TYBA COACHING CENTRE, AJMER

RMS / RMC CLASS VI MATHEMATICS • CHAPTER 16: PERIMETER, AREA & VOLUME (परिमाप, क्षेत्रफल एवं आयतन) — MASTER NOTES

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1. INTRODUCTION: PERIMETER, AREA & VOLUME — Section 1

1.1 Core Definitions (मूल परिभाषाएँ):

• **Perimeter (परिमाप):** The sum of the lengths of all outer sides of a closed plane (2D) figure. Measured in linear units: **mm, cm, m, km**. Real-life uses: fencing a field, putting lace around a tablecloth, or running along the boundary of a park.

• **Area (क्षेत्रफल):** The amount of flat surface enclosed inside a closed 2D figure. Measured in square units: **cm², m², km², hectare**. Real-life uses: laying floor tiles, painting a wall, spreading a carpet, or ploughing farmland.

• **Volume (आयतन):** The amount of three-dimensional space occupied by a solid object (or capacity of a container). Measured in cubic units: **cm³, m³, Litres**.

परिमाप: किसी बंद आकृति की बाहरी भुजाओं का योग (बाड़ लगाने या चक्कर लगाने में)। क्षेत्रफल: किसी बंद आकृति के अंदर की समतल जगह (टाइल, पेंट, कालीन)। आयतन: किसी 3D ठोस द्वारा घेरा गया स्थान या बर्तन की धारिता।

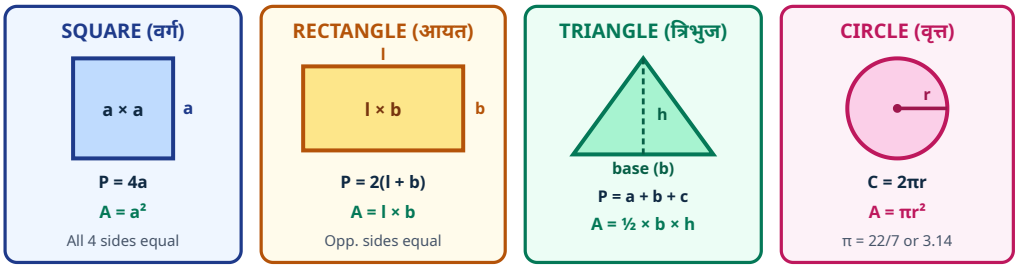

Figure 1: 2D Shapes — Perimeter (परिमाप) & Area (क्षेत्रफल) Formulas at a Glance

2. SQUARE & RECTANGLE — FORMULAS & SOLVED EXAMPLES — Section 2

2.1 Square (वर्ग): A 4-sided closed figure with all 4 sides equal (side = **a**) and all 4 angles = 90°.

• **Perimeter = 4 × a** | **Side = Perimeter ÷ 4**

• **Area = a × a = a²** | **Side = √Area** | **Diagonal = a√2**

वर्ग की चारों भुजाएँ बराबर (a) और प्रत्येक कोण 90° होता है। परिमाप = 4a; क्षेत्रफल = a^2; भुजा = √क्षेत्रफल या परिमाप ÷ 4।

2.2 Rectangle (आयत): Opposite sides are equal (length = **l**, breadth = **b**) and all angles = 90°.

• **Perimeter = 2 × (l + b)** | **l = (P ÷ 2) – b** | **b = (P ÷ 2) – l**

• **Area = l × b** | **l = Area ÷ b** | **b = Area ÷ l** | **Diagonal = √(l² + b²)**

आयत की आमने-सामने की भुजाएँ बराबर होती हैं। परिमाप = 2(l + b); क्षेत्रफल = l × b; लंबाई = क्षेत्रफल ÷ चौड़ाई।

Solved Example 1 (Square Perimeter → Area): The perimeter of a square park is 72 m. Find its area.
Solution: Side (a) = Perimeter ÷ 4 = 72 ÷ 4 = 18 m. Area = a^2 = 18 × 18 = **324 sq. m**.

