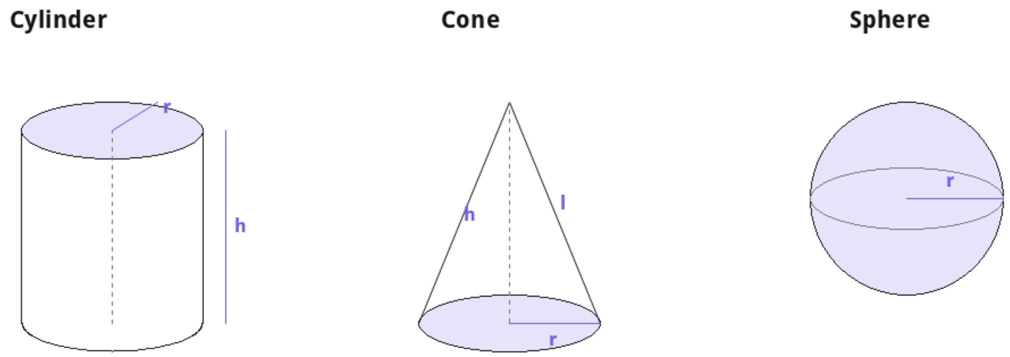
CLASS 10 MATHS EXTRA QUESTIONS

Class 10 Maths Chapter 12 Surface Areas and Volumes Extra Questions (HOTS)

These HOTS-level questions go beyond Exercise 12.1/12.2 — general/abstract reasoning, reverse-engineering, and fresh numbers not used in the Solutions post, designed for students aiming for full marks on combination-of-solids problems.

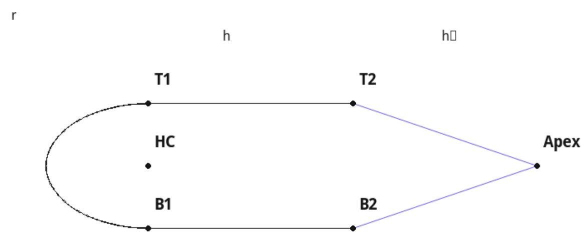


CSA / TSA / Volume formulas for each solid are given above -- this figure just shows what r (radius), h (height) and l (slant height) refer to.

Reference figure — solids covered in this chapter (cylinder, cone, sphere)

These HOTS-level questions go beyond Exercise 12.1/12.2 — general/abstract reasoning, reverse-engineering, and fresh numbers not used in the Solutions post, designed for students aiming for full marks on combination-of-solids problems.

Q1 (General derivation). A solid consists of a right circular cylinder of radius r and height h, with a hemisphere of the same radius attached to one end and a cone of the same radius and height h_1 attached to the other end. Derive a general formula for the total surface area of the solid in terms of r, h and h_1.



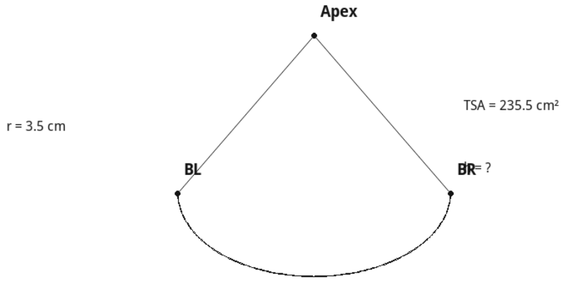
Cylinder (r,h) with hemisphere on one end and cone (height h_1) on the other -- general TSA derivation.

Cylinder (r,h) with hemisphere on one end and cone (height h_1) on the other -- general TSA derivation.

Solution: Slant height of cone, $l = \sqrt{r^2+h_1^2}$. The two curved ends are the hemisphere's curved surface and the cone's curved surface; the cylinder contributes only its curved

surface (both circular ends are covered by the attached solids).
TSA = (curved surface of cylinder) + (curved surface of hemisphere) + (curved surface of cone) = $2\pi rh + 2\pi r^2 + \pi rl$ = $\mathbf{\pi r(2h + 2r + \sqrt{r^2+h_1^2})}$**.**

Q2 (Reverse-engineering). A solid toy is in the shape of a hemisphere surmounted by a cone of the same radius. If the total surface area of the toy is 235.5 cm² and the radius is 3.5 cm, find the height of the cone.

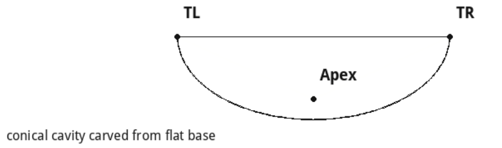


Hemisphere (r=3.5 cm) + cone toy, TSA=235.5 cm² -- find cone height.

Hemisphere (r=3.5 cm) + cone toy, TSA=235.5 cm² -- find cone height.

Solution: TSA = $\pi r(l+2r) \Longrightarrow 235.5 = (22/7)(3.5)(l+7) \Longrightarrow 235.5 = 11(l+7) \Longrightarrow l+7 = 21.409 \Longrightarrow l \approx 14.409$ cm.
$h = \sqrt{l^2-r^2} = \sqrt{207.6 - 12.25} = \sqrt{195.35} \approx$ **13.98 cm ≈ 14 cm.**

Q3 (Assertion-Reason). Assertion (A): When a solid cone is carved out of a solid hemisphere of the same base radius, the surface area of the remaining solid equals its original curved surface area plus the cone's curved surface area.



