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Affiliated to CBSE up to +2 Level

Class: 9<sup>th</sup>

Subject: Mathematics

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## Mensuration (3-D Shape)

What are the properties of different 3D shapes?

All three-dimensional shapes are different but have three primary properties in common. These main 3D shape properties include:

- **Faces:** A face is a flat or curved surface on a 3D shape. For example, a cube has six faces, a cylinder has three and a sphere has just one.
- **Edges:** An edge is where two faces meet. For example, a cube has 12 edges, a cylinder has two and a sphere has none.
- **Vertices:** A vertex is a corner where edges meet. The plural is vertices. For example, a cube has eight vertices, a cone has one vertex and a sphere has none.

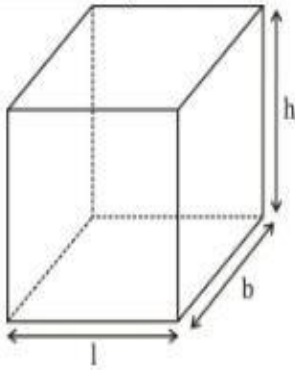
### Surface area and volume of 3D shapes

Here we are going to examine the formulas and how to calculate the surface area and volume of 3D shapes.

Surface area of an object is determined by the area occupied by an object. The surface area is measured in square units. It consists of three types of surface area

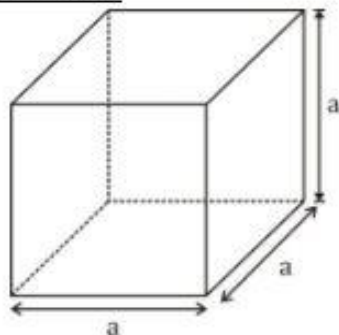
1. **Curved surface area (CSA):** Curved surface area is the area of space covered by all the curved regions.
2. **Lateral surface area (LSA):** Lateral surface area is the area of all the curved surface regions and the flat surface regions except the base of an object.
3. **Total surface area (TSA):** Total surface area is the area of all the regions including the base of 3D object.
4. **Volume:** Volume of a three-dimensional shape is defined as the total space occupied by the objects or solid shape. It is denoted as V. It is measured in cubic units.

## 1. Cuboid →



- Volume of cuboid =  $l \times b \times h$
- Lateral surface Area = Perimeter of Base  $\times$  Height Base =  $2(l + b) \times h$
- Total surface area = Lateral surface Area +  $2 \times$  Area of base =  $2(lh + bh + lb)$
- Diagonal =  $\sqrt{l^2 + b^2 + h^2}$
- $V = \sqrt{A_1 \times A_2 \times A_3}$ 
  - $A_1 \Rightarrow$  Area of base or top =  $lb$
  - $A_2 \Rightarrow$  Area of one side face =  $bh$
  - $A_3 \Rightarrow$  Area of another side face =  $hl$
- To find the total surface area of a cuboid if the sum of all three sides and diagonals are given.  
Total surface area = (sum of all three side)<sup>2</sup> - (Diagonal)<sup>2</sup>
- For painting the surface area of a box or to know how much tin sheet is required, we will use, Total surface area.
- To find the length of the longest pole to be placed in a room, we will calculate diagonal i.e.  $\sqrt{l^2 + b^2 + h^2}$

## 2. Cube →



- Volume = (side)<sup>3</sup> =  $a^3$
- Lateral surface area =  $4a^2$
- Total surface area =  $6a^2$
- Diagonal of the cube =  $\sqrt{3} a$
- Face diagonal of the cube =  $\sqrt{2} a$
- Volume of cube =  $\left( \sqrt{\frac{\text{total surface area}}{6}} \right)^3$
- In Radius of cube =  $\frac{a}{2}$
- Circumradius of cube =  $\frac{\sqrt{3}}{2} a$