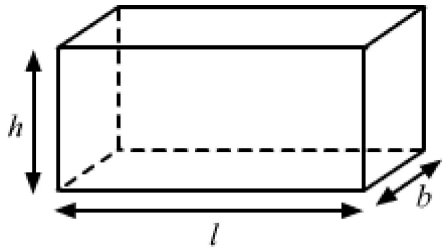
16. Surface area and volume

- **Surface areas of cuboid:**



Lateral surface area of the cuboid = $2h\ (l + b)$

Total surface area of the cuboid = $2\ (lb + bh + hl)$

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

Example:

Find the edge of a cube whose surface area is 294 m^2.

Solution:

Let the edge of the given cube be a.

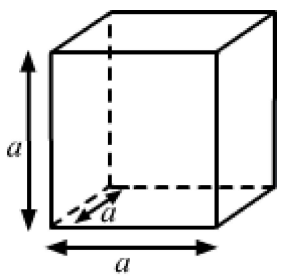
$\therefore$ Surface area of the cube = $6a^2$

Given, $6a^2 = 294$

$\Rightarrow a^2 = 49\ m^2$

$\therefore a = \sqrt{49}\ m = 7\ m$

- **Surface areas of cube:**



Lateral surface area of the cube = $4a^2$

Total surface area of the cube = $6a^2$

Note: Length of the diagonal of a cube = $\sqrt{a^2+a^2+a^2} = \sqrt{3a^2} = \sqrt{3}a$

- **Volume of cube and cuboid**
  - Volume of cube = a^3, where a is the side of the cube
  - Volume of cuboid = $l \times b \times h$, where l, b and h are respectively the length, breadth and height of the cuboid.

Example:

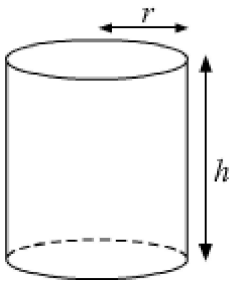
What is the side of a cube of volume 512 cm^3?

Solution:

Volume of cube = 512 cm^3

$$\Rightarrow a^3 = 512\,\text{cm}^3$$
$$\Rightarrow a = \sqrt[3]{512}\,\text{cm}^3$$
$$\Rightarrow a = 8\,\text{cm}$$

- **Surface areas of solid cylinder**
  - Curved surface area = $2\pi rh$, where r and h are the radius and height
  - Total surface area = $2\pi r\,(r + h)$, where r and h are the radius and height



Example :

What is the curved surface area of a cylinder of radius 2 cm and height 14 cm?

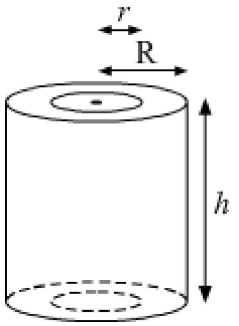
Solution:

Curved surface area of cylinder = $2\pi rh$

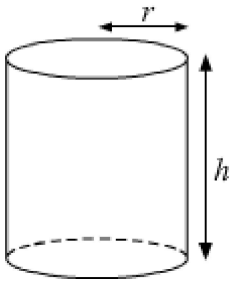
$$= 2 \times \frac{22}{7} \times 2 \times 14\,\text{cm}^2$$
$$= 176\,\text{cm}^2$$

- **Surface areas of hollow cylinder**
  - Curved surface area = $2\pi h\,(r + R)$, where r, R and h are the inner radius, outer radius and height
  - Total surface area = CSA of outer cylinder + CSA of inner cylinder + 2 × Area of base

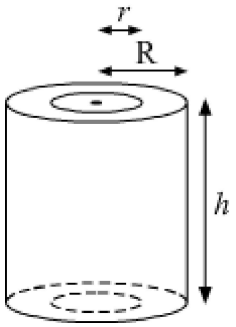
    $= 2\pi\,(r + R)\,(\text{h} + \text{R} - r)$, where r, R and h are the inner radius, outer radius and height



- **Volume of the solid cylinder and hollow cylinder**
  - Volume of solid cylinder = $\pi r^2 h$, where r and h are the radius and height of the solid cylinder



  - Volume of the hollow cylinder = $\pi (R^2 - r^2) h$, where r, R and h are the inner radius, outer radius and height of hollow cylinder



Example:

Find the volume of the pillar of radius 70 cm and height 10 m.

Solution:

Radius of the pillar (r) = 70 cm = $\frac{70 \text{ m}}{100}$ = 0.7 m

Height of the pillar (h) = 10 m

$$\text{Volume of the pillar} = \pi r^2 h$$

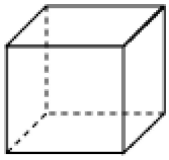
$$= \frac{22}{7} \times (0.7)^2 \times 10 \text{ m}^3$$

$$= 15.4 \text{ m}^3$$

- For any polyhedron, F + V – E = 2, where F is the number of faces, V is the number of vertices and E is the number of edges.

  This relationship is called Euler's formula.

  Example: Verify Euler's formula for the given solid.



  Solution:

  The given figure is a cube.

  We have

  Number of vertices, V = 8

  Number of edges, E = 12

  Number of faces, F = 6

  Thus, F + V – E = 6 + 8 – 12 = 14 – 12 = 2

  Hence, Euler's formula is verified.