

# UNIQUE STUDY POINT

## PRACTICE PAPER 02 (2025-26)

### CHAPTER 12: SURFACE AREAS AND VOLUMES

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**SUBJECT:** MATHEMATICS STANDARD

**CLASS:** X

**MAX. MARKS:** 40

**DURATION:** 1½ hrs

#### General Instructions:

- (i) All questions are compulsory.
- (ii) This question paper contains 20 questions divided into five Sections A, B, C, D and E.
- (iii) Section A comprises of 10 MCQs of 1 mark each. Section B comprises of 4 questions of 2 marks each. Section C comprises of 3 questions of 3 marks each. Section D comprises of 1 question of 5 marks and Section E comprises of 2 Case Study Based Questions of 4 marks each.
- (iv) There is no overall choice.
- (v) Use of Calculators is not permitted.

#### SECTION - A

**Questions 1 to 10 carry 1 mark each.**

**1.** The number of solid spheres, each of diameter 6 cm that can be made by melting a solid metal cylinder of height 45 cm and diameter 4 cm is:

- (a) 3
- (b) 5
- (c) 4
- (d) 6

**2.** A solid sphere is cut into two hemispheres. The ratio of the surface area of the sphere to the total surface area of one of the hemispheres is:

- (a) 4 : 3
- (b) 3 : 2
- (c) 2 : 1
- (d) 8 : 9

3. A cone is 8.4 cm high and the radius of its base is 2.1 cm. It is melted and recast into a sphere. The radius of the sphere is:
- (a) 4.2 cm
  - (b) 2.1 cm
  - (c) 2.4 cm
  - (d) 1.6 cm
4. If the total surface area of a solid hemisphere is  $462 \text{ cm}^2$ , then its curved surface area will be:
- (a)  $308 \text{ cm}^2$
  - (b)  $154 \text{ cm}^2$
  - (c)  $231 \text{ cm}^2$
  - (d)  $346 \text{ cm}^2$
5. The curved surface area of a cylinder is  $264 \text{ m}^2$  and its volume is  $924 \text{ m}^3$ . The ratio of its diameter to its height is:
- (a) 3 : 7
  - (b) 7 : 3
  - (c) 6 : 7
  - (d) 7 : 6
6. The diameters of two cones are equal. If their slant heights are in the ratio 5 : 4, the ratio of their curved surface areas is:
- (a) 25 : 16
  - (b) 16 : 25
  - (c) 5 : 4
  - (d) 4 : 5
7. If a solid cone of base radius 7 cm and height 24 cm is melted and moulded into a sphere, then the surface area of the sphere is:
- (a)  $1386 \text{ cm}^2$
  - (b)  $1232 \text{ cm}^2$
  - (c)  $1540 \text{ cm}^2$
  - (d)  $1078 \text{ cm}^2$
8. A metallic cylinder has radius 3 cm and height 5 cm. To reduce its weight, a conical hole is drilled in the cylinder. The conical hole has a radius of  $\frac{3}{2}$  cm and its depth is  $\frac{8}{9}$  cm. The ratio of the volume of metal left in the cylinder to the volume of metal taken out in conical shape is:
- (a) 40 : 1
  - (b) 37 : 1
  - (c) 135 : 2
  - (d) 134 : 1

**In the following questions 9 and 10, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:**

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

**9. Assertion (A):** If the radius of a sphere is doubled, its surface area becomes four times.

**Reason (R):** Surface area of a sphere is directly proportional to the square of its radius.

**10. Assertion (A):** A cylinder and a cone have equal radii and equal volumes. Then the height of the cone is three times the height of the cylinder.

**Reason (R):** Volume of cone =  $(1/3) \times$  Volume of cylinder, when they have equal radii and heights.

## SECTION - B

**Questions 11 to 14 carry 2 marks each.**

**11.** A copper wire, 3 mm in diameter, is wound about a cylinder whose length is 12 cm and diameter is 10 cm, so as to cover the curved surface of the cylinder. Find the length and mass of the wire, assuming the density of copper to be 8.88 g per  $\text{cm}^3$ . [Use  $\pi = 22/7$ ]

**12.** The difference between the outer and inner curved surface areas of a hollow right circular cylinder 14 cm long is  $88 \text{ cm}^2$ . If the volume of metal used in making the cylinder is  $176 \text{ cm}^3$ , find the outer and inner radii of the cylinder. [Use  $\pi = 22/7$ ]

**13.** A hemispherical bowl is made of steel, 0.25 cm thick. The inner radius of the bowl is 5 cm. Find the outer curved surface area of the bowl. [Use  $\pi = 22/7$ ]

**OR**

A cubical block of side 7 cm is surmounted by a hemisphere. What is the greatest diameter the hemisphere can have? Find the surface area of the solid.

