateral has parallel opposite sides, then it is called as Parallelogram.

1. Area = 1/2 x base x height 
   = 1/2 x b x h
2. Perimeter (P) = 2 (a+b)

**Isosceles Right Angled Triangle**
If triangle has 2 equal sides along with side makes right angle (90 degrees) is known as Isosceles Right angled Triangle.

1. Area = 1/2 x a^2
2. Perimeter = a+a+p 
   = 2a +p
(d) Trapezium

If a quadrilateral has one pair of parallel opposite sides is called as Trapezium

1. Area = \( \frac{1}{2} \) (sum of parallel sides x Height)
   \[ = \frac{1}{2} (a+b) \times h \]
   \( \text{OR} \)
   \[ \text{Area} = a+b/k \sqrt{(s-k)(s-c)(s-d)} \]
   \[ k = a-b \]
   \[ s = k+c+d/2 \]
   (when the lengths of parallel and non parallel sides are given.)

2. Perimeter (P) = AB + BC + CD + DA

3. Perpendicular distance between two parallel sides
   \[ = 2/k \sqrt{(s-k)(s-c)(s-d)} \]

(e) Rhombus

If a parallelogram has 4 equal sides and equal opposite angles, but not right angles.

1. Area = \( \frac{1}{2} \) x (product of two diagonals)
   \[ = \frac{1}{2} \times d1 \times d2 \]

2. Perimeter (P) = 4a

3. Side (a) = \( \frac{1}{2} \sqrt{d1^2 + d2^2} \)
   \( \text{or} \)
   \[ 4a^2 = d1^2 + d2^2 \]
   Here a = side;
   d1 and d2 = diagonals.

(e) Regular Polygon

If figure has more than 4 sides, then it is called as polygon. If all sides and interior angles are equal, then it is called as regular polygon.

Ex: 5 sides = Pentagon
6 sides = Hexagon
7 sides = Heptagon
8 sides = Octagon
9 sides = Nanogon
10 sides = Decagon

1. Area of regular pentagon = \( 5a^2 \sqrt{\frac{3}{4}} \)

2. Area of regular Hexagon = \( 6a^2 \sqrt{3/4} \)

3. Area of regular octagon = \( 2 (\sqrt{2}+1) a^2 \)

4. Each exterior angle = 360 degrees/n

5. Number of diagonals = \( n(n-1)/2 \) - n

6. Each interior angle = 180 degree - Exterior angle

The formula for calculating the sum of interior angles is:
\[ (n - 2) 180 \times (\text{where n is the number of sides}) \]
(a) Circle

A plane figure enclosed by a line on which every point is equidistant from a fixed point of center inside the curve is called as circle.

\[ r = \text{radius}; \]
\[ \theta = \text{Angle at center between two radii} \]
\[ O = \text{center} \]
\[ L = \text{Arc Length} \]

1. Area = \( \pi r^2 \)
2. Circumference = \( 2\pi r \)
3. Diameter = 2r
4. Length of arc (L) = \( \pi \theta / 180 \)
5. Area of sector AOB = \( \pi r^2 \theta / 360 \)

Note: Sector = area of circle between two radii

(b) Semi Circle

A circle when separated into two parts along its diameter, then each half part is known as semi-circle.

1. Area of semi circle = \( 1/2\pi r^2 \)
2. Perimeter = \( 2r + \pi r \)

(C) Circular Ring

A circular ring which has inner ring surface and outer ring surface and has two radii respectively "r" and "R".

1. Area of semi circle = \( \pi (R^2 - r^2) \)
2. Difference in circumference of both rings = \( 2\pi R - 2\pi r \) = \( 2\pi (R-r) \)
Miscellaneous Formulas

- If the length and breadth of a rectangle are increased by \(x\%\) and \(y\%\) respectively, the area will be increased by \((x+y+xy/100)\%\)
  
  **Note:** If any value of sides decreased, then put ".-" value in the formula.

- If all the sides of any 2D figure are changed by \(a\%\), then the area will be changed by \((2a +a^2/100)\%\).
  
