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CLASS X · MATHEMATICS BASIC (241) · CBSE BOARD EXAMINATION 2027

CHAPTER 12 BASIC

Surface Areas and Volumes

Chapter Practice Booklet · Questions only · Answers in the separate Answer Booklet

6 guided method questions | 30 practice questions | 3 case studies | Basic (430 series) board question index

INSIDE THIS BOOKLET

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STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE ____ / 20

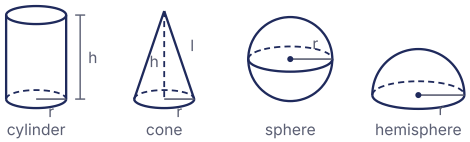
1

READ THIS FIRST · MATHEMATICS BASIC

Chapter Notes

The whole chapter in short-note form: every definition, formula, method and model answer. Revise from here – you should not need the textbook again.

1 The basic solids



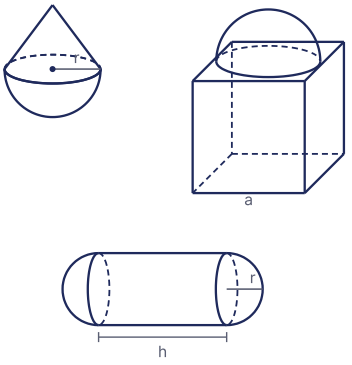
Solid	Curved SA	Total SA	Volume
Cuboid	$2h(l+b)$	$2(lb+bh+hl)$	lbh
Cube	$4a^2$	$6a^2$	a^3
Cylinder	$2\pi rh$	$2\pi r(r+h)$	$\pi r^2 h$
Cone	πrl	$\pi r(l+r)$	$\frac{1}{3}\pi r^2 h$
Sphere	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Hemisphere	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$

- Cuboid: length l, breadth b, height h. Cube: edge a.
- Slant height of a cone: $l = \sqrt{r^2+h^2}$. Use l for the curved surface and h for the volume.

Handy values with $\pi = \frac{22}{7}$ (learn them to save time and to check answers)

r	πr^2	$2\pi r^2$	$4\pi r^2$	$\frac{2}{3}\pi r^3$	$\frac{4}{3}\pi r^3$
3.5	38.5	77	154	89.83	179.67
7	154	308	616	718.67	1437.33
10.5	346.5	693	1386	2425.5	4851
14	616	1232	2464	5749.33	11498.67
21	1386	2772	5544	19404	38808

2 Surface area of joined solids



> Add only the surfaces you can see from outside. Faces that are joined together are hidden, so leave them out.

- **Cone on a hemisphere** (toy): $\pi rl + 2\pi r^2$.
- **Hemisphere on a cube**: $6a^2 - \pi r^2 + 2\pi r^2 = 6a^2 + \pi r^2$.
- **Cylinder with hemispherical ends** (capsule): $2\pi rh + 4\pi r^2$, where h is the length of the cylinder part.
- **Two cubes** of edge a joined: a cuboid $2a \times a \times a$, so the area is $10a^2$, not $12a^2$.

EXAMPLE

Two cubes of edge 4 cm joined end to end: $10 \times 16 = 160$ cm².

3 Volume of joined solids

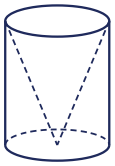
> The volume of a solid made of two parts is the sum of their volumes. If a part is cut out, subtract its volume.

- Toy (cone on a hemisphere): $\frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3$.
- Capsule: $\pi r^2 h + \frac{4}{3}\pi r^3$ (the two ends make one sphere).
- Cylinder with a cone of the same base and height cut out: $\pi r^2 h - \frac{1}{3}\pi r^2 h = \frac{2}{3}\pi r^2 h$.
- The height of each part = total height − height of the other part.

EXAMPLE

A cone of radius 7 cm and height 24 cm on a hemisphere of radius 7 cm: $1232 + 718.67 = 1950.67$ cm³.

4 Scooped and hollow solids



cone scooped out

- Scooping out a part lowers the volume but adds a new inside surface, so the surface area can go **up**.
- Cylinder with a cone scooped out: TSA $= 2\pi rh + \pi r^2 + \pi rl$ (side, base, inside of the cone).
- Cube with a hemispherical hollow on one face: $6a^2 - \pi r^2 + 2\pi r^2 = 6a^2 + \pi r^2$.
- **Hollow cylinder** (pipe), outer radius R, inner radius r, length h: volume $\pi(R^2 - r^2)h$; TSA $= 2\pi Rh + 2\pi rh + 2\pi(R^2 - r^2)$.

