MATHEMATICS

CBSE
CLASS 9

As per the latest revised syllabus prescribed by CBSE

Question Bank with Detailed Solutions

(Based on NCERT Part I & Part II — 14 Chapters, 2,170 Questions with Solutions, including 700 IIT Foundation Questions)

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Mobile: +91 96637 37998 **Email:** info@om-murugapublication.in

ISBN: 978-81-180191-2-1

Published by Om Muruga Publication

available at amazon

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50/31, Malai Veethi, Velayuthampalayam, Karur – 639117, Tamil Nadu
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How each chapter is organised

- Chapter at a Glance with Key Formulas
- Questions: A — MCQ (60), B — Very Short Answer (30), C — Short Answer (30), D — Long Answer (20), E — Case-Based (15)
- Level 1: Standard (Easy, Medium, Tough) followed by Level 2: IIT Foundation Questions & their Answers
- Solutions (Formula → Solution) follow each question section

Chapter 14: Math of Space: Surface Area and Volume

Chapter at a Glance

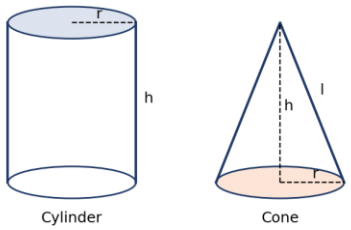
1. Surface Area and Volume

- **Surface area** is the total area of all the faces or curved surfaces of a solid (units cm^2, m^2). **Volume** is the space it occupies (units cm^3, m^3).
- 1 L = 1000 cm^3 and 1 m^3 = 1000 L.

2. Cuboids and Cubes

- Cuboid l × w × h: V = lwh; TSA = 2(lw + wh + hl); area of four walls = 2(l + w)h; diagonal = $\sqrt{l^2 + w^2 + h^2}$.
- Cube of side a: V = a^3; TSA = $6a^2$; diagonal = $a\sqrt{3}$.

3. Cylinders and Cones



Cylinder and cone with radius r, height h and slant height l

- Cylinder: V = $\pi r^2 h$; CSA = $2\pi rh$; TSA = $2\pi r(h + r)$.
- Cone: $l^2 = r^2 + h^2$; CSA = πrl; TSA = $\pi r(l + r)$; V = $\frac{1}{3}\pi r^2 h$ — one-third of the cylinder on the same base and height.

4. Pyramids, Spheres and Hemispheres

- Pyramid: V = $\frac{1}{3}$ × base area × height; surface area = sum of the areas of its faces.
- 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 = $\frac{2}{3}\pi r^3$.
- **Archimedes:** a sphere inside a cylinder that just encloses it has $\frac{2}{3}$ of its volume and the same area as its curved surface.

5. Scaling, Recasting and Guesstimates

- Multiplying every length by k multiplies areas by k^2 and volumes by k^3.
- When a solid is melted and recast, its **volume stays the same**.
- Guesstimates: choose sensible measurements, state your assumptions and round sensibly.

Key Formulas

Solid	Surface area	Volume
Cuboid	2(lw + wh + hl)	lwh
Cube	$6a^2$	a^3
Cylinder	CSA $2\pi rh$; TSA $2\pi r(h + r)$	$\pi r^2 h$
Cone	CSA πrl; TSA $\pi r(l + r)$	$\frac{1}{3}\pi r^2 h$
Pyramid	sum of faces	$\frac{1}{3}$ × base × h
Sphere	$4\pi r^2$	$\frac{4}{3}\pi r^3$

Hemisphere	CSA $2\pi r^2$; TSA $3\pi r^2$	$\frac{2}{3}\pi r^3$

Multiple Choice Questions

Level 1: Standard

Easy (15 questions)

Q1. The volume of a cube of side 5 cm is

(a) 25 cm³ **(b)** 125 cm³ **(c)** 150 cm³ **(d)** 100 cm³

Q2. The total surface area of a cube of side 4 cm is

(a) 64 cm² **(b)** 16 cm² **(c)** 96 cm² **(d)** 48 cm²

Q3. The volume of a cuboid 10 cm × 6 cm × 4 cm is

(a) 200 cm³ **(b)** 240 cm³ **(c)** 120 cm³ **(d)** 248 cm³

Q4. ($\pi = \frac{22}{7}$) The volume of a cylinder of radius 7 cm and height 10 cm is

(a) 440 cm³ **(b)** 154 cm³ **(c)** 1540 cm³ **(d)** 4400 cm³

Q5. **Assertion (A):** The volume of a cone is one-third of the volume of a cylinder with the same base and height.

Reason (R): Volume of a cone = $\frac{1}{3}\pi r^2 h$.

(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.

Q6. ($\pi = \frac{22}{7}$) The curved surface area of a cylinder of radius 7 cm and height 10 cm is

(a) 220 cm² **(b)** 1540 cm² **(c)** 880 cm² **(d)** 440 cm²

Q7. Read the two statements and choose the correct option.

Statement I: The surface area of a sphere is $4\pi r^2$.