हल: भुजा = 72 ÷ 4 = 18 मी। क्षेत्रफल = 18 × 18 = 324 वर्ग मीटर।

Solved Example 2 (Rectangle Area → Perimeter): The area of a rectangular hall is 240 sq. m and its length is 20 m. Find its breadth and perimeter.
Solution: Breadth (b) = Area ÷ l = 240 ÷ 20 = **12 m**. Perimeter = 2(l + b) = 2(20 + 12) = 2 × 32 = **64 m**.

हल: चौड़ाई = 240 ÷ 20 = 12 मी। परिमाप = 2(20 + 12) = 64 मीटर।

Solved Example 3 (Fencing Cost): A rectangular field is 65 m long and 35 m wide. Find the cost of fencing it twice with wire at ₹18 per metre.
Solution: Perimeter = 2(65 + 35) = 2 × 100 = 200 m. For 2 rounds, wire needed = 2 × 200 = 400 m. Cost = 400 × 18 = **₹7,200**.

हल: परिमाप = 200 मी। 2 चक्कर का तार = 400 मी। कुल खर्च = 400 × 18 = ₹7,200।

Solved Example 4 (Running Rounds): An athlete runs 5 rounds around a square ground of side 45 m. How much distance does he cover in km?
Solution: 1 round = 4 × 45 = 180 m. 5 rounds = 5 × 180 = 900 m = 900 ÷ 1000 = **0.9 km**.

हल: 1 चक्कर = 4 × 45 = 180 मी। 5 चक्कर = 900 मी = 0.9 किमी।

3. TRIANGLES, POLYGONS & CIRCLES — Section 3

3.1 Triangles & Regular Polygons (त्रिभुज एवं सम बहुभुज):
• **Scalene Triangle:** Perimeter = a + b + c.
• **Equilateral Triangle:** All 3 sides equal ⇒ Perimeter = **3 × side**.
• **Area of any Triangle = ½ × base × height**.
• **Regular Polygon with n equal sides:** Perimeter = **n × side** (Pentagon = 5a, Hexagon = 6a, Octagon = 8a).

समबाहु त्रिभुज का परिमाप = 3 × भुजा; त्रिभुज का क्षेत्रफल = ½ × आधार × ऊँचाई; सम बहुभुज का परिमाप = भुजाओं की संख्या × भुजा।

3.2 Circle (वृत्त): A circle has centre O, radius **r**, and diameter **d = 2r**. Take **π = 22/7** (or 3.14).
• **Circumference (परिधि) = 2πr = πd** | **Area (क्षेत्रफल) = πr²**
• **Semicircle Perimeter:** πr + 2r (curved part + diameter!) | **Semicircle Area:** ½πr².

वृत्त की परिधि = 2πr; क्षेत्रफल = πr² (π = 22/7)। अर्धवृत्त का परिमाप = πr + 2r होता है।

Solved Example 5 (Triangle Area): Find the area of a triangle whose base is 18 cm and height is 11 cm.
Solution: Area = ½ × base × height = ½ × 18 × 11 = 9 × 11 = **99 sq. cm**.

हल: क्षेत्रफल = ½ × 18 × 11 = 99 वर्ग सेमी।

Solved Example 6 (Finding Triangle Height): The area of a triangle is 84 sq. cm and its base is 14 cm. Find its height.
Solution: Height = (2 × Area) ÷ base = (2 × 84) ÷ 14 = 168 ÷ 14 = **12 cm**.

हल: ऊँचाई = (2 × 84) ÷ 14 = 12 सेमी।

Solved Example 7 (Circle Circumference & Area): Find the circumference and area of a circle of diameter 28 cm (use π = 22/7).
Solution: Radius (r) = 28 ÷ 2 = 14 cm. Circumference = 2 × (22/7) × 14 = **88 cm**. Area = (22/7) × 14 × 14 = 22 × 2 × 14 = **616 sq. cm**.

