

MATHEMATICS • CLASS 10

CHAPTER 12

Surface Areas and Volumes

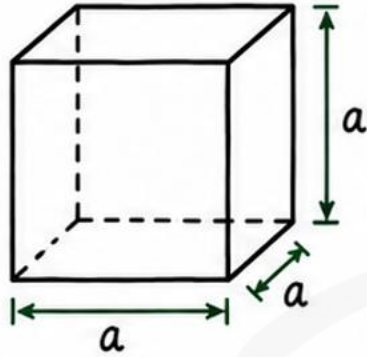
CHAPTER NOTES



BASIC SOLIDS: FORMULA RECALL

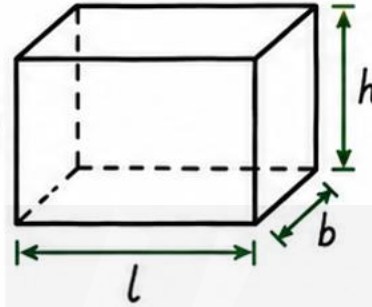
1. Cube (side a)

- $LSA = 4a^2$
- $TSA = 6a^2$
- $Volume = a^3$



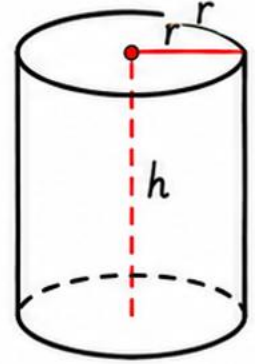
2. Cuboid (l, b, h)

- $LSA = 2h(l+b)$
- $TSA = 2(lb+bh+hl)$
- $Volume = lbh$



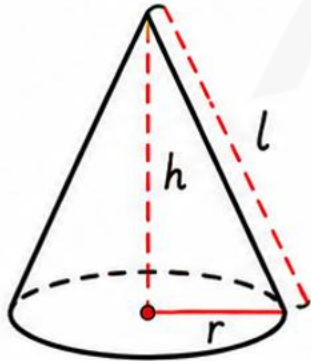
3. Cylinder (r, h)

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



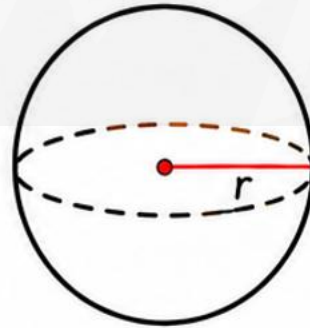
4. Cone (r, h, l)

- $l = \sqrt{r^2 + h^2}$
- $CSA = \pi rl$
- $TSA = \pi r(l+r)$
- $Volume = \frac{1}{3} \pi r^2 h$



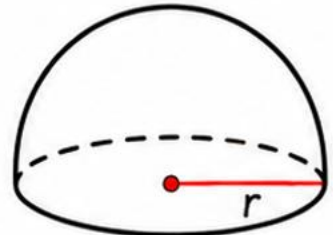
5. Sphere (r)

- $Surface Area = 4\pi r^2$
- $Volume = \frac{4}{3} \pi r^3$



6. Hemisphere (r)

- $CSA = 2\pi r^2$
- $TSA = 3\pi r^2$
- $Volume = \frac{2}{3} \pi r^3$



IMPORTANT DEFINITIONS

- CSA (Curved Surface Area) or LSA (Lateral Surface Area): Area of the curved or lateral surface only (excluding the bases).
- TSA (Total Surface Area): Sum of all surfaces (including curved/lateral and base(s)).

COMBINING SOLIDS: VISIBLE SURFACES

THE CENTRAL RULE

Count only the surfaces exposed to air.

When two solids are joined, the circular face(s) where they touch become hidden (not exposed) and are NOT counted.