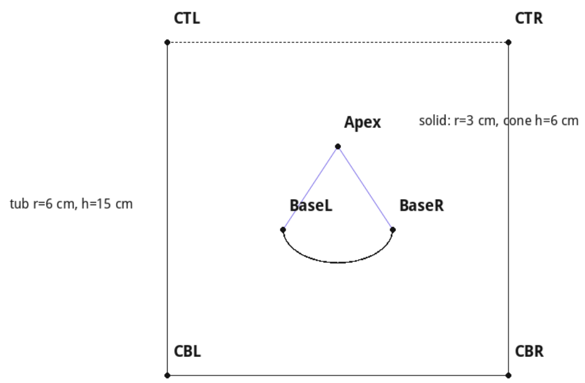
Cone carved out of a hemisphere of the same base radius -- new curved cavity replaces part of the flat base.

Cone carved out of a hemisphere of the same base radius -- new curved cavity replaces part of the flat base.

Reason (R): Removing the cone exposes a new conical cavity whose curved surface

becomes part of the outer boundary, while the flat circular base remains unaffected.
Solution: Both A and R are true, and R correctly explains A — the flat base stays as-is, only the top curved surface changes from a flat circle to the cone cavity's slant surface.
Answer: (a) Both A and R are true, and R is the correct explanation of A.

Q4 (Fresh-numbers word problem). A cylindrical tub of radius 6 cm and height 15 cm is full of water. A solid in the shape of a cone mounted on a hemisphere (both of radius 3 cm and the cone's height 6 cm) is dropped into the tub. Find the volume of water that overflows.

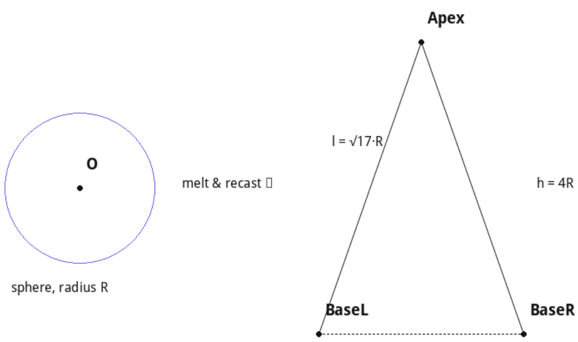


Cone+hemisphere solid (r=3 cm, cone h=6 cm) dropped into a full water tub (r=6 cm, h=15 cm).

Cone+hemisphere solid (r=3 cm, cone h=6 cm) dropped into a full water tub (r=6 cm, h=15 cm).

Solution: Volume of solid = $(1/3)\pi(3^2)(6) + (2/3)\pi(3^3) = 18\pi + 18\pi = 36\pi$ cm³ = $36\times22/7 \approx 113.14$ cm³.
Since the tub was full, the water that overflows equals the volume of the submerged solid = **≈113.14 cm³.**

Q5 (Ratio/general proof). A sphere of radius R is melted and recast into a right circular cone of the same radius R. Prove that the height of the cone is 4R, and find the ratio of the cone's slant height to R.

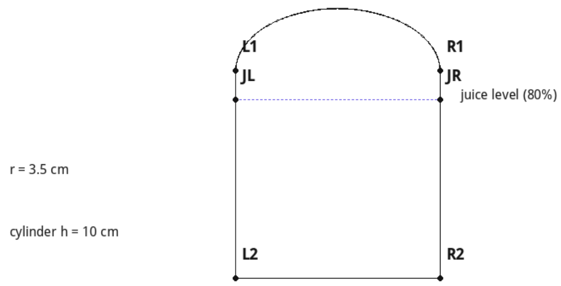


Sphere (radius R) melted and recast into a cone of the same radius R and height 4R.

Sphere (radius R) melted and recast into a cone of the same radius R and height 4R.

Solution: Volume conserved: $(4/3)\pi R^3 = (1/3)\pi R^2 h \Longrightarrow h = 4R$ (proved).
Slant height $l = \sqrt{(R^2+16R^2)} = \sqrt{17}\cdot R$. Ratio $l : R$ = **$\sqrt{17} : 1$ ($\approx 4.123 : 1$).**

Q6 (Multi-solid word problem, fresh numbers). A juice glass is a frustum-free combination: a cylinder of radius 3.5 cm and height 10 cm topped by a hemisphere of the same radius used as a lid. If the cylinder is filled with juice to 80% of its volume, find the volume of juice.



Juice glass: cylinder (r=3.5 cm, h=10 cm) with hemisphere lid, filled to 80% with juice.

Juice glass: cylinder (r=3.5 cm, h=10 cm) with hemisphere lid, filled to 80% with juice.

Solution: Cylinder volume = $\pi r^2 h = (22/7)(12.25)(10) = 385$ cm³. 80% of this = 0.8×385 = **308 cm³.** (The hemisphere lid is not filled — it is a cover, not a liquid-holding region, testing careful reading of “which part holds liquid.”)