हल: त्रिज्या r = 14 सेमी। परिधि = 2 × (22/7) × 14 = 88 सेमी; क्षेत्रफल = (22/7) × 14 × 14 = 616 वर्ग सेमी।

Solved Example 8 (Wheel Revolutions): A bicycle wheel has radius 35 cm. How far will it travel in 100 revolutions?
Solution: 1 revolution = Circumference = 2 × (22/7) × 35 = 220 cm. Distance in 100 revolutions = 220 × 100 = 22,000 cm = **220 m**.

हल: 1 चक्कर = 220 सेमी; 100 चक्कर = 22,000 सेमी = 220 मीटर।

4. TILING, CARPETING & PATHWAY PROBLEMS (RMS HIGH-YIELD) Section 4

4.1 Key RMS Word-Problem Shortcuts:
• **Number of Tiles / Bricks:** N = (Area of Floor / Wall) ÷ (Area of 1 Tile / Brick). Convert m to cm first!
• **Area of Path OUTSIDE a Rectangle (width w):** Path Area = **(l + 2w)(b + 2w) – (l × b)**.
• **Area of Path INSIDE a Rectangle (width w):** Path Area = **(l × b) – (l – 2w)(b – 2w)**.

टाइलों की संख्या = फर्श का क्षेत्रफल ÷ 1 टाइल का क्षेत्रफल। बाहरी रास्ते का क्षेत्रफल = (l+2w)(b+2w) − lb; भीतरी रास्ते का क्षेत्रफल = lb − (l−2w)(b−2w)।

Solved Example 9 (Floor Tiling): How many square tiles of side 25 cm are required to pave a hall 10 m long and 6 m wide?
Solution: Hall = 1000 cm × 600 cm = 6,00,000 cm^2. 1 Tile = 25 × 25 = 625 cm^2. Tiles = 6,00,000 ÷ 625 = **960 tiles**.

हल: हॉल = 1000 × 600 = 6,00,000 वर्ग सेमी; 1 टाइल = 625 वर्ग सेमी। टाइलें = 6,00,000 ÷ 625 = 960।

Solved Example 10 (Outer Path Around Garden): A rectangular garden is 30 m × 20 m. A 2 m wide path is built all around outside it. Find the area of the path.
Solution: Outer dimensions = (30 + 4) × (20 + 4) = 34 × 24 = 816 m^2. Garden = 30 × 20 = 600 m^2. Path Area = 816 − 600 = **216 sq. m**.

हल: बाहरी क्षेत्रफल = 34 × 24 = 816 वर्ग मी; बगीचा = 600 वर्ग मी। रास्ते का क्षेत्रफल = 816 − 600 = 216 वर्ग मी।

Solved Example 11 (Wire Rebending): A wire is bent into a square of side 12 cm. If the same wire is rebent into a rectangle of length 15 cm, find its breadth.
Solution: Wire length (Perimeter) = 4 × 12 = 48 cm. For rectangle: 2(15 + b) = 48 ⇒ 15 + b = 24 ⇒ b = **9 cm**.