METHOD (ALWAYS FOLLOW)

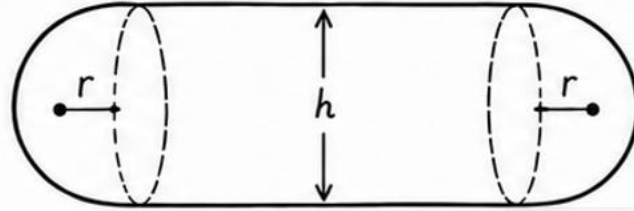
- Split the solid into known parts.
- Identify and mark all hidden faces (the ones joined together).
- Write the curved surfaces (or exposed surfaces) of each part.
- Add them to get the total visible surface area.

KEY TAKEAWAY

★ Always count only what is visible to the outside. Hidden faces (at the joins) are not exposed, so they are not counted.

1. CAPSULE

A cylinder of radius r and length h joined with two hemispherical ends.

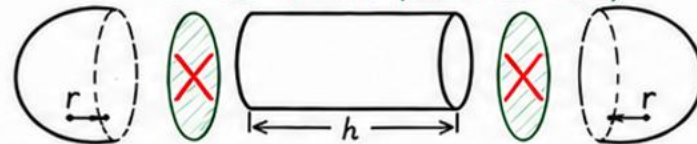


AFTER JOINING (VISIBLE SURFACES)

- The two circular faces where the hemispheres join the cylinder are hidden and NOT counted.
- Exposed surfaces:
 - Curved surface of cylinder
 - Curved surfaces of both hemispheres

$$\begin{aligned}
 \text{Exposed area} &= \text{CSA of cylinder} + \text{CSA of 2 hemispheres} \\
 &= 2\pi rh + 2(2\pi r^2) \\
 &= 2\pi rh + 4\pi r^2 \\
 &= \boxed{2\pi r(h + 2r)}
 \end{aligned}$$

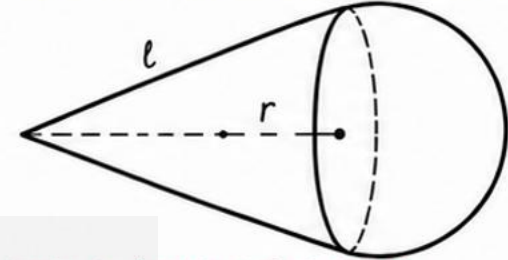
BEFORE JOINING (EXPLODED VIEW)



Common circular faces (hidden, not counted)

2. CONE JOINED TO A HEMISPHERE

A right circular cone of radius r and slant height l joined to a hemisphere of the same radius r .

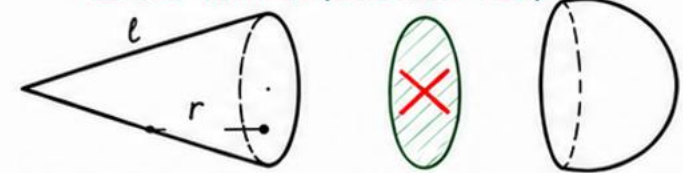


AFTER JOINING (VISIBLE SURFACES)

- The common circular base is hidden and NOT counted.
- Exposed surfaces:
 - Curved surface of the cone (CSA)
 - Curved surface of the hemisphere (CSA)

$$\begin{aligned}
 \text{Exposed area} &= \text{CSA of cone} + \text{CSA of hemisphere} \\
 &= \pi rl + 2\pi r^2 \\
 &= \boxed{\pi r(l + 2r)}
 \end{aligned}$$

BEFORE JOINING (EXPLODED VIEW)



Common circular face (hidden, not counted)

★ Curved surface area (CSA) formulas to remember:
Cylinder: $2\pi rh$ Hemisphere: $2\pi r^2$ Cone: πrl

★ Split → Mark hidden → Write exposed surfaces → Add.



CONE + HEMISPHERE: SURFACE AREA

EXAMPLE – Playing Top

A playing top is a cone joined to a hemisphere.

- Total height = 5 cm
- Common diameter = 3.5 cm
- $\pi = \frac{22}{7}$
- Find the area to be coloured.

