

Surface Area of a Combination of Solids

Surface area of a combination = the sum of the **exposed surfaces only.**
The faces that meet at the join are inside the solid — nothing can paint them.

Why the answer is always smaller than the sum

Join two solids and the two faces that touch leave the outside of the object. They still exist, but they are now internal, so they are **not** part of the surface. That is why a combined solid's surface area is **always less** than the two solids' separate total surface areas — and why these questions mostly use **curved** surface area (CSA) rather than TSA.

For a toy that is a cone standing on a hemisphere of the same radius: **surface area = CSA of cone + CSA of hemisphere = $\pi r l + 2\pi r^2$** . The circle where they meet is counted *zero* times, not once and not twice.

The paint test: if a brush could not reach it, it is not in your sum.

The method, and where each line earns a mark

Step	What you write	Why it scores
1. Name the basic solids	"cone + hemisphere"	Fixes which formulas are even allowed
2. Decide which faces are exposed	"the two curved surfaces"	This is the decision being marked
3. Write the sum in symbols	$SA = \pi r l + 2\pi r^2$	A method mark, before any number
4. Handle any cavity or bump	$-\pi r^2$ then $+2\pi r^2$	The step most answers skip
5. Substitute, compute, unit it	$\dots = 858 \text{ cm}^2$	The unit is a mark of its own

Step 4 in one line: a hemisphere scooped into a face, or sitting on it, changes the area the same way — remove the flat circle πr^2 , add the curved $2\pi r^2$, so the solid gains $+\pi r^2$ either way. Only the *volume* tells the two cases apart.

The four joins you will actually meet

Figure	What disappears	What you add
Cone on a hemisphere (a toy)	Both flat circles	$\pi r l + 2\pi r^2$
Hemisphere on a cube	One circle, πr^2	$6a^2 - \pi r^2 + 2\pi r^2 = 6a^2 + \pi r^2$
Cylinder with a conical cavity	One end circle only	$2\pi r h + \pi r^2 + \pi r l$ — the <i>other</i> flat end is still visible
Capsule: cylinder + 2 hemispheres	Both end circles	$2\pi r h + 4\pi r^2$

Read the length twice. A 14 mm capsule of diameter 5 mm has a cylinder only $14 - 5 = 9 \text{ mm}$ long; the hemispheres eat 2.5 mm at each end.

What NCERT and CBSE actually ask

Question	Answer
Where is this in NCERT?	Chapter 12, Section 12.2 — examined by Exercise 12.1 , 9 questions. Section 12.3 is examined by Exercise 12.2. The numbers never match.
What is the chapter worth?	Unit VI Mensuration, 10 of the 80 theory marks, shared with Areas Related to Circles. CBSE sets marks by unit, never by chapter.
How does it appear in the paper?	A 3-mark question in Section C or a 5-mark in Section D; sometimes inside a 4-mark case study.

The whole scope, in CBSE's own words: "Surface areas and volumes of combinations of any two of the following: cubes, cuboids, spheres, hemispheres and right circular cylinders/cones." Read **any two** as two *kinds* of solid, not two pieces — a capsule is three pieces of two kinds. The **frustum** and **conversion of solids** are no longer examinable.

Key takeaways

- Add only the **exposed** surfaces; the joined faces are counted zero times.
- The combined surface area is **always less** than the sum of the two separate areas.
- Use **CSA** of each part: $\pi r l$ for a cone, $2\pi r^2$ for a hemisphere, $2\pi r h$ for a cylinder.
- Cavity or bump: $-\pi r^2$, then $+2\pi r^2$ — a net gain of πr^2 .
- Hemisphere on a cube shortcut: $6a^2 + \pi r^2$.
- CSA of a cone needs the **slant** height, $l = \sqrt{r^2 + h^2}$ — never the vertical height.

Three questions, one rule

NCERT EX 12.1 Q5 · THE STEP MOST ANSWERS SKIP

A hemispherical depression is cut out from one face of a cubical block, so that the diameter of the hemisphere equals the edge of the cube. Find the surface area of the remaining solid, in terms of the edge l .

Step 1. The solids: a cube of edge l , and a hemisphere of radius $r = l/2$ removed from one face.

Step 2. Exposed: all six cube faces, *except* the circle the depression replaces, *plus* the curved inside of the depression.

Step 3. $SA = 6l^2 - \pi r^2 + 2\pi r^2 = 6l^2 + \pi r^2$.

Step 4. Substitute $r = l/2$: $\pi r^2 = \pi l^2/4$.

$$SA = 6l^2 + \pi l^2/4 = (l^2/4)(24 + \pi)$$

Check – scooping does not remove surface. A depression takes away $\pi l^2/4$ of flat face and gives back $2 \times \pi l^2/4$ of curved face, so the solid ends up with *more* surface than the plain cube, not less. If your answer is below $6l^2$, you subtracted twice.

NCERT EX 12.1 Q6 · THREE PIECES, TWO KINDS

A medicine capsule is a cylinder with two hemispheres stuck to each of its ends. The entire capsule is 14 mm long and its diameter is 5 mm. Find its surface area.

Step 1. $r = 5/2 = 2.5$ mm. The 14 mm is the *whole* capsule, so the cylinder is $14 - 2(2.5) = 9$ mm long.

Step 2. Exposed: the cylinder's curved side and both hemispheres' curved surfaces. Both end circles are hidden at the joins.

Step 3. $SA = 2\pi rh + 2(2\pi r^2) = 2\pi rh + 4\pi r^2$.

Step 4. $2 \times (22/7) \times 2.5 \times 9 = 990/7$; $4 \times (22/7) \times 6.25 = 550/7$.

$$SA = 990/7 + 550/7 = 1540/7 = 220 \text{ mm}^2$$

Check. Two hemispheres of the same radius make one whole sphere, so $4\pi r^2$ is just the sphere's surface area – a clean way to see the answer before computing it.

WHERE THE MARKS ACTUALLY GO

- **Adding both full TSAs.** The hidden join gets counted twice and every later line is wrong.
- **Skipping the symbolic line.** " $SA = \pi rl + 2\pi r^2$ " is a method mark you can bank before a single number appears.
- **Using h where l belongs.** A cone's CSA needs the slant height; find it with $l = \sqrt{r^2 + h^2}$ first.
- **Losing the unit.** Surface area is cm^2 or mm^2 . A bare number is an incomplete answer.

NOW TRY THIS ONE · NCERT EX 12.1 Q8

A solid cylinder of height 2.4 cm and diameter 1.4 cm has a conical cavity of the *same* height and diameter hollowed out of it. Find the total surface area of the remaining solid, to the nearest cm^2 .

The trap: only *one* flat end is lost. The other circular face is still there to be painted, so your sum has three terms, not two. Start with $r = 0.7$, $h = 2.4$, and $l = \sqrt{0.49 + 5.76} = 2.5$.

Answer: $2\pi rh + \pi r^2 + \pi rl = 10.56 + 1.54 + 5.5 = 17.6$, so **18 cm^2** .

Practise this until the exposed faces are obvious

- **Chapter 1 free** – start on examfront at no cost and see how it works.
- **Mistake identification** – find out whether you keep losing the join, the slant height or the unit.
- **Anytime tests** – drill combinations of solids the moment a figure stops making sense.
- **Weekly tests** – keep Mensuration warm while you move on to the next unit.
- **Mock tests before the exam** – full papers under the clock, marked the way CBSE marks them.

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