हल: तार की लंबाई = 4 × 12 = 48 सेमी। आयत का परिमाप: 2(15 + b) = 48 ⇒ b = 9 सेमी।

5. 3D MENSURATION: CUBE & CUBOID (घन एवं घनाभ) Section 5

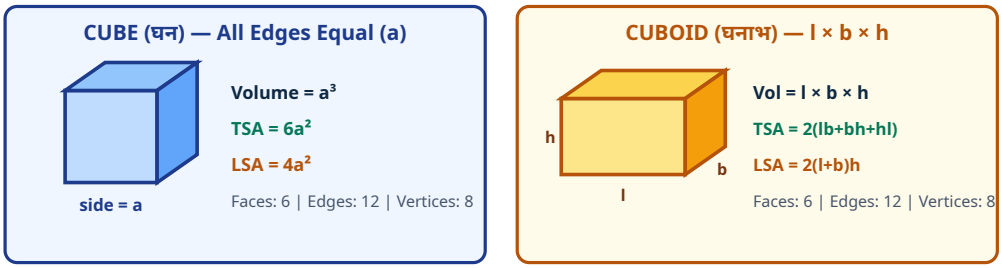

Figure 2: 3D Solids — Cube (घन) & Cuboid (घनाभ) Volume & Surface Area Formulas

5.1 Complete 3D Formula Bank (3D सूत्र संग्रह):
• **Cube (side = a):** Volume = **a^3** | Total Surface Area (TSA) = **$6a^2$** | Lateral Surface Area (4 walls) = **$4a^2$** | Longest Diagonal = **$a\sqrt{3}$**.
• **Cuboid (l, b, h):** Volume = **l × b × h** | TSA = **2(lb + bh + hl)** | Area of 4 walls (LSA) = **2(l + b) × h**.
• **Number of Small Cubes / Bricks:** N = Volume of Big Solid ÷ Volume of 1 Small Solid.

घन: आयतन = a^3, कुल पृष्ठ = $6a^2$, 4 दीवारें = $4a^2$। घनाभ: आयतन = l×b×h, कुल पृष्ठ = 2(lb+bh+hl), 4 दीवारें = 2(l+b)h।

Solved Example 12 (Cube Volume & TSA): Find the volume and total surface area of a cube whose edge is 7 cm.
Solution: Volume = 7 × 7 × 7 = **343 cu. cm**. TSA = 6 × 7^2 = 6 × 49 = **294 sq. cm**.

हल: आयतन = 7^3 = 343 घन सेमी; कुल पृष्ठीय क्षेत्रफल = 6 × 49 = 294 वर्ग सेमी।

Solved Example 13 (Water Tank Capacity): A cuboidal water tank is 6 m long, 4 m wide, and 2.5 m deep. How many litres of water can it hold?
Solution: Volume = 6 × 4 × 2.5 = 60 cu. m. Since 1 m^3 = 1,000 Litres, Capacity = 60 × 1,000 = **60,000 Litres**.

हल: आयतन = 6 × 4 × 2.5 = 60 घन मी। धारिता = 60 × 1,000 = 60,000 लीटर।

Solved Example 14 (Cutting Small Cubes): How many cubes of edge 3 cm can be cut out from a wooden cuboid of 12 cm × 9 cm × 6 cm?
Solution: Cuboid Volume = 12 × 9 × 6 = 648 cm^3. 1 Cube Volume = 3 × 3 × 3 = 27 cm^3. Number of cubes = 648 ÷ 27 = **24 cubes**.

हल: घनाभ का आयतन = 648 घन सेमी; 1 घन का आयतन = 27 घन सेमी। घनों की संख्या = 648 ÷ 27 = 24।

Solved Example 15 (Area of 4 Walls of a Room): A room is 8 m long, 6 m wide, and 4 m high. Find the cost of whitewashing its 4 walls at ₹12 per sq. m.
Solution: Area of 4 walls = 2(l + b) × h = 2(8 + 6) × 4 = 2 × 14 × 4 = 112 sq. m. Cost = 112 × 12 = **₹1,344**.

हल: 4 दीवारों का क्षेत्रफल = 2(8 + 6) × 4 = 112 वर्ग मी। खर्च = 112 × 12 = ₹1,344।

6. UNIT CONVERSION & SCALING LAWS (इकाई परिवर्तन एवं अनुपात) Section 6

Linear Unit (लंबाई)	Area Unit (क्षेत्रफल)	Volume / Capacity Unit (आयतन)
1 m = 100 cm	1 m^2 = 100 × 100 = **10,000 cm^2**	1 m^3 = 100^3 = **10,00,000 cm^3**
1 cm = 10 mm	1 cm^2 = 10 × 10 = **100 mm^2**	1 cm^3 = 10^3 = **1,000 mm^3**
1 km = 1,000 m	1 km^2 = **10,00,000 m^2** = 100 Hectares	1 m^3 = **1,000 Litres**
1 Are = 10 m × 10 m	1 Hectare = **10,000 m^2** = 100 Ares	1 Litre = **1,000 cm^3** (1,000 mL)