STEP 1: Find the dimensions

Radius: $r = \frac{3.5}{2} = 1.75 \text{ cm}$

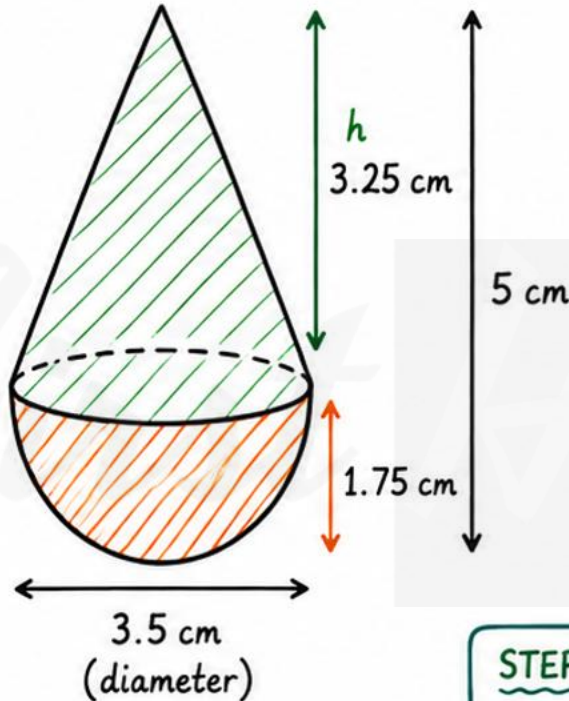
Cone height: $h = 5 - 1.75 = 3.25 \text{ cm}$

Slant height: $l = \sqrt{r^2 + h^2}$
 $= \sqrt{1.75^2 + 3.25^2}$
 $= \sqrt{3.0625 + 10.5625}$
 $= \sqrt{13.625} \approx 3.7 \text{ cm}$

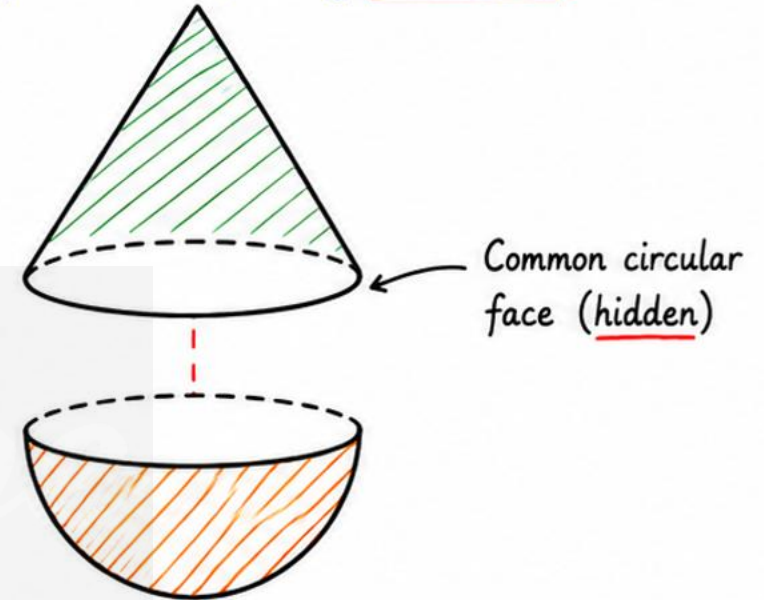
IMPORTANT NOTE

- ★ Do not simply add the total surface areas of the cone and the hemisphere separately.
- The common circular face is internal and not exposed.

Joined solid (playing top)



Exploded view (showing hidden face)



STEP 2: Find the exposed (coloured) area

Only the curved surface of the cone and the curved surface of the hemisphere are exposed.

Exposed area = $2\pi r^2 + \pi r l$
 $= \pi r(2r + l)$
 $= (\frac{22}{7})(1.75)(3.5 + 3.7)$
 $= (\frac{22}{7})(1.75)(7.2)$
 $= 39.6 \text{ cm}^2$

Area to be
coloured =
39.6 cm²



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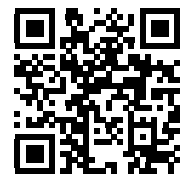


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