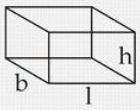
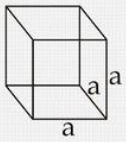
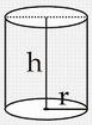
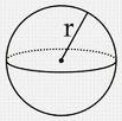
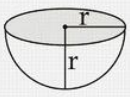
Volume and Surface Area of Solids

Understanding of Volume and Surface Area of Solids

- Solids are three-dimensional objects having length, breadth, and height.
- Volume is the amount of space occupied by a solid and is expressed in cubic units like cm^3, m^3.
- Surface Area is the total area of the outer surface of a solid and is expressed in square units like cm^2, m^2.
- Different solids like cube, cuboid, cylinder, cone, sphere, and hemisphere have different formulas for volume and surface area.

Name of the solid	Figure	Volume	Laterial/Curved Surface Area	Total Surface Area
Cuboid		lbh	$2lh + 2bh$ or $2h(l+b)$	$2lh+2bh+2lb$ or $2(lh+bh+lb)$
Cube		a^3	$4a^2$	$4a^2+2a^2$ or $6a^2$
Right circular cylinder		$\pi r^2 h$	$2\pi rh$	$2\pi rh + 2\pi r^2$ or $2\pi r(h+r)$
Right circular cone		$\frac{1}{3}\pi r^2 h$	πrl	$\pi rl + \pi r^2$ or $\pi r(l+r)$
Sphere		$\frac{4}{3}\pi r^3$	$4\pi r^2$	$4\pi r^2$
Hemisphere		$\frac{2}{3}\pi r^3$	$2\pi r^2$	$2\pi r^2+\pi r^2$ or $3\pi r^2$

Important Points

- Volume of cube = side³
- Surface area of cube = 6 × side²
- Volume of cuboid = length × breadth × height
- Surface area of cuboid = 2(lb + bh + hl)
- Volume of cylinder = $\pi r^2 h$
- Surface area of cylinder = $2\pi r(h + r)$
- Volume of cone = $\frac{1}{3}\pi r^2 h$
- Surface area of cone = $\pi r(l + r)$ where l is slant height
- Volume of sphere = $\frac{4}{3}\pi r^3$
- Surface area of sphere = $4\pi r^2$

Examples with Solutions

Example: Volume and Surface Area of a Cube

➢ **Find the volume and surface area of a cube of side 4 cm.**

Solution: Volume = $4^3 = 64$ cm³, Surface Area = $6 \times 4^2 = 6 \times 16 = 96$ cm²

Example: Volume and Surface Area of a Cuboid

➢ **Find the volume and surface area of a cuboid of length 5 cm, breadth 3 cm, and height 2 cm.**

Solution: Volume = $5 \times 3 \times 2 = 30$ cm³,

Surface Area $= 2(5 \times 3 + 3 \times 2 + 2 \times 5)$

$= 2(15 + 6 + 10)$

$= 2(31) = 62$ cm²

Example: Volume and Surface Area of a Cylinder

➢ **Find the volume and surface area of a cylinder of radius 3 cm and height 7 cm. Take $\pi = \frac{22}{7}$.**

Solution: Volume = $\pi r^2 h = \frac{22}{7} \times 3 \times 3 \times 7 = 198$ cm³,

Surface Area $= 2\pi r(h + r) = 2 \times \frac{22}{7} \times 3 \times (7 + 3)$

$= 2 \times \frac{22}{7} \times 3 \times 10$

$= \frac{660}{7} \approx 94.29\ cm^2$

Example: Volume and Surface Area of a Cone

➢ **Find the volume and surface area of a cone with radius 4 cm, height 9 cm. Take π = 3.14.**

Solution: Slant height l = $\sqrt{4^2 + 9^2}$

$= \sqrt{16 + 81}$

$= \sqrt{97} \approx 9.8\ cm$

Volume = $\frac{1}{3}\pi r^2 h = \frac{1}{3} \times 3.14 \times 4 \times 4 \times 9$

$= \frac{1}{3} \times 3.14 \times 16 \times 9$

$= 150.72\ cm^3$

Surface Area = πr(l + r) = 3.14 × 4 × (9.8 + 4)

= 3.14 × 4 × 13.8

= 173.28 cm^2

Example: Volume and Surface Area of a Sphere

➢ **Find the volume and surface area of a sphere of radius 5 cm. Take π = 3.14.**

Solution: Volume = $\frac{4}{3}\pi r^3$

$= \frac{4}{3} \times 3.14 \times 5 \times 5 \times 5$

$= \frac{4}{3} \times 3.14 \times 125$

$= 523.33\ cm^3$

Surface Area = $4\pi r^2 = 4 \times 3.14 \times 5 \times 5 = 314\ cm^2$

Summary Points

- Volume measures the space occupied by a solid, expressed in cubic units.
- Surface area measures the total outer area, expressed in square units.
- Different solids have different formulas.
- Always use same units throughout calculation.
- Use correct value of π based on question requirements ($\frac{22}{7}$ or 3.14)