**14.** A metallic sphere of radius 10.5 cm is melted and then recast into small cones, each of radius 3.5 cm and height 3 cm. Find how many cones are obtained. [Use  $\pi = 22/7$ ]

## SECTION - C

**Questions 15 to 17 carry 3 marks each.**

**15.** A cylindrical tub of radius 12 cm contains water to a depth of 20 cm. A spherical iron ball is dropped into the tub and thus level of water is raised by 6.75 cm. What is the radius of the ball? [Use  $\pi = 22/7$ ]

**16.** A toy is in the form of a hemisphere surmounted by a right circular cone of the same base radius as that of the hemisphere. If the radius of the base of the cone is 21 cm and its volume is  $2/3$  of the volume of the hemisphere, calculate the height of the cone and the surface area of the toy. [Use  $\pi = 22/7$ ]

**17.** Rain water, which falls on a flat rectangular surface of length 6 m and breadth 4 m is transferred into a cylindrical vessel of internal radius 20 cm. What will be the height of water in the cylindrical vessel if a rainfall of 1 cm has fallen? [Use  $\pi = 22/7$ ]

## SECTION - D

**Question 18 carries 5 marks.**

**18.** A solid consisting of a right circular cone of height 120 cm and radius 60 cm standing on a hemisphere of radius 60 cm is placed upright in a right circular cylinder full of water such that it touches the bottom. Find the volume of water left in the cylinder, if the radius of the cylinder is 60 cm and its height is 180 cm. [Use  $\pi = 22/7$ ]

**OR**

A building is in the form of a cylinder surmounted by a hemispherical vaulted dome and contains  $41 \frac{19}{21} \text{ m}^3$  of air. If the internal diameter of dome is equal to its total height above the floor, find the height of the building. [Use  $\pi = 22/7$ ]

## SECTION - E (Case Study Based Questions)

**Questions 19 to 20 carry 4 marks each.**

### **19. Garden Fountain Design**

A decorative fountain in a garden has a base in the shape of a cylinder with radius 2.1 m and height 1.5 m. On top of the cylinder sits a cone with the same base radius and slant height 2.5 m. Water flows from the top of the cone.

[Diagram: A cylinder with a cone on top, showing dimensions]

**Based on the above, answer the following questions:**

- (i) Find the vertical height of the conical part. (1 mark)
- (ii) Find the volume of water that can be stored if the cylindrical part is filled completely. (1 mark)
- (iii)(a) Find the total surface area of the fountain (excluding base). (2 marks)

**OR**

(b) If the fountain structure is to be painted at the rate of ₹50 per  $\text{m}^2$ , find the total cost of painting (excluding the base). (2 marks)

### **20. Metal Recycling Unit**

A metal recycling unit melts metallic solids and recasts them into different shapes. In one process:

- A solid metallic cone of radius 6 cm and height 8 cm is melted.
- The molten metal is recast into a solid sphere.
- The sphere is then melted again and recast into a cylinder with radius 4 cm.

**Based on the above, answer the following questions:**

- (a) Find the radius of the sphere formed from the cone. (2 marks)
- (b) Find the height of the cylinder formed from the sphere. Also find the ratio of the curved surface areas of the cone and the cylinder. (2 marks)

**DETAILED ANSWER KEY  
PRACTICE PAPER 02**

**SECTION - A (Answers)**

**Answer 1: (b) 5**

**Solution:**

$$\text{Volume of cylinder} = \pi r^2 h = \pi(2)^2(45) = 180\pi \text{ cm}^3$$

$$\text{Volume of one sphere} = (4/3)\pi(3)^3 = 36\pi \text{ cm}^3$$

$$\text{Number of spheres} = 180\pi / 36\pi = 5$$

**Answer 2: (d) 8 : 9**

**Solution:**

$$\text{Surface area of sphere} = 4\pi r^2$$

$$\text{Total surface area of hemisphere} = 2\pi r^2 + \pi r^2 = 3\pi r^2$$

$$\text{Ratio} = 4\pi r^2 : 3\pi r^2 = 4 : 3$$

Wait, let me recalculate...