5 Units, mass and cost

- $1\ \text{cm}^3 = 1\ \text{mL}$; $1000\ \text{cm}^3 = 1\ \text{L}$; $1\ \text{m}^3 = 1000\ \text{L}$.
- $1\ \text{m}^2 = 10\,000\ \text{cm}^2$; $1\ \text{m}^3 = 1\,000\,000\ \text{cm}^3$.
- Mass = volume × density (for example, grams per cm^3).
- Cost = area (or volume) × rate. Change every length to the same unit first.

EXAMPLE
A tank holds $2.5\ \text{m}^3$, that is $2.5 \times 1000 = 2500$ L.

6 Model answer: surface area of a toy (3 marks)

A toy is a cone of radius 7 cm and height 24 cm on a hemisphere of the same radius. Find its total surface area.

1. Slant height $l = \sqrt{7^2 + 24^2} = 25$ cm 1
2. Cone: $\pi rl = \frac{22}{7} \times 7 \times 25 = 550\ \text{cm}^2$; hemisphere: $2\pi r^2 = 2 \times \frac{22}{7} \times 49 = 308\ \text{cm}^2$ 1
3. Total surface area $= 550 + 308 = 858\ \text{cm}^2$ 1

7 Model answer: a hollow in a cube (3 marks)

A hemisphere of diameter 8 cm is scooped out of one face of a cube of edge 8 cm. Find the surface area of the solid left. (Use $\pi = 3.14$.)

1. Surface area of the cube $= 6 \times 8^2 = 384\ \text{cm}^2$ 1
2. A circle of radius 4 cm is removed ($-\pi r^2$) and the inside of the bowl is added ($+2\pi r^2$): net $+\pi r^2 = 3.14 \times 16 = 50.24\ \text{cm}^2$ 1
3. Surface area $= 384 + 50.24 = 434.24\ \text{cm}^2$ 1

8 Checks that save marks

- Draw the solid and mark the faces that are hidden.
- Radius = diameter ÷2. Read whether a length is a radius or a diameter.
- Find the slant height before the curved area of a cone.
- Never add the area of a face that is joined to another part.
- Write cm^2 for area and cm^3 for volume.

Exam snapshot

What the board asks, and how to prepare

SYLLABUS 2026–27

- Surface areas and volumes of combinations of any two of: cubes, cuboids, spheres, hemispheres, right circular cylinders and cones.
- The frustum of a cone is not in the syllabus.

BOARD WEIGHTAGE

10 / 80

Unit V Mensuration together. Basic papers give a 1-mark question on joined solids or slant height, and two of three had a 5-mark question on a toy or a cube with a hemisphere.

MOST ASKED IN BASIC BOARD PAPERS + SAMPLE PAPER 2026–27 (3 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★★	1 mark: joined cubes, slant height, a solid whose CSA equals its TSA	1	3 of 3
★★☆	5 marks: toy (cone on a hemisphere) or a cube with a hemisphere: volume and surface area	5	2 of 3

MISTAKES THAT COST MARKS

- Using the diameter as the radius.
- Adding the hidden faces of joined solids.
- Using h in place of l for the curved area of a cone.
- Taking TSA of a hemisphere as $2\pi r^2$ when the flat face is on show ($3\pi r^2$).
- Forgetting the $\frac{1}{3}$ in the volume of a cone.
- Writing cm² for a volume.

HOW TO USE THIS BOOKLET

1. **Day 1:** Notes, then Part A (guided methods) – fill every blank.
2. **Day 2:** Part B (NCERT practice). Do every MUST DO question first.
3. **Day 3:** Part C (board pattern), Part D (case studies) and the real board questions in Part E.
4. **Wed 13 Jan: zero-period chapter test – 20 marks in 40 minutes, without the booklet.**
5. Check every answer in the Answer Booklet. Write each mistake on the My Mistakes page.

RULES AT A GLANCE

Cylinder	CSA $2\pi rh$, V $\pi r^2 h$
Cone	CSA πrl, V $\frac{1}{3}\pi r^2 h$, $l = \sqrt{r^2 + h^2}$
Sphere	SA $4\pi r^2$, V $\frac{4}{3}\pi r^3$
Hemisphere	CSA $2\pi r^2$, TSA $3\pi r^2$, V $\frac{2}{3}\pi r^3$
Joined solids	SA = visible faces; V = sum (minus any part cut out)

PART A · LEARN THE METHODS

A Guided Practice

Fill in the blanks to learn each board method step by step. Then use the same steps on your own in Part B.

