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CLASS X · MATHEMATICS STANDARD (041) · CBSE BOARD EXAMINATION 2027

CHAPTER 12

Surface Areas and Volumes

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

51 practice questions | 4 case studies | Board question index | Original diagrams

INSIDE THIS BOOKLET

1	**Chapter Notes** Formulas for every solid, surface area and volume of joined solids, scooped and hollow solids, units, model answers + exam snapshot	2
A	**NCERT Practice** 17 questions	4
B	**Exemplar Practice** 14 questions	6
C	**Board Pattern Practice** 14 questions, with frequency stars	7
D	**Case-Based Questions** 4 case studies	9
E	**Challenge Questions** 6 questions for 95+	11
F	**Board PYQ Index** Real board questions by type	12
G	**My Mistakes** Your error log	13

STUDENT DETAILS

NAME _____

CLASS & SECTION _____

ROLL NO. _____

BOOKLET STARTED ON _____

CHAPTER TEST SCORE _____ / 20

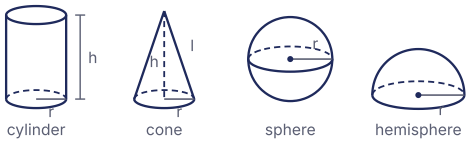
1

READ THIS FIRST

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



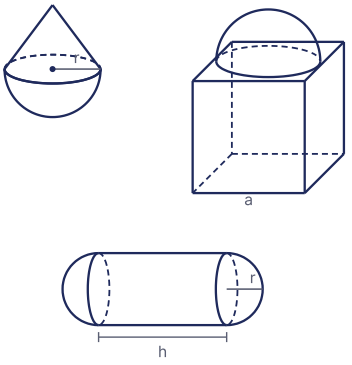
Solid	Curved SA	Total SA	Volume
Cuboid	$2h(l+b)$	$2(lb+bh+hl)$	lbh
Cube	$4a^2$	$6a^2$	a^3
Cylinder	$2\pi rh$	$2\pi r(r+h)$	$\pi r^2 h$
Cone	πrl	$\pi r(l+r)$	$\frac{1}{3}\pi r^2 h$
Sphere	$4\pi r^2$	$4\pi r^2$	$\frac{4}{3}\pi r^3$
Hemisphere	$2\pi r^2$	$3\pi r^2$	$\frac{2}{3}\pi r^3$

- 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

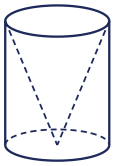
The volume of a solid made of two parts is the sum of their volumes. If a part is cut out, subtract its volume.

- 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

- $1\ \text{cm}^3 = 1$ mL; $1000\ \text{cm}^3 = 1$ L; $1\ \text{m}^3 = 1000$ 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 (Areas Related to Circles and Surface Areas and Volumes) together. Every paper checked had a 1-mark question here, three of four had a 3-mark question on a joined or hollow solid, and the Sample Paper has a 5-mark one. In all, about 4–8 marks.

MOST ASKED IN BOARD PAPERS, 2024–2026 + SAMPLE PAPER 2026–27 (4 PAPERS CHECKED)

How often	Question type	Marks	Papers
★★★	1 mark: surface area or volume of joined solids (two cubes, two hemispheres, a cone inside a cube)	1	4 of 4
★★★	3 marks: volume of a joined or hollow solid (capsule, dome on a cylinder, pipe)	3	3 of 4
★☆☆	5 marks: tent or toy: canvas, painting cost, height from the volume	5	1 of 4

MISTAKES THAT COST MARKS

- Adding the area of a joined face (for example the base of the cone in a toy).
- Using the height h in place of the slant height l in πrl.
- Taking the whole length of a capsule as the length of its cylinder part.
- Forgetting that a scooped-out part adds a new inside surface.
- Mixing m and cm, or m^3 and litres.
- Using the diameter as the radius.

HOW TO USE THIS BOOKLET

1. **Day 1:** Notes, then Part A (NCERT) and Part B (Exemplar). Do every MUST DO question first.
2. **Day 2:** Part C (board pattern) and Part D (case studies).
3. **Day 3:** Part E (challenge) and the real board questions in Part F.
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 · NCERT PRACTICE

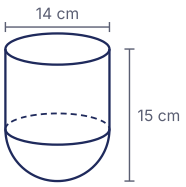
A NCERT Practice

The same skills as the NCERT examples and exercises, with new numbers. Finish every question before moving on.

