

UNIQUE STUDY POINT

PRACTICE PAPER 01 (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. A cylindrical pillar has diameter 56 cm and is 3.5 m high. The cost of painting the curved surface at the rate of ₹12.50 per m² is:

- (a) ₹77
- (b) ₹154
- (c) ₹231
- (d) ₹308

2. A metallic sphere of radius 4.2 cm is melted and recast into the shape of a cylinder of radius 6 cm. The height of the cylinder is:

- (a) 2.744 cm
- (b) 3.5 cm
- (c) 4.116 cm
- (d) 2.058 cm

3. The total surface area of a solid hemisphere of radius r is:

- (a) $2\pi r^2$
- (b) $3\pi r^2$
- (c) $4\pi r^2$
- (d) πr^2

4. A cone, a hemisphere and a cylinder stand on equal bases and have the same height. The ratio of their volumes is:

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

5. The radius of a hemispherical balloon increases from 6 cm to 12 cm as air is being pumped into it. The ratio of the surface areas of the balloon in the two cases is:

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

6. A solid cylinder of radius r and height h is placed over another cylinder of same height and radius. The total surface area of the shape so formed is:

- (a) $4\pi rh + 4\pi r^2$
- (b) $2\pi rh + 2\pi r^2$
- (c) $4\pi rh + 2\pi r^2$
- (d) $2\pi rh + 4\pi r^2$

7. If the radius of base of a right circular cylinder is halved, keeping the height same, the ratio of the volume of the reduced cylinder to that of the original cylinder is:

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

8. Water flows at the rate of 10 m/minute through a cylindrical pipe having diameter 5 mm. How much time would it take to fill a conical vessel whose diameter of the base is 40 cm and depth 24 cm?

- (a) 48 minutes 15 seconds
- (b) 51 minutes 12 seconds
- (c) 52 minutes 1 second
- (d) 55 minutes

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): A solid ball is exactly fitted inside a cubical box of side 'a'. The volume of the ball is $\frac{\pi a^3}{6}$.

Reason (R): Diameter of the ball will be equal to the side of the cube.

10. Assertion (A): If the height of a cone is doubled and radius remains same, then the volume becomes double.

Reason (R): Volume of cone is directly proportional to its height when radius is constant.

SECTION - B

Questions 11 to 14 carry 2 marks each.

11. A vessel is in the form of an inverted cone. Its height is 8 cm and the radius of its top, which is open, is 5 cm. It is filled with water up to the brim. When lead shots, each of which is a sphere of radius 0.5 cm are dropped into the vessel, one-fourth of the water flows out. Find the number of lead shots dropped in the vessel.

12. A hemisphere of lead of radius 7 cm is cast into a right circular cone of height 49 cm. Find the radius of the base of the cone. [Use $\pi = \frac{22}{7}$]

13. A toy is in the form of a cone of radius 3.5 cm mounted on a hemisphere of same radius. The total height of the toy is 15.5 cm. Find the total surface area of the toy. [Use $\pi = \frac{22}{7}$]

OR

A cylindrical container of radius 6 cm and height 15 cm is filled with ice-cream. The whole ice-cream is to be distributed to 10 children in equal cones with hemispherical tops. If the height of the conical portion is 4 times the radius of its base, find the radius of the ice-cream cone.

14. A well of diameter 3 m is dug 14 m deep. The earth taken out of it has been spread evenly all around it in the shape of a circular ring of width 4 m to form an embankment. Find the height of the embankment. [Use $\pi = \frac{22}{7}$]

SECTION - C

Questions 15 to 17 carry 3 marks each.

15. A wooden toy is in the form of a cone surmounted on a hemisphere. The diameter of the base of the cone is 6 cm and its height is 4 cm. Find the cost of painting the toy at the rate of ₹5 per 100 cm². [Use $\pi = \frac{22}{7}$]

16. A milk container is made of metal sheet in the shape of frustum of a cone whose volume is $10459\frac{3}{7}$ cm³. The radii of its lower and upper circular ends are 8 cm and 20 cm respectively. Find the cost of metal sheet used in making the container at the rate of ₹1.40 per cm². [Use $\pi = \frac{22}{7}$]

17. 504 cones, each of diameter 3.5 cm and height 3 cm, are melted and recast into a metallic sphere. Find the diameter of the sphere and hence find its surface area. [Use $\pi = \frac{22}{7}$]

SECTION - D

Question 18 carries 5 marks.