Surface area

A1. Two cubes of edge 5 cm are joined end to end. Complete the steps to find the surface area of the cuboid formed. MUST DO [2]

Cuboid: $l =$ ___, $b =$ ___, $h =$ ___. Area $= 2(lb + bh + hl) = 2($___ + ___ + ___$) =$ ___ cm²

A2. A toy is a cone of radius 3.5 cm and height 12 cm on a hemisphere of the same radius. Complete the steps to find its total surface area. MUST DO [3]

$l = \sqrt{r^2 + h^2} = \sqrt{12.25 + 144} =$ ___ cm. Cone: $\pi rl =$ ___ cm². Hemisphere: $2\pi r^2 =$ ___ cm².

TSA = ___ + ___ = ___ cm²

A3. A cube of edge 4 cm has a hemisphere of diameter 4 cm on top. Complete the steps to find the surface area. (Use $\pi = 3.14$.) [2]

Area $= 6a^2 - \pi r^2 + 2\pi r^2 = 6a^2 +$ ___. $= 6 \times$ ___ $+3.14 \times$ ___ = ___ cm²

Volume

A4. A solid is a cylinder of radius 3.5 cm and height 10 cm with a hemisphere of the same radius on top. Complete the steps to find its volume. MUST DO [2]

Cylinder $= \pi r^2 h =$ ___ cm³. Hemisphere $= \frac{2}{3}\pi r^3 =$ ___ cm³. Total = ___ cm³

A5. A cone of the same base and height is scooped out of a cylinder of radius 7 cm and height 9 cm. Complete the steps to find the volume left. [2]

Volume left $= \pi r^2 h -$ _____ $= \frac{2}{3}\pi r^2 h = \frac{2}{3} \times \frac{22}{7} \times$ ___ $\times$ ___ = ___ cm³

A6. A pipe is 14 cm long with outer radius 4 cm and inner radius 3 cm. Complete the steps to find the volume of metal. [2]

Volume $= \pi(R^2 - r^2)h = \frac{22}{7} \times ($___ $-$ ___$) \times 14 =$ ___ cm³

B

PART B · NCERT PRACTICE

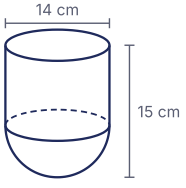
NCERT Practice

The same skills as the NCERT examples and exercises, with new numbers. Basic papers are built on NCERT, so finish every question.

Surface area of joined solids

B1. Two cubes, each of volume 216 cm³, are joined end to end. Find the surface area of the cuboid formed. MUST DO [2]

B2. A vessel is a hollow hemisphere with a hollow cylinder on top. The diameter is 14 cm and the total height is 15 cm. Find the inner surface area of the vessel. MUST DO [3]



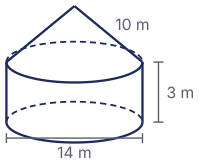
B3. A toy is a cone of radius 6 cm on a hemisphere of the same radius. The total height of the toy is 14 cm. Find its total surface area. (Use $\pi = 3.14$.) MUST DO [3]

B4. A cube of edge 12 cm has a hemisphere on one face. Find the greatest possible diameter of the hemisphere and, for it, the surface area of the solid. (Use $\pi = 3.14$.) [2]

B5. A hemisphere of diameter 10 cm is scooped out of one face of a cube of edge 10 cm. Find the surface area of the solid left. (Use $\pi = 3.14$.) [2]

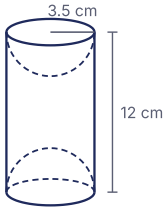
B6. A capsule is a cylinder with two hemispheres stuck to its ends. Its total length is 20 mm and its diameter is 6 mm. Find its surface area. MUST DO [3]

B7. A tent is a cylinder of diameter 14 m and height 3 m with a cone on top of slant height 10 m. Find the area of canvas used and its cost at ₹500 per m². [3]



B8. A cone of the same height and diameter is scooped out of a solid cylinder of height 4 cm and diameter 6 cm. Find the total surface area of the solid left. [3]