Surface area of joined solids

A1. Two cubes, each of volume 216 cm^3, are joined end to end. Find the surface area of the cuboid formed. MUST DO [2]

A2. 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]



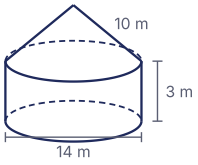
A3. A toy is a cone of radius 6 cm on a hemisphere of the same radius. The total height of the toy is 14 cm. Find its total surface area. (Use $\pi = 3.14$.) MUST DO [3]

A4. 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]

A5. 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]

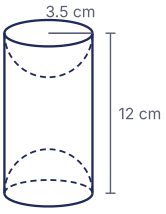
A6. A capsule is a cylinder with two hemispheres stuck to its ends. Its total length is 20 mm and its diameter is 6 mm. Find its surface area. MUST DO [3]

A7. 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]



A8. 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]

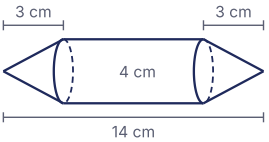
A9. A wooden article is a cylinder of height 12 cm and radius 3.5 cm with a hemisphere of the same radius scooped out of each end. Find its total surface area. [3]



Volume of joined solids

A10. 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]

A11. 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]



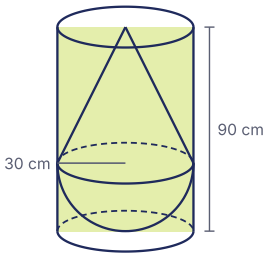
A12. Each gulab jamun is a cylinder with two hemispherical ends, 5.6 cm long and 2.8 cm in diameter. It holds syrup equal to 30% of its volume. Find the syrup in 50 gulab jamuns. [3]

A13. 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]

A14. 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]

A15. 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 cm^3 of iron has mass 8 g. [3]

A16. 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]



A17. 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]

B · Exemplar Practice

PART B · EXEMPLAR PRACTICE

Exemplar-style questions on the same ideas, one step harder. Give a reason for every 2-mark answer.

Multiple choice

1 mark each

B1. A pencil sharpened at one end is a combination of: [1]

(a) a hemisphere and a cylinder (b) two cones
(c) a cone and a cylinder (d) a sphere and a cone

B2. The volume of the largest right circular cone that can be cut from a cube of edge 7 cm is: [1]

(a) 44.92 cm^3 (b) 89.83 cm^3 (c) 179.67 cm^3 (d) 343 cm^3

B3. The total surface area of a solid hemisphere of radius 7 cm is: [1]

(a) 308 cm^2 (b) 154 cm^2 (c) 616 cm^2 (d) 462 cm^2

B4. A cube of edge 6 cm is cut into two equal cuboids. The total surface area of the two cuboids is: [1]

(a) 288 cm^2 (b) 216 cm^2 (c) 252 cm^2 (d) 324 cm^2

B5. A cylinder, a cone and a hemisphere have the same radius r, and the cylinder and cone have height r. The ratio of their volumes is: [1]

(a) 1 : 2 : 3 (b) 2 : 1 : 3 (c) 3 : 1 : 2 (d) 3 : 2 : 1

B6. ASSERTION–REASON [1]

Assertion (A): If a cone and a cylinder have the same base radius and height, the volume of the cone is one-third of the volume of the cylinder.

Reason (R): The volume of a cone is $\frac{1}{3}\pi r^2 h$ and of a cylinder is $\pi r^2 h$.

B7. ASSERTION–REASON [1]

Assertion (A): Two cubes of edge 4 cm are joined end to end. The surface area of the solid formed is 192 cm².

Reason (R): When two solids are joined, the faces that touch are no longer on the surface.

B8. ASSERTION–REASON [1]

Assertion (A): The volume of a hemisphere of radius r is $\frac{2}{3}\pi r^3$.

Reason (R): The curved surface area of a hemisphere is $2\pi r^2$.

Short answer with reasons

2–3 marks

B9. A solid is a cylinder of radius 7 cm and height 10 cm with a cone of the same radius and height 24 cm on top. Find its volume. [2]

B10. A cylindrical hole of radius 1 cm is drilled straight through a cuboid $8 \times 6 \times 4$ cm along its 4 cm height. Find the volume left. [2]

B11. A capsule is a cylinder with hemispherical ends. Its total length is 21 mm and its diameter is 7 mm. Find its volume. MUST DO [3]

B12. A hemisphere of diameter 14 cm stands on one face of a cube of edge 28 cm. Find the total surface area and the volume of the solid. [3]

Long answer

3–5 marks

B13. A water tank is a cylinder of diameter 14 m and height 5 m with a hemispherical bottom. Find (i) its capacity in litres, (ii) the cost of painting the inside (no lid) at ₹20 per m². MUST DO [5]

B14. A metal pipe is 21 cm long. Its inner diameter is 4 cm and outer diameter is 6 cm. Find (i) the volume of metal, (ii) its total surface area. [3]

C

PART C · BOARD PATTERN

Board Pattern Practice

Question types from real 2024–2026 board papers and the 2026–27 Sample Paper, grouped by type. ★★★ = asked in 3 or 4 of the 4 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

★★★ 4 of 4 papers · 1 mark

C1. Two cubes, each of volume 27 cm³, are joined end to end. The surface area of the cuboid formed is: MUST DO [1]

(a) 108 cm² **(b)** 90 cm² **(c)** 72 cm² **(d)** 54 cm²

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 cm² (b) 462 cm² (c) 616 cm² (d) 308 cm²

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

(a) $1437\frac{1}{3}$ cm³ (b) 2744 cm³ (c) $718\frac{2}{3}$ cm³ (d) 616 cm³

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.