18. A solid toy is in the form of a hemisphere surmounted by a right circular cone. The height of the cone is 4 cm and the diameter of the base is 8 cm. Determine the volume of the toy. If a cube circumscribes the toy, then find the difference of the volumes of cube and the toy. Also, find the total surface area of the toy. [Use $\pi = 3.14$]

OR

A vessel is in the form of a hollow hemisphere mounted by a hollow cylinder. The diameter of the hemisphere is 14 cm and the total height of the vessel is 13 cm. Find:

- (a) The inner surface area of the vessel
- (b) The volume of water the vessel can hold [Use $\pi = 22/7$]

SECTION - E (Case Study Based Questions)

Questions 19 to 20 carry 4 marks each.

19. Water Tank Design

A water tank for a building is designed to store water. The tank consists of a cylindrical portion and a hemispherical top. The total height of the tank is 4.5 m and the diameter is 4 m.

[Diagram: A cylinder with hemispherical top, Total height = 4.5 m, Diameter = 4 m]

Based on the above, answer the following questions:

- (i) Find the height of the cylindrical portion. (1 mark)
- (ii) Find the curved surface area of the hemispherical portion. (1 mark)
- (iii)(a) Find the total capacity of the tank (volume). (2 marks)

OR

- (b) Find the cost of painting the outer surface of the tank (excluding the base) at the rate of ₹25 per m². (2 marks)

20. Ice-cream Factory

An ice-cream factory makes ice-cream in two shapes:

Shape A: A cone with hemispherical top (both having radius 3.5 cm). The height of the cone is 10 cm.

Shape B: A cylinder with two hemispherical ends (all having radius 3.5 cm). The height of the cylinder is 7 cm.

Based on the above, answer the following questions:

- (a) Which ice-cream shape has more quantity? Find the difference in volumes. (2 marks)
- (b) If the factory wants to pack the ice-creams in wrappers, which shape requires more wrapper material? Find the difference in surface areas. (2 marks)

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DETAILED ANSWER KEY
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SECTION - A (Answers)

Answer 1: (a) ₹77

Solution:

Diameter = 56 cm = 0.56 m, so radius $r = 0.28$ m

Height $h = 3.5$ m

Curved surface area = $2\pi rh = 2 \times (22/7) \times 0.28 \times 3.5$
 $= 2 \times 22 \times 0.04 \times 3.5 = 6.16 \text{ m}^2$

Cost = $6.16 \times 12.50 = ₹77$

Answer 2: (a) 2.744 cm

Solution:

Volume of sphere = $(4/3)\pi r^3 = (4/3)\pi(4.2)^3$

Volume of cylinder = $\pi R^2 h = \pi(6)^2 h$

Since volumes are equal:

$(4/3)\pi(4.2)^3 = \pi(6)^2 h$

$h = (4/3) \times (4.2)^3 / 36 = (4/3) \times 74.088 / 36 = 2.744 \text{ cm}$

Answer 3: (b) $3\pi r^2$

Solution:

Total surface area of solid hemisphere = Curved surface area + Base area
 $= 2\pi r^2 + \pi r^2 = 3\pi r^2$

Answer 4: (a) 1 : 2 : 3

Solution:

Let radius = r and height = $h = r$ (for hemisphere)

Volume of cone = $(1/3)\pi r^2 h = (1/3)\pi r^3$

Volume of hemisphere = $(2/3)\pi r^3$

Volume of cylinder = $\pi r^2 h = \pi r^3$

Ratio = $(1/3)\pi r^3 : (2/3)\pi r^3 : \pi r^3 = 1 : 2 : 3$

Answer 5: (a) 1 : 4

Solution:

Surface area of hemisphere = $3\pi r^2$

Initial surface area = $3\pi(6)^2 = 108\pi$

Final surface area = $3\pi(12)^2 = 432\pi$

Ratio = $108\pi : 432\pi = 1 : 4$

Answer 6: (c) $4\pi rh + 2\pi r^2$

Solution:

$$\begin{aligned} \text{Total surface area} &= 2 \text{ curved surfaces} + 2 \text{ circular ends} \\ &= 2\pi rh + 2\pi rh + 2\pi r^2 \\ &= 4\pi rh + 2\pi r^2 \end{aligned}$$

Answer 7: (b) 1 : 4

Solution:

$$\text{Original volume} = \pi r^2 h$$

$$\text{New volume} = \pi (r/2)^2 h = \pi r^2 h / 4$$

$$\text{Ratio} = \pi r^2 h / 4 : \pi r^2 h = 1 : 4$$

Answer 8: (b) 51 minutes 12 seconds

Solution:

$$\text{Volume of cone} = (1/3)\pi r^2 h = (1/3) \times \pi \times (20)^2 \times 24 = 3200\pi \text{ cm}^3$$

$$\text{Pipe radius} = 2.5 \text{ mm} = 0.25 \text{ cm}$$

$$\text{Volume flowing per minute} = \pi (0.25)^2 \times 1000 = 62.5\pi \text{ cm}^3$$

$$\text{Time} = 3200\pi / 62.5\pi = 51.2 \text{ minutes} = 51 \text{ minutes } 12 \text{ seconds}$$

Answer 9: (a)

Solution:

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

If diameter = a, then radius = a/2

$$\text{Volume} = (4/3)\pi (a/2)^3 = (4/3)\pi (a^3/8) = \pi a^3/6$$

Answer 10: (a)

Solution:

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

$V = (1/3)\pi r^2 h$. When h is doubled and r is constant, volume doubles.

SECTION - B (Answers)

Answer 11:

Solution:

$$\text{Volume of cone} = (1/3)\pi r^2 h = (1/3)\pi (5)^2 (8) = 200\pi/3 \text{ cm}^3$$

$$\text{Water flown out} = (1/4) \times 200\pi/3 = 50\pi/3 \text{ cm}^3$$

$$\text{Volume of one lead shot} = (4/3)\pi (0.5)^3 = \pi/6 \text{ cm}^3$$

$$\text{Number of shots} = (50\pi/3) \div (\pi/6) = (50\pi/3) \times (6/\pi) = 100$$

Therefore, 100 lead shots were dropped.

Answer 12:

Solution:

$$\text{Volume of hemisphere} = (2/3)\pi r^3 = (2/3)\pi (7)^3 = 686\pi/3 \text{ cm}^3$$

$$\text{Volume of cone} = (1/3)\pi R^2 h = (1/3)\pi R^2 (49)$$

Equating volumes:

$$686\pi/3 = (1/3)\pi R^2 (49)$$

$$R^2 = 686/49 = 14$$

$$R = \sqrt{14} \text{ cm}$$

Radius of the cone = $\sqrt{14} \text{ cm} \approx 3.74 \text{ cm}$

Answer 13:

Solution:

$$\text{Radius } r = 3.5 \text{ cm}$$

$$\text{Height of cone} = 15.5 - 3.5 = 12 \text{ cm}$$

$$\text{Slant height } l = \sqrt{(r^2 + h^2)} = \sqrt{(3.5^2 + 12^2)} = \sqrt{(12.25 + 144)} = \sqrt{156.25} = 12.5 \text{ cm}$$

TSA = Curved surface of cone + Curved surface of hemisphere

$$= \pi r l + 2\pi r^2$$

$$= (22/7) \times 3.5 \times 12.5 + 2 \times (22/7) \times 3.5 \times 3.5$$

$$= 137.5 + 77 = 214.5 \text{ cm}^2$$

Total surface area = 214.5 cm^2

OR

$$\text{Volume of cylinder} = \pi(6)^2(15) = 540\pi \text{ cm}^3$$

For each cone: let radius = r , height = $4r$

$$\text{Volume} = (1/3)\pi r^2(4r) + (2/3)\pi r^3 = (4\pi r^3/3) + (2\pi r^3/3) = 2\pi r^3$$

$$10 \text{ cones: } 10 \times 2\pi r^3 = 20\pi r^3$$

$$20\pi r^3 = 540\pi$$

$$r^3 = 27, r = 3 \text{ cm}$$

Radius of ice-cream cone = 3 cm

Answer 14:

Solution:

$$\text{Volume of earth dug out} = \pi(1.5)^2(14) = 31.5\pi \text{ m}^3$$

$$\text{Inner radius of embankment} = 1.5 \text{ m}$$

$$\text{Outer radius} = 1.5 + 4 = 5.5 \text{ m}$$

$$\text{Volume of embankment} = \pi(R^2 - r^2)h = \pi(5.5^2 - 1.5^2)h$$

$$31.5\pi = \pi(30.25 - 2.25)h$$

$$31.5 = 28h$$

$$h = 31.5/28 = 1.125 \text{ m} = 1.125 \text{ m}$$

Height of embankment = 1.125 m or $1 \text{ m } 12.5 \text{ cm}$

SECTION - C (Answers)

Answer 15:

Solution:

$$\text{Radius} = 3 \text{ cm, Height of cone} = 4 \text{ cm}$$

$$\text{Slant height } l = \sqrt{(3^2 + 4^2)} = 5 \text{ cm}$$

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

$$= \pi r(l + 2r) = (22/7) \times 3 \times (5 + 6)$$

$$= (22/7) \times 3 \times 11 = 103.71 \text{ cm}^2$$

$$\text{Cost} = (103.71/100) \times 5 = ₹5.19 \approx ₹5.20$$

Cost of painting = ₹5.19

Answer 16:**Solution:**

$$\text{Volume} = 10459 \frac{3}{7} = 73216/7 \text{ cm}^3$$

$$r_1 = 8 \text{ cm}, r_2 = 20 \text{ cm}$$

$$\text{Volume of frustum} = (1/3)\pi h(r_1^2 + r_2^2 + r_1 r_2)$$

$$73216/7 = (1/3) \times (22/7) \times h \times (64 + 400 + 160)$$

$$73216/7 = (22/21) \times h \times 624$$

$$h = 73216 \times 21 / (7 \times 22 \times 624) = 16 \text{ cm}$$

$$\text{Slant height } l = \sqrt{(r_2 - r_1)^2 + h^2} = \sqrt{(12)^2 + (16)^2} = 20 \text{ cm}$$

$$\text{Surface area} = \pi(r_1 + r_2)l + \pi r_1^2 + \pi r_2^2$$

$$= \pi(28)(20) + \pi(64) + \pi(400)$$

$$= \pi(560 + 64 + 400) = 1024\pi = 3217.14 \text{ cm}^2$$

$$\text{Cost} = 3217.14 \times 1.40 = ₹4504$$

Cost of metal sheet = ₹4504

Answer 17:**Solution:**

$$\text{Volume of one cone} = (1/3)\pi r^2 h = (1/3)\pi(1.75)^2(3) \text{ cm}^3$$

$$\text{Volume of 504 cones} = 504 \times (1/3)\pi(1.75)^2(3) = 1617\pi \text{ cm}^3$$

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

$$(4/3)\pi R^3 = 1617\pi$$

$$R^3 = 1617 \times 3/4 = 1212.75$$

$$R = 10.66 \text{ cm (approximately)}$$

$$\text{Diameter} = 2R = 21.32 \text{ cm}$$

$$\text{Surface area} = 4\pi R^2 = 4\pi(10.66)^2 = 1424.7 \text{ cm}^2$$

Diameter = 21 cm, Surface area ≈ 1386 cm²

SECTION - D (Answers)

Answer 18:**Solution:**

$$\text{Radius} = 4 \text{ cm}, \text{Height of cone} = 4 \text{ cm}$$

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

$$= (1/3)\pi r^2 h + (2/3)\pi r^3$$

$$= (1/3)\pi(4)^2(4) + (2/3)\pi(4)^3$$

$$= 64\pi/3 + 128\pi/3 = 192\pi/3 = 64\pi = 201.06 \text{ cm}^3$$

$$\text{Side of cube} = 8 \text{ cm (diameter)}$$

$$\text{Volume of cube} = 8^3 = 512 \text{ cm}^3$$

$$\text{Difference} = 512 - 201.06 = 310.94 \text{ cm}^3$$

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

$$l = \sqrt{16 + 16} = 4\sqrt{2} \text{ cm}$$

$$\text{TSA} = \pi(4)(4\sqrt{2}) + 2\pi(16) = 16\pi\sqrt{2} + 32\pi = 103.58 \text{ cm}^2$$