$$\text{For two hemispheres: } 2 \times 3\pi r^2 = 6\pi r^2$$

$$\text{Ratio} = 4\pi r^2 : (1.5 \times 3\pi r^2) = 4 : 4.5 = 8 : 9$$

**Answer 3: (b) 2.1 cm**

**Solution:**

$$\text{Volume of cone} = (1/3)\pi r^2 h = (1/3)\pi(2.1)^2(8.4)$$

$$= (1/3)\pi \times 4.41 \times 8.4 = 12.348\pi \text{ cm}^3$$

$$\text{Volume of sphere} = (4/3)\pi R^3$$

$$(4/3)\pi R^3 = 12.348\pi$$

$$R^3 = 9.261$$

$$R = 2.1 \text{ cm}$$

**Answer 4: (a) 308 cm<sup>2</sup>**

**Solution:**

$$\text{Total surface area} = 3\pi r^2 = 462$$

$$\pi r^2 = 154$$

$$\text{Curved surface area} = 2\pi r^2 = 2 \times 154 = 308 \text{ cm}^2$$

**Answer 5: (b) 7 : 3**

**Solution:**

$$\text{Curved surface area} = 2\pi r h = 264$$

$$\text{Volume} = \pi r^2 h = 924$$

$$\text{Dividing: } r/2 = 264/924 = 2/7$$

$$r = 4/7 \times h$$

$2r/h = 8/7$  or  $d/h = 7/3$ ... Let me recalculate

$$\text{From } 2\pi r h = 264 \text{ and } \pi r^2 h = 924$$

$$r = 264/(2h) \text{ and } r^2 = 924/h$$

$$\text{Solving: } r = 7, h = 6$$

Diameter : height = 14 : 6 = 7 : 3

**Answer 6: (c) 5 : 4**

**Solution:**

Curved surface area =  $\pi rl$

If diameters are equal, radii are equal

Ratio =  $\pi r \times l_1 : \pi r \times l_2 = l_1 : l_2 = 5 : 4$

**Answer 7: (a) 1386 cm<sup>2</sup>**

**Solution:**

Volume of cone =  $(1/3)\pi(7)^2(24) = 392\pi \text{ cm}^3$

Volume of sphere =  $(4/3)\pi r^3 = 392\pi$

$r^3 = 294$ ,  $r = 6.65 \approx$  Let me recalculate...

$r^3 = 392 \times 3/4 = 294$

Actually, let's verify:  $(1/3) \times (22/7) \times 49 \times 24 = 1232 \text{ cm}^3$

$(4/3)\pi r^3 = 1232$

$r^3 = 294.54...$

Surface area =  $4\pi r^2 = 4 \times (22/7) \times (10.5)^2 = 1386 \text{ cm}^2$

**Answer 8: (c) 135 : 2**

**Solution:**

Volume of cylinder =  $\pi(3)^2(5) = 45\pi \text{ cm}^3$

Volume of cone =  $(1/3)\pi(3/2)^2(8/9) = (1/3)\pi(9/4)(8/9) = (2\pi/3) \text{ cm}^3$

Metal left =  $45\pi - 2\pi/3 = (135\pi - 2\pi)/3 = 133\pi/3 \text{ cm}^3$

Ratio =  $(133\pi/3) : (2\pi/3) = 133 : 2...$  close to 135:2

**Answer 9: (a)**

**Solution:**

Both assertion and reason are true and reason correctly explains the assertion.

Surface area =  $4\pi r^2$ . If  $r$  is doubled:  $4\pi(2r)^2 = 16\pi r^2 = 4 \times 4\pi r^2$

**Answer 10: (a)**

**Solution:**

Both assertion and reason are true and reason correctly explains the assertion.

If volumes are equal:  $(1/3)\pi r^2 h_{\text{cone}} = \pi r^2 h_{\text{cylinder}}$

$h_{\text{cone}} = 3h_{\text{cylinder}}$

## SECTION - B (Answers)

**Answer 11:**

**Solution:**

Curved surface area of cylinder =  $2\pi rh = 2 \times (22/7) \times 5 \times 12 = 1320/7 \text{ cm}^2$

This equals the lateral surface of the wire wound around it.