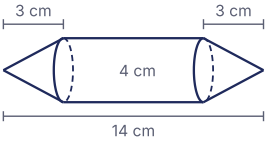
B9. A wooden article is a cylinder of height 12 cm and radius 3.5 cm with a hemisphere of the same radius scooped out of each end. Find its total surface area. [3]



Volume of joined solids

B10. A solid is a cone of radius 3 cm and height 3 cm on a hemisphere of the same radius. Find its volume in terms of π. MUST DO [2]

B11. A model is a cylinder with a cone at each end. The diameter is 4 cm, the total length is 14 cm and each cone is 3 cm long. Find the volume of the model. MUST DO [3]



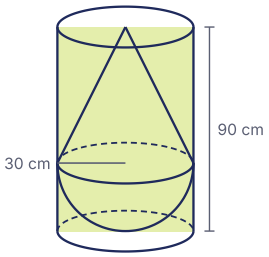
B12. Each gulab jamun is a cylinder with two hemispherical ends, 5.6 cm long and 2.8 cm in diameter. It holds syrup equal to 30% of its volume. Find the syrup in 50 gulab jamuns. [3]

B13. A pen stand is a wooden cuboid $20 \times 12 \times 4$ cm with four conical holes, each of radius 0.7 cm and depth 2.1 cm. Find the volume of wood in the stand. [3]

B14. An inverted cone of radius 6 cm and height 10 cm is full of water. Lead shots, each a sphere of radius 0.5 cm, are dropped in until one-fifth of the water flows out. How many shots are dropped? [3]

B15. An iron pole is a cylinder of height 200 cm and base diameter 28 cm, with a cylinder of height 70 cm and radius 7 cm on top. Find its mass if 1 cm³ of iron has mass 8 g. [3]

B16. A solid is a cone of radius 30 cm and height 60 cm on a hemisphere of radius 30 cm. It stands upright in a cylinder of radius 30 cm and height 90 cm that was full of water, touching the bottom. Find the water left in the cylinder in m^3. (Use $\pi = 3.14$.) [4]



B17. A glass vessel is a sphere of diameter 14 cm with a cylindrical neck 7 cm long and 2 cm in diameter. Find the volume of water it can hold. [2]

C · Board Pattern Practice

PART C · BOARD PATTERN (BASIC)

Question types from real Mathematics Basic papers (430 series) and the 2026–27 Sample Paper. ★★★ = asked in all 3 papers checked · ★★ = 2 papers · ★ = 1 paper.

ASSERTION–REASON: HOW TO ANSWER

(a) Both A and R are true, and R is the correct explanation of A.
(b) Both A and R are true, but R is not the correct explanation of A.
(c) A is true, but R is false.
(d) A is false, but R is true.

Joined solids: one-mark questions

★★★ 3 of 3 papers · 1 mark

C1. Two cubes, each of volume 27 cm^3, are joined end to end. The surface area of the cuboid formed is: MUST DO [1]

(a) 108 cm^2 (b) 90 cm^2 (c) 72 cm^2 (d) 54 cm^2

C2. Two solid hemispheres of radius 7 cm are joined along their flat faces. The surface area of the solid formed is: MUST DO [1]

(a) 924 cm^2 (b) 462 cm^2 (c) 616 cm^2 (d) 308 cm^2

C3. The volume of the largest sphere that fits inside a cube of edge 14 cm is: [1]

(a) $1437\frac{1}{3}$ cm^3 (b) 2744 cm^3 (c) $718\frac{2}{3}$ cm^3 (d) 616 cm^3

C4. A cone has radius 5 cm and height 12 cm. Its slant height is: MUST DO [1]

(a) 17 cm (b) 7 cm (c) $\sqrt{119}$ cm (d) 13 cm

C5. For which solid is the curved surface area equal to the total surface area? [1]

(a) sphere (b) cylinder (c) cone (d) hemisphere

C6. ASSERTION–REASON [1]

Assertion (A): The surface area of a sphere is equal to the sum of the total surface areas of the two hemispheres made by cutting it.

Reason (R): Cutting a sphere into two hemispheres makes two new flat circular faces.

