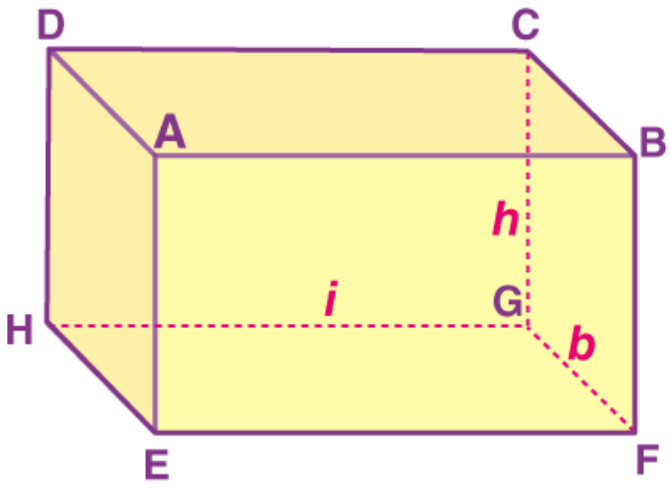
Surface Areas and Volumes

Cuboid

A cuboid is a three-dimensional Shape. The cuboid is made of six rectangular faces, which are placed at right angles. The total surface area of a cuboid is equal to the sum of the areas of its six rectangular faces.

Total Surface Area of a Cuboid



Consider a cuboid whose length is "*l*" cm, breadth is *b* cm and height *h* cm.

Area of face ABCD = Area of Face EFGH = ($l \times b$) cm^2

Area of face AEHD = Area of face BFGC = ($b \times h$) cm^2

Area of face ABFE = Area of face DHGC = ($l \times h$) cm^2

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

$= 2(l \times b) + 2(b \times h) + 2(l \times h)$

TSA (cuboid)$= 2(lb + bh + lh)$

Lateral Surface Area of a Cuboid

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

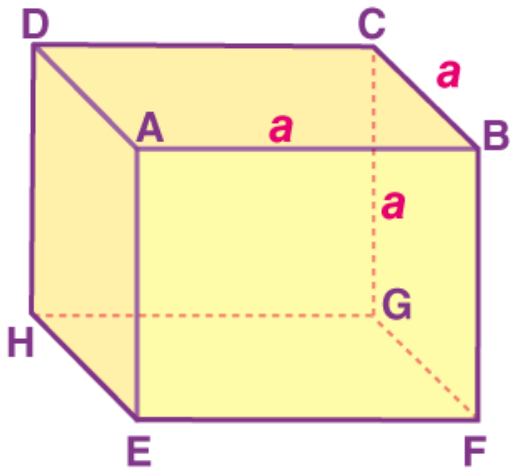
= 2(b × h) + 2(l × h)

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

Cube

A cuboid whose length, breadth and height are all equal is called a cube. It is a three-dimensional shape bounded by six equal squares. It has 12 edges and 8 vertices.