  **Note:** For circle diameter or radius changed instead of sides.

- If all the measuring sides of any 2D figure are either increased or decreased by \(x\%,\) then its perimeter also changes by \(x\%\),
  
  **Note:** For circle diameter or radius changed instead of sides.

- If the area of the square is \(a^2\) unit, then the area of the circle formed by the same perimeter.

- Area of a square inscribed in a circle of radius "\(r\)" is equal to \(2r^2\).

- The area of the largest triangle inscribed in a semi-circle of radius "\(r\)" is equal to \(r^2\).

- The length and breadth of a rectangle are "\(l\)" and "\(b\)", then the area of the circle of maximum radius inscribed in that the rectangle is \(\pi b^2/4\).

- If pathway of width \(x\) is made inside or outside a rectangular plot of length "\(l\)" and breadth "\(b\)", then
  
  the area of the pathway is

  (i) If the path is made outside of the plot, the formula for area is \(2x\ (l+b+2x)\).
  
  (ii) If the path is made inside of the plot, the formula for area is \(2\ x\ (l+b-2x)\).

- If two paths, each one's width '\(x\)' are made parallel to length (l) and breadth (b) of the rectangular plot in the middle of the plot, then the area of the paths is \(x(l+b-x)\)

- The length increases \(x\%\) and breadth decreases \(x\%\) and not to change in area = \(100x/100+x\ %\)

- If any side of 2D figure changed by \(X\%\) then change in area = \(x(2+x/100) \%\).

- If sides of 2D figure either increased or decreased, then \(P\) also either increased or decreased respectively.

- If the ratio of areas of 2 squares be \(a:b\), then
  
  The ratio of their sides,

  The ratio of their perimeters,

  The ratio of their diagonals = \(\sqrt{a} : \sqrt{b}\)

- If diagonal of square increases \(x\) times, the area of square \(x^2\) times.
**NAME**

**3D- SHAPE**

**FORMULAS**

### Cube

If a solid body has 6 equal faces with equal length, breadth and height, then that solid body is called as cube which is exactly in square shape of 3D structure.

![Cube Diagram]

- Volume of Cube = $a^3$
- Lateral surface area of the cube = $4a^2$
- Total surface area of cube = $6a^2$
- Diagonal of the cube = $\sqrt{3}a$

### Cuboid

If a solid body has 6 faces and in rectangular shape of 3D structure, it is called as Cuboid.

(l= length, w= breadth/width, h = height, d = diagonal)

![Cuboid Diagram]

- Volume of Cuboid = $lwh$
- Lateral surface area of the cuboid = $2(l+b)h$
- Total surface area of cube = $2(lb+lh+hl)$
- Diagonal of the cube = $\sqrt{l^2 + b^2 + h^2}$

### Rectangular Room

A room which is in rectangular shape and has 4 walls and opposite walls have equal areas.

(l= length, w= breadth/width, h = height, d = diagonal)

![Rectangular Room Diagram]

- Volume of room = $lwh$
- Total area of the walls = $2(l+b)h$
- Area of floor or roof= $l \times b$

### Box

A box like cube or cuboid in shape. capacity is the internal volume.

(t = thickness of box, l = length, w= breadth/width, h = height, d = diagonal)

![Box Diagram]

- Surface area of an open box= $2(lb+lh+hl)$
- Capacity of box $= (l-2t)(b-2t)(h-2t)$
Cylinder

A cylinder is a solid or hollow body and it is formed by keeping of circles of equal radii one upon another. It can also formed by rolling a rectangular sheet.
where
R= External radius
r= radius
h= height

![Cylinder Diagram]

Solid Cylinder
1. Volume of cylinder = Area of base x height
   \[ = \pi r^2 h \]
2. Curved Surface area = perimeter of base x height
   \[ = 2\pi rh \]
3. Total surface area = Curved surface area + Area of both top surface and bottom base
   \[ = 2\pi rh + \pi r = 2\pi r (r+h) \]