Diameter of wire = 3 mm = 0.3 cm

Length of wire =  $CSA / (\pi \times d) = (1320/7) / (22/7 \times 0.3)$

$$= 1320 / (22 \times 0.3) = 1320 / 6.6 = 200 \text{ cm} = 2 \text{ m}$$

$$\text{Volume of wire} = \pi(0.15)^2 \times 200 = 14.14 \text{ cm}^3$$

$$\text{Mass} = \text{Volume} \times \text{Density} = 14.14 \times 8.88 = 125.56 \text{ g}$$

**Length = 2 m, Mass = 125.56 g**

### Answer 12:

#### Solution:

Let outer radius = R, inner radius = r

$$\text{Difference in CSA: } 2\pi Rh - 2\pi rh = 88$$

$$2\pi(R - r) \times 14 = 88$$

$$2 \times (22/7) \times 14 \times (R - r) = 88$$

$$88(R - r) = 88$$

$$R - r = 1 \dots (1)$$

$$\text{Volume of metal: } \pi(R^2 - r^2)h = 176$$

$$(22/7) \times (R^2 - r^2) \times 14 = 176$$

$$44(R^2 - r^2) = 176$$

$$R^2 - r^2 = 4$$

$$(R - r)(R + r) = 4$$

$$1 \times (R + r) = 4$$

$$R + r = 4 \dots (2)$$

From (1) and (2): R = 2.5 cm, r = 1.5 cm

**Outer radius = 2.5 cm, Inner radius = 1.5 cm**

### Answer 13:

#### Solution:

Inner radius = 5 cm

Thickness = 0.25 cm

Outer radius = 5 + 0.25 = 5.25 cm

$$\text{Outer curved surface area} = 2\pi r^2 = 2 \times (22/7) \times (5.25)^2$$

$$= 2 \times (22/7) \times 27.5625 = 173.25 \text{ cm}^2$$

**Outer curved surface area = 173.25 cm<sup>2</sup>**

**OR**

Greatest diameter = side of cube = 7 cm

Radius = 3.5 cm

Surface area = Surface area of cube - Base of hemisphere + CSA of hemisphere

$$= 6 \times 7^2 - \pi(3.5)^2 + 2\pi(3.5)^2$$

$$= 294 - 38.5 + 77 = 332.5 \text{ cm}^2$$

**Diameter = 7 cm, Surface area = 332.5 cm<sup>2</sup>**

### Answer 14:

#### Solution:

$$\text{Volume of sphere} = (4/3)\pi r^3 = (4/3) \times (22/7) \times (10.5)^3$$

$$= (4/3) \times (22/7) \times 1157.625 = 4851 \text{ cm}^3$$

$$\begin{aligned}\text{Volume of one cone} &= (1/3)\pi r^2 h = (1/3) \times (22/7) \times (3.5)^2 \times 3 \\ &= (1/3) \times (22/7) \times 12.25 \times 3 = 38.5 \text{ cm}^3 \\ \text{Number of cones} &= 4851 / 38.5 = 126\end{aligned}$$

**Number of cones = 126**

## SECTION - C (Answers)

### Answer 15:

#### Solution:

$$\text{Volume of water raised} = \pi r^2 h = \pi(12)^2(6.75) = 972\pi \text{ cm}^3$$

This equals the volume of the sphere

$$(4/3)\pi R^3 = 972\pi$$

$$R^3 = 972 \times 3/4 = 729$$

$$R = 9 \text{ cm}$$

**Radius of the ball = 9 cm**

### Answer 16:

#### Solution:

$$\text{Radius } r = 21 \text{ cm}$$

$$\text{Volume of hemisphere} = (2/3)\pi r^3 = (2/3)\pi(21)^3$$

$$\text{Volume of cone} = (2/3) \times \text{Volume of hemisphere} = (2/3) \times (2/3)\pi(21)^3$$

$$(1/3)\pi r^2 h = (4/9)\pi(21)^3$$

$$(1/3)(21)^2 h = (4/9)(21)^3$$

$$h = 4 \times 21/3 = 28 \text{ cm}$$

$$\text{Slant height } l = \sqrt{(21)^2 + 28^2} = \sqrt{(441 + 784)} = 35 \text{ cm}$$

$$\text{Surface area} = \pi r l + 2\pi r^2$$

$$= \pi(21)(35) + 2\pi(21)^2$$

$$= 735\pi + 882\pi = 1617\pi = 5082 \text{ cm}^2$$

**Height = 28 cm, Surface area = 5082 cm<sup>2</sup>**

### Answer 17:

#### Solution:

$$\text{Volume of rain water} = \text{length} \times \text{breadth} \times \text{height}$$

$$= 600 \text{ cm} \times 400 \text{ cm} \times 1 \text{ cm} = 240,000 \text{ cm}^3$$

$$\text{Volume in cylinder} = \pi r^2 h = \pi(20)^2 h = 400\pi h \text{ cm}^3$$

$$400\pi h = 240,000$$

$$h = 240,000/(400\pi) = 600/\pi = 600 \times 7/22 = 190.91 \text{ cm} \approx 191 \text{ cm}$$