Total Surface Area of a Cube



For cube, length = breadth = height

Suppose the length of an edge = a

Total surface area(TSA) of the cube = $2(a \times a + a \times a + a \times a)$

TSA(cube) = $2 \times (3a^2) = 6a^2$

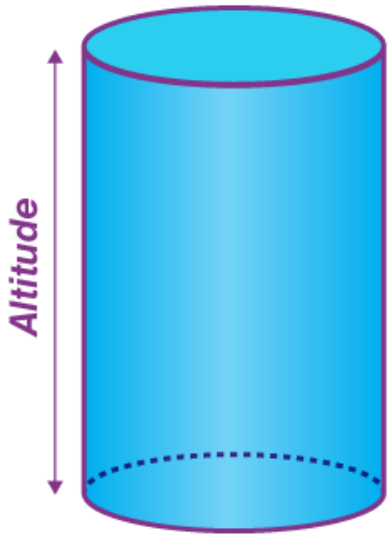
Lateral Surface Area of a Cube

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

Lateral surface area of cube = $2(a \times a + a \times a) = 4a^2$

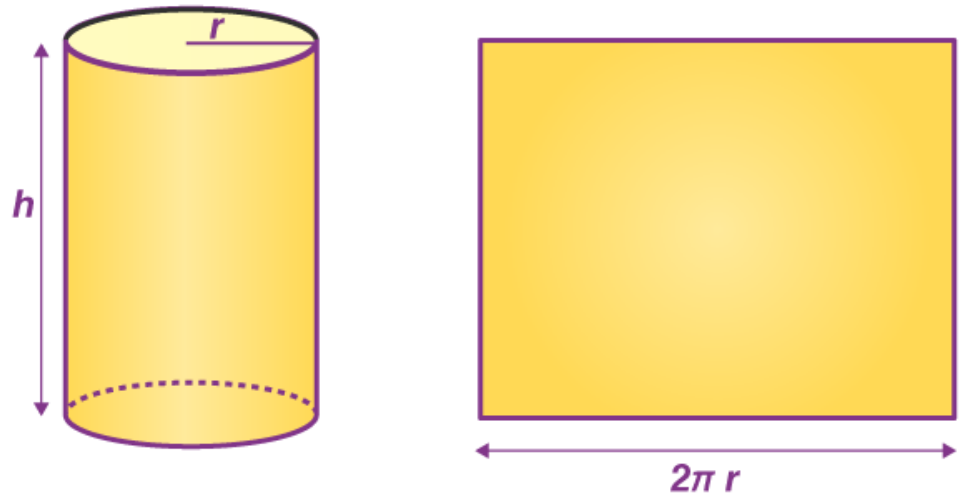
Right Circular Cylinder

A right circular cylinder is a closed solid that has two parallel circular bases connected by a curved surface in which the two bases are exactly over each other and the axis is at right angles to the base.



Curved Surface Area of a Right Circular Cylinder

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



Curved surface area(CSA) of a cylinder of base radius r and height $h = 2\pi \times r \times h$

Total Surface Area of a Right Circular Cylinder

Total surface area(TSA) of a cylinder of base radius r and height $h = 2\pi \times r \times h$ + area of two circular bases

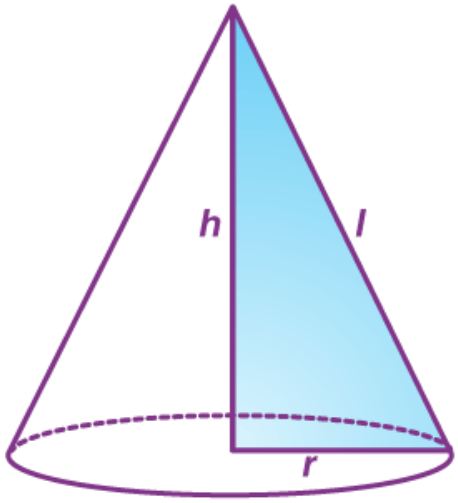
$\Rightarrow$ TSA $= 2\pi \times r \times h + 2 \times \pi r^2$

$\Rightarrow$ TSA $= 2\pi r(h + r)$

Right Circular Cone

A right circular cone is a circular cone whose axis is perpendicular to its base.

Relation between Slant Height and Height of a Right Circular Cone



The relationship between slant height(l) and height(h) of a right circular cone is:

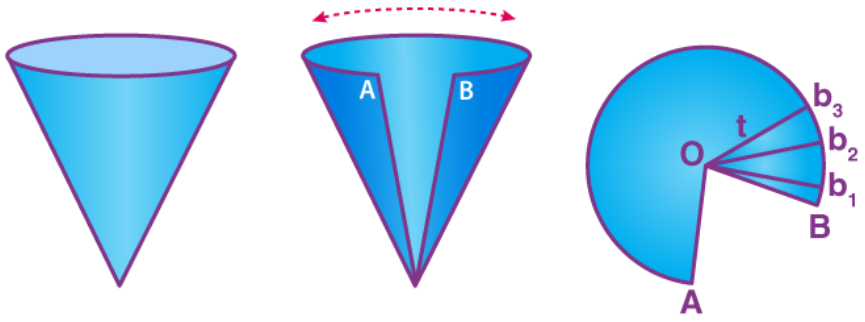
$l^2 = h^2 + r^2$ (Using Pythagoras Theorem)

Where r is the radius of the base of the cone.