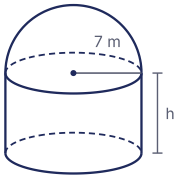
C7. A solid cylinder of radius 3.5 cm and height 10 cm has a hemisphere of the same radius on one end. Find its total surface area. MUST DO [2]

Joined and hollow solids: volume, surface area, cost

★★☆ 2 of 3 papers · 5 marks

C8. A solid is a cylinder with a hemisphere at each end. Its total length is 19 cm and its diameter is 7 cm. Find its volume. MUST DO [3]

C9. A godown is a cylinder of radius 7 m with a hemispherical dome on top. It holds $1642\frac{2}{3}$ m³ of air. Find the height of the cylindrical part. MUST DO [3]

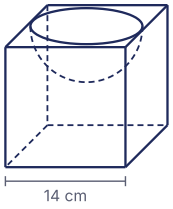


C10. A metal pipe 14 cm long contains 704 cm³ of metal. Its outer radius is 5 cm. Find its inner radius. [3]

C11. A solid is a cone on a hemisphere, both of radius 6 cm. Its volume is 216π cm³. Find the height of the cone. [3]

C12. A toy is a cone of radius 9 cm and height 12 cm on a hemisphere of the same radius. Find its total surface area and volume. (Use $\pi = 3.14$.) MUST DO [5]

C13. A hemisphere of diameter 14 cm is scooped out of one face of a solid cube of edge 14 cm. Find the volume and the total surface area of the solid left. [5]



D

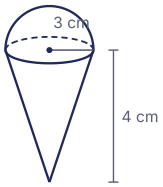
PART D · SECTION E STYLE

Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in Section E of the board paper. Underline the numbers in the passage before you start.

D1. Case Study · Ice-cream Cone [4]

An ice-cream cone is a cone of radius 3 cm and height 4 cm, filled with ice cream, with a hemisphere of ice cream of the same radius on top. (Use $\pi = 3.14$.)



(i) Find the slant height of the cone. [1]

(ii) Find the volume of the hemisphere of ice cream. [1]

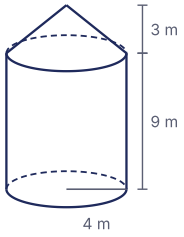
(iii) Find the total volume of ice cream. [2]

OR

(iii) Find the area of wafer needed for the curved surface of one cone, and for 20 cones. [2]

D2. Case Study · Grain Silo [4]

A grain silo is a cylinder of radius 4 m and height 9 m with a conical roof of height 3 m. (Use $\pi = 3.14$.)



(i) Find the slant height of the roof. [1]

(ii) Find the volume of the cylindrical part. [1]

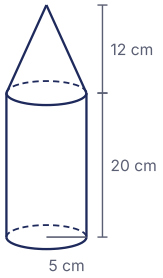
(iii) Find the total capacity of the silo. [2]

OR

(iii) Find the area of metal sheet needed for the curved wall and the roof (no floor). [2]

D3. Case Study · Toy Rocket [4]

A wooden toy rocket is a cylinder of radius 5 cm and height 20 cm with a cone of the same radius and height 12 cm on top. (Use $\pi = 3.14$.)



(i) Find the slant height of the cone. [1]

(ii) Find the curved surface area of the cone. [1]

(iii) The whole outside, including the base, is painted at ₹0.50 per cm². Find the area painted and the cost. [2]

OR

(iii) Find the volume of wood in the rocket. [2]

E

PART E · REAL BOARD QUESTIONS

Board PYQ Index (Basic)

Real questions from the Mathematics Basic (430 series) papers and the 2026–27 Sample Paper, by type. Open the official paper and solve the listed questions.

Frequency	Question type	Marks	Where asked (year: paper code, question number)	Practise here
★★★	**Joined cubes, slant height, CSA = TSA (1 mark)**	1	**2026:** 430/1/2 Q12 · **2025:** 430/1/1 Q15 · **SQP 2026–27:** Q18	A1–A3, B1–B9, C1–C7, D2–D3
★★☆	**Toy or cube with a hemisphere: volume and surface area**	5	**2025:** 430/1/1 Q34(a), Q34(b) · **SQP 2026–27:** Q34	A4–A6, B10–B17, C8–C13, D1

Papers checked (3): 2026 – 430/1/2 (Section A only could be read online) · 2025 – 430/1/1 · CBSE Sample Paper 2026–27 (Mathematics Basic). Sets of one code family share most questions, so they count as one paper. Download the official papers from cbse.gov.in → Previous Year Question Papers → Mathematics Basic.

F

PART F · YOUR RECORD

My Mistakes

Write down each mistake from this chapter, including the chapter test.

Every wrong answer is a free lesson. Write it here, find the rule you missed, and redo the question after three days. Bring this page to class before the next test.

Date	Part & Q No.	What went wrong	Correct rule or method	Redone ✓