📘 Chapter 13: Surface Areas and Volumes

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🔹 A. Cuboid

Let length = l, breadth = b, height = h

- Volume (आयतन) = $l \times b \times h$
- Total Surface Area (TSA) = $2(lb + bh + hl)$
- Lateral Surface Area (LSA) = $2h(l + b)$
- Diagonal = $\sqrt{l^2 + b^2 + h^2}$

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🔹 B. Cube

Let edge = a

- Volume = a^3
- TSA = $6a^2$
- LSA = $4a^2$
- Diagonal = $\sqrt{3} \times a$

📘 Tip: Cube is a special case of cuboid where all sides are equal.

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🔹 C. Cylinder

Let radius = r, height = h

- Volume = $\pi r^2 h$
- Curved Surface Area (CSA) = $2\pi rh$
- TSA = $2\pi r(r + h)$

📌 Remember: TSA = CSA + 2 × area of base (πr^2)

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🔹 D. Cone

Let radius = r, height = h, slant height = l

- Volume = $(1/3)\pi r^2 h$
- CSA = πrl
- TSA = $\pi r(l + r)$
- Slant height: $l = \sqrt{h^2 + r^2}$

📘 Use Pythagoras to find slant height if height and radius are given.

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🔹 E. Sphere

Let radius = r

- Volume = $(4/3)\pi r^3$
- Surface Area = $4\pi r^2$

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🔹 F. Hemisphere

Let radius = r

- Volume = $(2/3)\pi r^3$
- CSA = $2\pi r^2$
- TSA = $3\pi r^2$

📌 TSA = CSA + base area

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🧠 Important Concepts & Reasoning

✔ Cone, sphere and cylinder with same radius and height → volume ratio = 1 : 2 : 3
✔ Volume of cone is 1/3rd of cylinder with same base and height
✔ Diagonal of cube/cuboid = use 3D Pythagoras theorem
✔ Volume remains constant when radius and height are proportionally adjusted (e.g. radius halved, height doubled)

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📝 Real-Life Applications

🧃 **Cylinders** = cans, pipes, water tanks
🎯 **Spheres** = balls, bubbles, globes
⛺ **Cones** = ice cream cones, tents
🧱 **Cubes/Cuboids** = boxes, bricks, tanks

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📏 Summary Formula Table

Shape	Volume	Surface Area (TSA)	Curved Surface
Cuboid	$l \times b \times h$	$2(lb + bh + hl)$	$2h(l + b)$
Cube	a^3	$6a^2$	$4a^2$
Cylinder	$\pi r^2 h$	$2\pi r(r + h)$	$2\pi rh$
Cone	$(1/3)\pi r^2 h$	$\pi r(l + r)$	πrl
Sphere	$(4/3)\pi r^3$	$4\pi r^2$	—
Hemisphere	$(2/3)\pi r^3$	$3\pi r^2$	$2\pi r^2$

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📘 Example (Conceptual):

If radius of a cone is halved and height is doubled,

→ Volume = $(1/3)\pi \times (r/2)^2 \times 2h = (1/6)\pi r^2 h$ ⇒ Halved

✅ Final volume is halved

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📚 Sample Calculation (Example-based):

Q: A cylinder has radius = 3 cm, height = 7 cm

Volume = $\pi r^2 h = \pi \times 9 \times 7 = 198$ cm³

CSA = $2\pi rh = 2\pi \times 3 \times 7 = 42\pi$ = approx. 131.88 cm²

TSA = CSA + $2\pi r^2 = 42\pi + 18\pi = 60\pi$ = approx. 188.4 cm² ✅