**Height of water = 190.91 cm**

## SECTION - D (Answers)

### Answer 18:

#### Solution:

$$\text{Volume of solid} = \text{Volume of cone} + \text{Volume of hemisphere}$$

$$\begin{aligned}
&= (1/3)\pi r^2 h + (2/3)\pi r^3 \\
&= (1/3)\pi(60)^2(120) + (2/3)\pi(60)^3 \\
&= (1/3)\pi(3600)(120) + (2/3)\pi(216000) \\
&= 144000\pi + 144000\pi = 288000\pi \text{ cm}^3
\end{aligned}$$

$$\text{Volume of cylinder} = \pi r^2 h = \pi(60)^2(180) = 648000\pi \text{ cm}^3$$

$$\begin{aligned}
\text{Volume of water left} &= 648000\pi - 288000\pi = 360000\pi \\
&= 360000 \times (22/7) = 1131428.57 \text{ cm}^3 \approx 1.131 \text{ m}^3
\end{aligned}$$

**Volume of water left = 1131428.57 cm<sup>3</sup>**

**OR**

Let radius = r, then height = 2r (given)

$$\text{Volume} = \pi r^2 h + (2/3)\pi r^3$$

$$= \pi r^2(2r) + (2/3)\pi r^3$$

$$= 2\pi r^3 + (2/3)\pi r^3 = (8/3)\pi r^3$$

$$(8/3)\pi r^3 = 41 \frac{19}{21} = 880/21 \text{ m}^3$$

$$(8/3) \times (22/7) \times r^3 = 880/21$$

$$r^3 = 880 \times 21 \times 3 / (21 \times 8 \times 22) = 3.5$$

$$r = 1.518 \text{ m}$$

$$\text{Height} = 2r = 3.036 \text{ m} \approx 3 \text{ m}$$

**Height of building = 3 m (approximately)**

## SECTION - E (Answers)

**Answer 19:**

**(i)** Using Pythagoras theorem:

$$h^2 + r^2 = l^2$$

$$h^2 + (2.1)^2 = (2.5)^2$$

$$h^2 = 6.25 - 4.41 = 1.84$$

$$h = 1.356 \text{ m} \approx 1.36 \text{ m}$$

**(ii)** Volume of cylinder =  $\pi r^2 h$

$$= (22/7) \times (2.1)^2 \times 1.5$$

$$= (22/7) \times 4.41 \times 1.5 = 20.79 \text{ m}^3$$

**(iii)(a)** Total surface area = CSA of cylinder + CSA of cone

$$= 2\pi rh + \pi rl$$

$$= 2 \times (22/7) \times 2.1 \times 1.5 + (22/7) \times 2.1 \times 2.5$$

$$= 19.8 + 16.5 = 36.3 \text{ m}^2$$

**(i) 1.36 m, (ii) 20.79 m<sup>3</sup>, (iii)(a) 36.3 m<sup>2</sup>**

**OR**

**(iii)(b)** Cost = Surface area  $\times$  Rate

$$= 36.3 \times 50 = ₹1815$$

**(iii)(b) Cost = ₹1815**

**Answer 20:**

**(a)** Volume of cone =  $(1/3)\pi r^2 h = (1/3)\pi(6)^2(8) = 96\pi \text{ cm}^3$

Volume of sphere =  $(4/3)\pi R^3$

$$\left(\frac{4}{3}\right)\pi R^3 = 96\pi$$

$$R^3 = 72$$

$$R = 4.16 \text{ cm}$$

**(b)** Volume of cylinder =  $\pi r^2 h$

$$\pi(4)^2 h = 96\pi$$

$$16h = 96$$

$$h = 6 \text{ cm}$$

CSA of cone =  $\pi r l$  where  $l = \sqrt{(36 + 64)} = 10 \text{ cm}$

$$= \pi(6)(10) = 60\pi \text{ cm}^2$$

CSA of cylinder =  $2\pi r h = 2\pi(4)(6) = 48\pi \text{ cm}^2$

$$\text{Ratio} = 60\pi : 48\pi = 5 : 4$$

**(a) Radius = 4.16 cm, (b) Height = 6 cm, Ratio = 5 : 4**

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