1 Fundamentals of Surface Area and Volume

Surface area and volume formulas for different 3D shapes are as follows:

Shape	Curved Surface Area (CSA)	Total Surface Area (TSA)	Volume
Cuboid	$2(lb + bh + hl)$	$2(lb + bh + hl)$	$l \cdot b \cdot h$
Cube	$4s^2$	$6s^2$	s^3
Right Circular Cylinder	$2\pi rh$	$2\pi r(r + h)$	$\pi r^2 h$
Right Circular Cone	πrl	$\pi r(r + l)$	$\frac{1}{3}\pi r^2 h$
Sphere	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Hemisphere	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$
Frustum of a Cone	$\pi l(R + r)$	$\pi(R + r)l + \pi R^2 + \pi r^2$	$\frac{1}{3}\pi h(R^2 + r^2 + Rr)$
Hollow Cylinder	$2\pi h(R + r)$	$2\pi(R + r)h + 2\pi(R^2 - r^2)$	$\pi h(R^2 - r^2)$
Spherical Shell	$4\pi(R^2 - r^2)$	$4\pi R^2 - 4\pi r^2$	$\frac{4}{3}\pi(R^3 - r^3)$

Table 1: Surface Area and Volume of 3D Shapes

Where:

- l = length, b = breadth, h = height
- r = radius of base, R = outer radius (for hollow shapes)
- s = side length of a cube
- l = slant height (for cones and frustums)

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2 Important Tips and Conversions

- **Conversions:**

$$1 \text{ m} = 100 \text{ cm}, \quad 1 \text{ m}^2 = 10,000 \text{ cm}^2, \quad 1 \text{ m}^3 = 1,000,000 \text{ cm}^3$$

$$1 \text{ L} = 1000 \text{ cm}^3, \quad 1 \text{ hectare} = 10,000 \text{ m}^2$$

- **Formulas to Remember:**

$$\text{Area} \times \text{Rate} = \text{Cost}$$

$$\text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

- **Speed Conversions:**

$$1 \text{ km/hr} = \frac{5}{18} \text{ m/s}, \quad 1 \text{ m/s} = \frac{18}{5} \text{ km/hr}$$

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3 Applications of Surface Area and Volume

- Calculating the amount of material required to manufacture objects.
- Finding the cost of painting or covering curved surfaces.
- Estimating storage capacities of cylindrical tanks and reservoirs.
- Determining the amount of liquid required to fill a container.

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4 Example Problems

Example 1: A cylindrical water tank has a radius of 7 m and a height of 10 m. Find the total surface area and volume of the tank.

Solution:

$$\begin{aligned}\text{Total Surface Area} &= 2\pi r(r+h)\\ &= 2 \times \frac{22}{7} \times 7 \times (7+10)\\ &= 2 \times 22 \times 17 = 748 \text{ m}^2\end{aligned}$$

$$\begin{aligned}\text{Volume} &= \pi r^2 h\\ &= \frac{22}{7} \times 7^2 \times 10\\ &= 1540 \text{ m}^3\end{aligned}$$

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Example 2: Find the cost of painting a spherical dome of radius 14 m at the rate of 50 per square meter.

Solution:

$$\begin{aligned}\text{Surface Area} &= 4\pi r^2\\ &= 4 \times \frac{22}{7} \times 14^2\\ &= 2464 \text{ m}^2\end{aligned}$$

$$\text{Cost} = 2464 \times 50 = 123200$$

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5 Conclusion

- Understanding formulas for surface area and volume is crucial in solving real-world problems.
- Different shapes have unique formulas for TSA, CSA, and volume.
- Proper unit conversions are essential for accurate calculations.