

surface area and volume of the standard solids, and what happens when they are combined or melted down

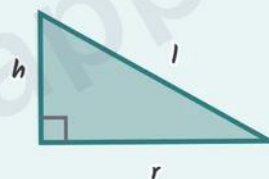
Two different questions the words are asking

- **volume** is the space filled inside a solid, measured in cubic units such as cm^3 or m^3
- **surface area** is the skin of the solid, measured in square units such as cm^2 or m^2
- **curved surface area** counts only the rounded part, leaving out any flat circular ends
- **total surface area** counts the curved part plus every flat face the solid actually has
- the words in the question decide which: painting or covering wants **area**, while filling, holding or melting wants **volume**
- a solid open at the top, such as a bucket or a pipe, does **not** include that face in its total surface area

The slant height, which the cone formulas need

*

- a cone has three lengths: the radius r , the vertical height h and the slant height l
- they form a right angled triangle, so $l^2 = r^2 + h^2$
- the area formulas use l , while the volume formula uses h , and that is the distinction most often missed
- a question that gives r and h and asks for surface area wants the Pythagoras step **first**
- a question that gives r and l and asks for volume needs h recovered as $h = \sqrt{l^2 - r^2}$



the cone cut down its axis: the radius lies along the base, the vertical height stands up the middle, and the slant is the hypotenuse joining them, which is why l is always the largest of the three

Cylinder, cone and sphere

cylinder, curved surface then total $2\pi rh, 2\pi r(h + r)$

cylinder, volume $V = \pi r^2 h$

cone, curved surface then total $\pi rl, \pi r(l + r)$

cone, volume, one third of the cylinder $V = \frac{1}{3} \pi r^2 h$

sphere, surface area then volume $4\pi r^2, \frac{4}{3} \pi r^3$

hemisphere, curved then total, then volume $2\pi r^2, 3\pi r^2, \frac{2}{3} \pi r^3$

the cone and the cylinder of the same radius and height are in the ratio 1 to 3, and a hemisphere's total surface is three times its flat circle, both worth remembering as checks