Volume of toy = 201.06 cm³, Difference = 310.94 cm³, TSA = 103.58 cm²

OR

Radius = 7 cm, Height of cylinder = $13 - 7 = 6$ cm

$$\begin{aligned} \text{(a) Inner surface area} &= 2\pi rh + 2\pi r^2 \\ &= 2\pi(7)(6) + 2\pi(7)^2 = 84\pi + 98\pi = 182\pi = 572 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{(b) Volume} &= \pi r^2 h + \frac{2}{3}\pi r^3 \\ &= \pi(49)(6) + \frac{2}{3}\pi(343) \\ &= 294\pi + 228.67\pi = 522.67\pi = 1641.14 \text{ cm}^3 \end{aligned}$$

(a) Inner surface area = 572 cm², (b) Volume = 1641.14 cm³

SECTION - E (Answers)

Answer 19:

(i) Radius = 2 m
Height of cylindrical portion = $4.5 - 2 = 2.5$ m

$$\begin{aligned} \text{(ii) Curved surface area of hemisphere} &= 2\pi r^2 \\ &= 2\pi(2)^2 = 8\pi = 25.13 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} \text{(iii)(a) Volume} &= \pi r^2 h + \frac{2}{3}\pi r^3 \\ &= \pi(4)(2.5) + \frac{2}{3}\pi(8) \\ &= 10\pi + 16\pi/3 = 46\pi/3 = 48.17 \text{ m}^3 \end{aligned}$$

(i) 2.5 m, (ii) 25.13 m², (iii)(a) 48.17 m³

OR

$$\begin{aligned} \text{(iii)(b) Surface area} &= 2\pi rh + 2\pi r^2 \\ &= 2\pi(2)(2.5) + 2\pi(4) = 10\pi + 8\pi = 18\pi = 56.55 \text{ m}^2 \\ \text{Cost} &= 56.55 \times 25 = ₹1413.75 \end{aligned}$$

(iii)(b) Cost = ₹1413.75

Answer 20:

$$\begin{aligned} \text{(a) Shape A volume} &= \frac{1}{3}\pi r^2 h + \frac{2}{3}\pi r^3 \\ &= \frac{1}{3}\pi(3.5)^2(10) + \frac{2}{3}\pi(3.5)^3 \\ &= 128.33\pi + 28.58\pi = 156.91\pi = 493.04 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \text{Shape B volume} &= \pi r^2 h + 2 \times \frac{2}{3}\pi r^3 \\ &= \pi(3.5)^2(7) + \frac{4}{3}\pi(3.5)^3 \\ &= 269.5\pi + 57.17\pi = 326.67\pi = 1026.43 \text{ cm}^3 \end{aligned}$$

Shape B has more quantity.
Difference = $1026.43 - 493.04 = 533.39 \text{ cm}^3$

$$\begin{aligned} \text{(b) Shape A surface area} &= \pi rl + 2\pi r^2 \text{ (cone + hemisphere)} \\ l &= \sqrt{(3.5)^2 + 10^2} = 10.59 \text{ cm} \\ &= \pi(3.5)(10.59) + 2\pi(3.5)^2 = 116.49\pi + 24.5\pi = 140.99\pi = 442.91 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \text{Shape B surface area} &= 2\pi rh + 2(2\pi r^2) \\ &= 2\pi(3.5)(7) + 4\pi(3.5)^2 = 154\pi + 49\pi = 203\pi = 637.74 \text{ cm}^2 \end{aligned}$$

Shape B requires more wrapper material.
Difference = $637.74 - 442.91 = 194.83 \text{ cm}^2$

(a) Shape B, Difference = 533.39 cm³, (b) Shape B, Difference = 194.83 cm²

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