6.1 Scaling Laws (भुजा बदलने पर प्रभाव — RMS Favorite!):
• If side of a square (or radius of circle) becomes **k times**: Perimeter becomes **k times**, Area becomes **k^2 times**!
• If edge of a cube becomes **k times**: Surface Area becomes **k^2 times**, Volume becomes **k^3 times**!

यदि भुजा k गुना हो जाए: परिमाप k गुना, क्षेत्रफल k^2 गुना और घन का आयतन k^3 गुना हो जाता है!

Solved Example 16 (Scaling Question): If the edge of a cube is tripled (3 times), how many times does its volume increase?
Solution: Volume becomes 3^3 = 3 × 3 × 3 = **27 times**!

हल: भुजा 3 गुना होने पर आयतन 3^3 = 27 गुना हो जाएगा।

Solved Example 17 (Bricks in a Wall): How many bricks of size 20 cm × 10 cm × 5 cm are needed to build a wall 4 m long, 2 m high, and 25 cm thick?
Solution: Wall = 400 cm × 200 cm × 25 cm = 20,00,000 cm^3. 1 Brick = 20 × 10 × 5 = 1,000 cm^3. Bricks = 20,00,000 ÷ 1,000 = **2,000 bricks**.

हल: दीवार = 400 × 200 × 25 = 20,00,000 घन सेमी; 1 ईंट = 1,000 घन सेमी। ईंटें = 2,000।

Solved Example 18 (Perimeter vs Area Comparison): A square has side 10 cm and a rectangle has length 14 cm and breadth 6 cm. Compare their perimeters and areas.
Solution: Square P = 40 cm, Area = 100 cm^2. Rectangle P = 2(14+6) = 40 cm, Area = 14 × 6 = 84 cm^2. Both have the **same perimeter (40 cm)**, but the **square has greater area (100 > 84)**!

हल: दोनों का परिमाप बराबर (40 सेमी) है, लेकिन वर्ग का क्षेत्रफल (100 वर्ग सेमी) आयत (84 वर्ग सेमी) से अधिक है!

7. COMMON EXAM TRAPS & 100% SCORE CHECKLIST — Section 7

Common RMS Exam Mistake (सामान्य गलती)	Correct Rule (सही नियम)
Mixing m and cm in tiling or brick problems	Always convert ALL dimensions to cm (or m) BEFORE multiplying
Using Perimeter = 4a for Area of square	Perimeter = 4a (cm), Area = a^2 (sq. cm)
Forgetting the diameter in Semicircle perimeter	Semicircle perimeter = πr + 2r (not just πr)
Using 1 m^2 = 100 cm^2	1 m^2 = 100 cm × 100 cm = **10,000 cm^2**!
Confusing 1 m^3 with 100 Litres	1 m^3 = **1,000 Litres**; 1 Litre = **1,000 cm^3**

8. ADVANCED RMS CET PROBLEMS: RATIOS, PERCENTAGE & COMPOSITE SHAPES — Section 8

Solved Example 19 (Ratio of Sides → Ratio of Areas): The sides of two squares are in the ratio 3 : 5. Find the ratio of their perimeters and areas.
Solution: Let sides be 3x and 5x. Ratio of Perimeters = (4 × 3x) : (4 × 5x) = **3 : 5**. Ratio of Areas = $(3x)^2 : (5x)^2$ = **9 : 25**.