Curved Surface Area of a Right Circular Cone

Consider a right circular cone with slant length l and radius r.

If a perpendicular cut is made from a point on the circumference of the base to the vertex and the cone is opened up, a sector of a circle with radius l is produced, as shown in the figure below:



Label A and B and corresponding b_1, b_2 ...b_n at equal intervals, with O as the common vertex. The Curved surface area(CSA) of the cone will be the sum of the areas of the small triangles: $1/2 \times (b_1 + b_2.....b_n) \times l$

(bl + b2...bn) is also equal to the circumference of base = $2\pi r$

CSA of right circular cone = $(1/2) \times (2\pi r) \times l = \pi rl$ (On substituting the values)

Total Surface Area of a Right Circular Cone

Total surface area(TSA) = Curved surface area(CSA) + area of base = $\pi rl + \pi r2 = \pi r(l + r)$

Sphere

A sphere is a closed three-dimensional solid figure, where all the points on the surface of the sphere are equidistant from the common fixed point called "centre". The equidistant is called the "radius".

Surface Area of a Sphere

The surface area of a sphere of radius r = 4 times the area of a circle of radius $r = 4 \times (\pi r2)$

For a sphere Curved surface area (CSA) = Total Surface area(TSA) = $4\pi r2$

Surface Area Formulas

Shapes	Surface Areas

Cuboid	$2(lb + bh + hl)$
Cube	$6a^2$
Right Circular Cylinder	$2\pi r(r + h)$
Right Circular Cone	$\pi r(l + r)$, $(l^2 = h^2 + r^2)$
Sphere	$4 \pi r^2$

Volume of a Cuboid

The volume of a cuboid is the product of its dimensions.

Volume of a cuboid = length × breadth × height= lbh

Where l is the length of the cuboid, b is the breadth, and h is the height of the cuboid.

Volume of a Cube

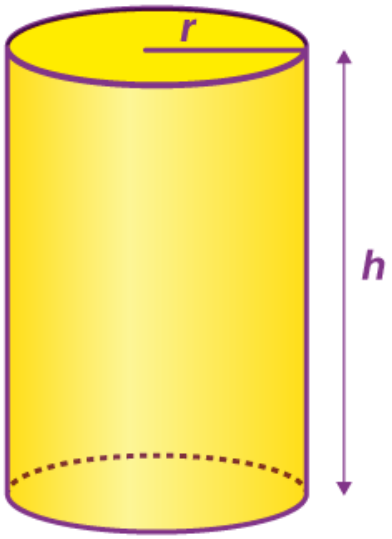
The volume of a cube = base area × height.

Since all dimensions are identical, the volume of the cube = $a3$

Where a is the length of the edge of the cube.

Volume of a Right Circular Cylinder

The volume of a right circular cylinder is equal to base area × its height.



The volume of a cylinder $=\pi r^2 h$

Where r is the radius of the base of the cylinder and h is the height of the cylinder.

Volume of a Right Circular Cone

The volume of a Right circular cone is 1/3 times the volume of a cylinder with the same radius and height. In other words, three cones make one cylinder of the same height and base.

The volume of right circular cone $= (1/3)\pi r^2 h$

Where r is the radius of the base of the cone and h is the height of the cone.

Volume of a Sphere

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

To know more about Volume Formulas for Different Geometric Shapes, visit here.

Volume Formulas

Shapes	Volumes
Cuboid	length × breadth × height
Cube	a^3
Right Circular Cylinder	$\pi r^2 h$
Right Circular Cone	$\frac{1}{3} \pi r^2 h$
Sphere	$4/3\ \pi\ r^3$

Volume and Capacity

The volume of an object is the measure of the space it occupies, and the capacity of an object is the volume of substance its interior can accommodate. The unit of measurement of either volume or capacity is a cubic unit.