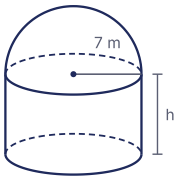
C7. A solid cylinder of radius 3.5 cm and height 10 cm has a hemisphere of the same radius on one end. Find its total surface area. MUST DO [2]

Joined and hollow solids: volume, surface area, cost

★★★ 4 of 4 papers · 3–5 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]



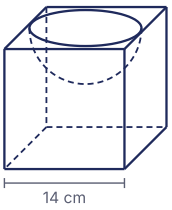
C10. A metal pipe 14 cm long contains 704 cm³ of metal. Its outer radius is 5 cm. Find its inner radius. [3]

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 tent is a cylinder of radius 7 m and height 4 m with a conical top of slant height 10 m. 10% extra canvas is needed for stitching. Find the canvas needed and its cost at ₹600 per m². [5]

C14. 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

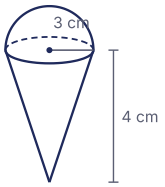
PART D · SECTION E STYLE

Case-Based Questions

Each case carries 4 marks (1 + 1 + 2), as in Section E of the board paper. Read the situation carefully before answering.

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]

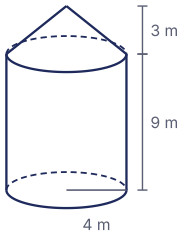
(iii) Find the total volume of ice cream. [2]

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]

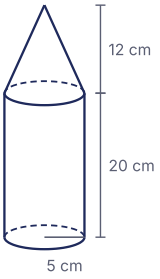
(iii) Find the total capacity of the silo. [2]

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]

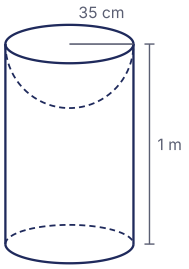
(iii) The whole outside, including the base, is painted at ₹0.50 per cm². Find the area painted and the cost. [2]

OR

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

D4. Case Study · Bird Bath [4]

A garden bird bath is a solid cylinder of radius 35 cm and height 1 m, with a hemispherical hollow of the same radius at the top.



(i) Find the curved surface area of the cylinder. [1]

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

(iii) Find the total area to be painted (all except the base) in m^2. [2]

OR

(iii) Find the volume of material in the bird bath. [2]

E

PART E · FOR 95+

Challenge Questions

Harder than the usual board question. Try these after Parts A–D: they stretch the same methods to the toughest 3- and 5-mark questions.

E1. A solid cone (radius 3 cm, height 4 cm) on a hemisphere of radius 3 cm is put fully under water in a cylinder of radius 10 cm. Find the rise in the water level. [3]

E2. A hemisphere of radius r is scooped out of each end of a solid cylinder of radius r and height $2r$. Show that the volume left is $\frac{2}{3}\pi r^3$ and the total surface area is $8\pi r^2$. [3]

E3. Find the ratio of the volumes of the largest cone and largest sphere cut from a cube of edge a. [3]

E4. A toy is a cone on a hemisphere of the same radius. The volumes of the cone and the hemisphere are equal, and the toy is 21 cm tall. Find its total surface area. (Use $\sqrt{5} = 2.236$.) [3]

E5. A conical hollow of diameter 12 cm and depth 8 cm is cut into one end of a solid cylinder of diameter 12 cm and height 15 cm. Find the total surface area of the solid left. [3]

E6. A sphere fits exactly inside a cylinder, touching its curved side, top and bottom. Show that the ratio of their volumes and the ratio of their total surface areas are both 2 : 3. [3]

F

PART F · REAL BOARD QUESTIONS

Board PYQ Index

Real questions from recent Maths Standard board 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
★★★	**Surface area or volume of joined solids (1 mark)**	1	**2026:** 30/1/1 Q16 · **2025:** 30/1/1 Q20 · **2024:** 30/1/1 Q13, Q15 · **SQP 2026–27:** Q11	A1–A9, C1–C7, D2–D3
★★★	**Volume of a joined or hollow solid**	3	**2026:** 30/1/1 Q30 · **2025:** 30/1/1 Q30 · **2024:** 30/1/1 Q31	A10–A17, C8–C14, D1, D4
★☆☆	**Tent or toy: canvas, cost, height from the volume**	5	**SQP 2026–27:** Q34(A), Q34(B)	A1–A9, C1–C7, D2–D3

PAPERS CHECKED

- **2026:** 30/1/1 (Delhi, Set 1)
- **2025:** 30/1/1 (Delhi, Set 1)
- **2024:** 30/1/1 (Delhi, Set 1)
- **CBSE Sample Paper 2026–27** (Mathematics Standard)

Sets of one code family (30/1/1, 30/1/2, 30/1/3) share most questions, so each counts as one paper. Download the official papers from cbse.gov.in → Previous Year Question Papers, and solve the exact questions listed above.

PART G · YOUR RECORD

G 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 ✓