हल: भुजाओं का अनुपात = 3:5 ⇒ परिमापों का अनुपात = 3:5 तथा क्षेत्रफलों का अनुपात = $3^2 : 5^2$ = 9 : 25।

Solved Example 20 (Percentage Change in Area): If the length of a rectangle is increased by 20% and breadth is decreased by 20%, find the net percentage change in its area.
Solution: Let original l = 10, b = 10 ⇒ Area = 100. New l = 12, New b = 8 ⇒ New Area = 12 × 8 = 96. Decrease = 100 − 96 = **4% decrease**.

हल: मूल क्षेत्रफल = 10×10 = 100; नया क्षेत्रफल = 12×8 = 96। अतः 4% की कमी होगी।

Solved Example 21 (Carpeting with Margin): A room is 10 m × 8 m. A carpet is laid leaving a 1 m margin all around. Find the area of the carpet.
Solution: Carpet length = 10 − 2(1) = 8 m; breadth = 8 − 2(1) = 6 m. Carpet Area = 8 × 6 = **48 sq. m**.

हल: कालीन की लंबाई = 10 − 2 = 8 मी, चौड़ाई = 8 − 2 = 6 मी। क्षेत्रफल = 8 × 6 = 48 वर्ग मी।

Solved Example 22 (Melting & Recasting Cubes): Three solid metal cubes of sides 3 cm, 4 cm, and 5 cm are melted to form one single large cube. Find the edge of the new cube.
Solution: Total Volume = $3^3 + 4^3 + 5^3$ = 27 + 64 + 125 = 216 cm^3. Since a^3 = 216, new edge a = $\sqrt[3]{216}$ = **6 cm**.

हल: कुल आयतन = 27 + 64 + 125 = 216 घन सेमी। नया किनारा = $\sqrt[3]{216}$ = 6 सेमी।

Solved Example 23 (Semicircular Protractor Perimeter): Find the perimeter of a semicircular protractor of diameter 14 cm (use π = 22/7).
Solution: Radius r = 14 ÷ 2 = 7 cm. Perimeter = πr + 2r = (22/7)×7 + 14 = 22 + 14 = **36 cm**.

हल: त्रिज्या r = 7 सेमी। परिमाप = πr + 2r = 22 + 14 = 36 सेमी।

Solved Example 24 (Cost of Digging a Cuboidal Pit): A pit 8 m long, 6 m wide, and 3 m deep is dug. Find the cost of digging at ₹50 per cubic metre.
Solution: Volume of earth dug = 8 × 6 × 3 = 144 m^3. Cost = 144 × 50 = **₹7,200**.

हल: मिट्टी का आयतन = 8 × 6 × 3 = 144 घन मी। खर्च = 144 × 50 = ₹7,200।

9. COMPLETE FORMULA FLASHCARDS & PYQ MEMORY BANK — Section 9

Concept / Question Type	Direct Formula / Shortcut	Unit
Diagonal of a Square (side a)	$d = a\sqrt{2}$ | Area = $d^2 \div 2$	cm / m
Diagonal of a Rectangle (l, b)	$d = \sqrt{(l^2 + b^2)}$	cm / m
Longest Rod in a Room (l, b, h)	Diagonal = $\sqrt{(l^2 + b^2 + h^2)}$	cm / m
Number of Revolutions of Wheel	Total Distance ÷ (2πr)	Count
Height of Cuboid from Volume	h = Volume ÷ (l × b) = Volume ÷ Base Area	cm / m

Narayan Sir's Final Revision Mantra: (1) For the same perimeter, a **Square** always has a larger area than any other rectangle. (2) Perimeter = boundary (1D), Area = surface (2D), Volume = space/capacity (3D). (3) Always check units in RMS MCQ options (cm vs m, sq. cm vs cu. cm) before darkening the OMR bubble!

अंतिम मंत्र: (1) समान परिमाप वाले आयतों में वर्ग का क्षेत्रफल सबसे बड़ा होता है। (2) OMR भरने से पहले इकाई (सेमी, वर्ग सेमी, घन सेमी) अवश्य जाँचें!