Hollow Cylinder
1. Volume of hollow cylinder = Outer volume - Inner volume
   \[ = \pi h (R^2 - r^2) \]
2. Curved Surface area = curved surface area of outer surface + curved surface area of inner surface
   \[ = 2\pi h (R+r) \]
3. Total surface area of hollow cylinder = Curved surface area + Area of both top surface and bottom base
   \[ = 2\pi h (R+r) + 2(R^2 - r^2) \]

Cone

It is either hollow or solid body with a circular base and pointed top.
where
l = slant height
d= diameter
r= radius
h= height

![Cone Diagram]

1. Volume of cone
   \[ = \frac{1}{3} \times \text{base area} \times \text{height} = \frac{1}{3} \times \pi r^2 h \]
2. Slant height \( l = \sqrt{h^2 + r^2} \)
3. curved surface area
   \[ = \pi r \sqrt{r^2 + l^2} = \pi rl \]
4. Total surface area=
   curved surface area + area of base
   \[ = \pi rl + \pi r^2 = \pi r(l+r) \]
Frustum of Cone

If pointed top of cone cut as parallel to base, the resultant lower part of cone is called as frustum.
where
\[ \begin{align*}
L &= \text{slant height} \\
d &= \text{diameter} \\
r &= \text{radius of top} \\
R &= \text{radius of base} \\
h &= \text{height}
\end{align*} \]

1. Volume of cone
\[ V = \frac{\pi h}{3} \left( r^2 + R^2 + \frac{1}{2} r R \right) \]
2. Slant height \( L = \sqrt{h^2 + (R - r)^2} \)
3. Curved surface area
\[ A = \pi\left( r + R \right) \]
4. Total surface area
\[ A = \pi\left\{ \left( r + R \right) + r + R \right\} \]

Sphere

This is a 3d circular solid/hollow shape. All points on its space have constant distance from fixed center point.
\[ \begin{align*}
d &= \text{diameter} \\
r &= \text{radius}
\end{align*} \]

1. Volume of sphere
\[ V = \frac{4}{3} \pi r^3 \]
2. Total surface area
\[ A = 4\pi r^2 \]

Hollow Sphere (or) Spherical shell

1. Volume of hollow sphere
\[ V = \frac{4}{3} \pi (R^3 - r^3) \]
2. Internal surface area
\[ A = 4\pi r^2 \]
3. External surface area
\[ A = 4\pi R^2 \]

Hemisphere

This is a half part of sphere.
\[ r = \text{radius} \]

1. Volume of hemisphere
\[ V = \frac{2}{3} \pi R^3 \]
2. Total surface area
\[ A = 3\pi r^2 \]
3. Curved surface area
\[ A = 2\pi r^2 \]

Prism

This is a structure whose top and bottom faces are parallel to each other and these are identical polygons. Top and bottom faces are rectangles and are called lateral faces. The distance between top and base is called as height or length of the prism.

1. Volume of Prism
\[ V = \text{Area of base} \times \text{height of prism} \]
2. Lateral surface area
\[ A = \text{perimeter of base} \times \text{height of prism} \]
3. Total surface area
\[ A = \text{Lateral surface area} + 2(\text{Area of base}) \]
Pyramid
A solid whose base is a polygon and whose faces are triangles is called pyramid.

1. Volume of Pyramid
   \[ V = \frac{1}{3} \times \text{area of base} \times \text{height} \]

2. Lateral surface area
   \[ A = \frac{1}{2} \times \text{perimeter of base} \times \text{slant height} \]

3. Total surface area
   \[ S = \text{Lateral surface area} + \text{Area of the base} \]

- Radius of bigger sphere formed by mixing of 'n' smaller spheres having radius 'r' is
  \[ R = \sqrt[3]{n} \]

- By melting of bigger sphere formed 'n' number of smaller spheres
  \[ n = \frac{\text{Volume of bigger sphere}}{\text{volume of smaller spheres}} \]
  \[ n = \left( \frac{R}{r} \right)^3 \]