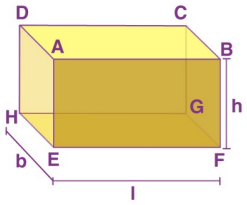
Chapter- 13

SURFACE AREAS AND VOLUMES

STUDY NOTES

The surface area of a cuboid is equal to the sum of the areas of its six rectangular faces. Consider a cuboid whose dimensions are l × b × h, respectively.



Cuboid with length *l*, breadth b and height h

The total surface area of the cuboid (TSA) = Sum of the areas of all its six faces

TSA (cuboid) = 2(l × b) + 2(b × h) + 2(l × h) = 2(lb + bh + lh)

Lateral surface area (LSA) is the area of all the sides apart from the top and bottom faces.

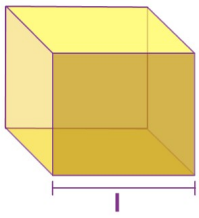
The lateral surface area of the cuboid = Area of face AEHD + Area of face BFGC + Area of face ABFE + Area of face DHGC

LSA (cuboid) = 2(b × h) + 2(l × h) = 2h(l + b)

Length of diagonal of a cuboid =$\sqrt{l^2 + b^2 + h^2}$.

Cube and its Surface Area

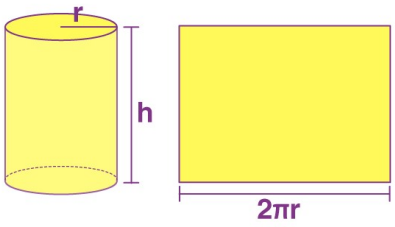
For a cube, length = breadth = height



Cube with length *l*
TSA (cube) =2 × (3l2) = $6l^2$
Similarly, the Lateral surface area of cube = $2(l \times l + l \times l) = 4l^2$
Note: Diagonal of a cube =√3l

Cylinder and its Surface Area

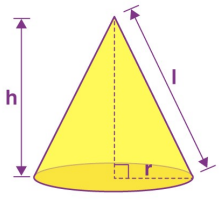
Take a cylinder of base radius *r* and height *h* units. The curved surface of this cylinder, if opened along the diameter (*d* = 2*r*) of the circular base can be transformed into a rectangle of length 2πr and height *h* units. Thus,



Transformation of a Cylinder into a rectangle.
CSA of a cylinder of base radius *r* and height h = 2π × r × h
TSA of a cylinder of base radius *r* and height h = 2π × r × h + area of two circular bases
$=2\pi \times r \times h + 2\pi r^2$
$=2\pi r(h + r)$

Right Circular Cone and its Surface Area

Consider a right circular cone with slant length *l*, radius *r* and height *h*.



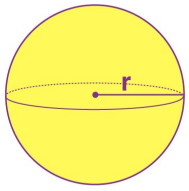
Cone with base radius r and height h

CSA of right circular cone = πrl
TSA = CSA + area of base = $\pi rl + \pi r^2 = \pi r(l + r)$

Sphere and its Surface Area

For a sphere of radius *r*

Curved Surface Area (CSA) = Total Surface Area (TSA) = $4\pi r^2$



Sphere with radius r

Volume of a Cuboid

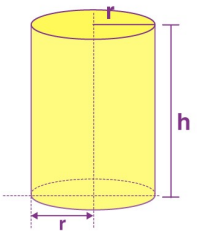
Volume of a cuboid = (base area) × height = (lb)h = lbh

Volume of a Cube

Volume of a cube = base area × height
Since all dimensions of a cube are identical, volume = l^3
Where *l* is the length of the edge of the cube.

Volume of a Cylinder

Volume of a cylinder = Base area × height = $(\pi r^2) \times h = \pi r^2 h$



Cylinder with height h and base radius r

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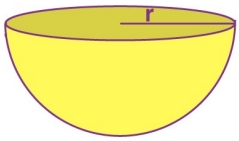
Volume of a Right Circular Cone

The volume of a Right circular cone is 1/3 times that of a cylinder of same height and base.
In other words, 3 cones make a cylinder of the same height and base.
The volume of a Right circular cone $=(1/3)\pi r^2 h$
Where *r* is the radius of the base and *h* is the height of the cone.

The volume of a Sphere

The volume of a sphere of radius $r = (4/3)\pi r^3$

Hemisphere and its Surface Area



Hemisphere of radius r

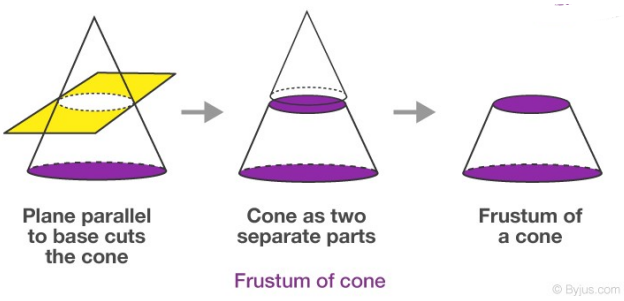
We know that the CSA of a sphere $= 4\pi r^2$.

A hemisphere is half of a sphere.
∴ CSA of a hemisphere of radius $r = 2\pi r^2$
Total Surface Area = curved surface area + area of the base circle
⇒TSA $= 3\pi r^2$

Volume of Hemisphere

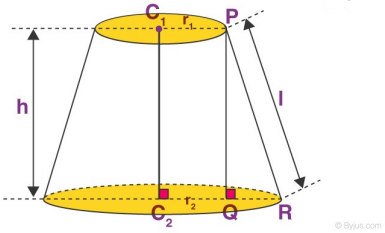
The volume (V) of a hemisphere will be half of that of a sphere.
∴ The volume of the hemisphere of radius $r = (2/3)\pi r3$

Frustum of a Cone



If a right circular cone is sliced by a plane parallel to its base, then the part with the two circular bases is called a Frustum.

Surface Area of a Frustum



Frustum with radius r1 and r2 and height h

CSA of frustum $=\pi(r1+r2)l$, where $l= \sqrt{[h^2+(r2 - r1)^2]}$

TSA of the frustum is the CSA + the areas of the two circular faces
$= \pi(r1 + r2)l + \pi(r_1^2 + r_2^2)$

Volume of a Frustum

The volume of a frustum of a cone $=(1/3)\pi h(r_1^2 + r_2^2 + r1r2)$