Statement II: The total surface area of a solid hemisphere is $2\pi r^2$.

(a) Only Statement I is true. **(b)** Only Statement II is true.

(c) Both statements are true. **(d)** Neither statement is true.

Q8. Match each solid with its volume.

Column I	Column II
(i) cube	(p) $\frac{1}{3}\pi r^2 h$
(ii) cylinder	(q) a^3
(iii) cone	(r) $\frac{4}{3}\pi r^3$
(iv) sphere	(s) $\pi r^2 h$

(a) (i)-(q), (ii)-(s), (iii)-(r), (iv)-(p)

(b) (i)-(s), (ii)-(q), (iii)-(p), (iv)-(r)

(c) (i)-(q), (ii)-(p), (iii)-(s), (iv)-(r)

(d) (i)-(q), (ii)-(s), (iii)-(p), (iv)-(r)

Q9. The total surface area of the cuboid in the figure is

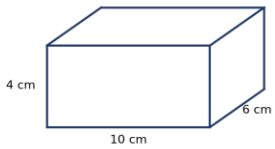


Fig. 14.1

(a) 240 cm² **(b)** 248 cm² **(c)** 124 cm² **(d)** 200 cm²

Q10. A cone has radius 6 cm and height 8 cm. Its slant height is

(a) 7 cm **(b)** 14 cm **(c)** 10 cm **(d)** 12 cm

Q11. 1 m³ equals

(a) 1000 L **(b)** 100 L **(c)** 10 L **(d)** 10000 L

Q12. The volume of a sphere of radius 3 cm is

(a) 12π cm³ **(b)** 36π cm³ **(c)** 27π cm³ **(d)** 9π cm³

Q13. A cube has volume 64 cm³. Its side is

(a) 8 cm **(b)** 6 cm **(c)** 16 cm **(d)** 4 cm

Q14. The area of the four walls of a room 5 m × 4 m × 3 m is

(a) 60 m² **(b)** 47 m² **(c)** 94 m² **(d)** 54 m²

Q15. ($\pi = \frac{22}{7}$) The curved surface area of a cone of radius 7 cm and slant height 10 cm is

(a) 154 cm² **(b)** 440 cm² **(c)** 220 cm² **(d)** 374 cm²

Medium (15 questions)

Q16. ($\pi = \frac{22}{7}$) The total surface area of a closed cylinder of radius 7 cm and height 13 cm is

(a) 572 cm² **(b)** 1144 cm² **(c)** 880 cm² **(d)** 616 cm²

Q17. ($\pi = \frac{22}{7}$) The volume of a cone of radius 7 cm and height 12 cm is

(a) 616 cm³ **(b)** 1848 cm³ **(c)** 924 cm³ **(d)** 308 cm³

Q18. **Assertion (A):** Doubling the radius of a sphere makes its volume 8 times as large.
Reason (R): The volume of a sphere is proportional to r^3.
(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.

Q19. **Assertion (A):** The curved surface area of a hemisphere is $3\pi r^2$.
Reason (R): The total surface area of a solid hemisphere = curved surface + flat base.
(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.

Q20. Read the two statements and choose the correct option.
Statement I: If the edge of a cube is doubled, its surface area becomes 4 times.
Statement II: If the edge of a cube is doubled, its volume becomes 8 times.
(a) Only Statement I is true. **(b)** Only Statement II is true.
(c) Both statements are true. **(d)** Neither statement is true.

Q21. Read the two statements and choose the correct option.
Statement I: For a cone, $l^2 = r^2 + h^2$.
Statement II: The total surface area of a cone is πrl.
(a) Only Statement I is true. **(b)** Only Statement II is true.
(c) Both statements are true. **(d)** Neither statement is true.

Q22. Read the two statements and choose the correct option.
Statement I: A tank 2 m × 1.5 m × 1 m holds 3000 litres.
Statement II: 1 litre = 100 cm³.
(a) Only Statement I is true. **(b)** Only Statement II is true.
(c) Both statements are true. **(d)** Neither statement is true.

Q23. ($\pi = \frac{22}{7}$) Match each sphere radius with its surface area.

Column I	Column II
(i) 7 cm	(p) 2464 cm²
(ii) 3.5 cm	(q) 616 cm²
(iii) 14 cm	(r) 5544 cm²
(iv) 21 cm	(s) 154 cm²

(a) (i)-(q), (ii)-(s), (iii)-(r), (iv)-(p)
(b) (i)-(s), (ii)-(q), (iii)-(p), (iv)-(r)
(c) (i)-(q), (ii)-(p), (iii)-(s), (iv)-(r)
(d) (i)-(q), (ii)-(s), (iii)-(p), (iv)-(r)

Q24. How many 2 cm cubes can be cut from a cuboid 12 cm × 8 cm × 6 cm?
(a) 48 **(b)** 576 **(c)** 72 **(d)** 96

Q25. ($\pi = \frac{22}{7}$) The volume of a hemispherical bowl of radius 21 cm is
(a) 38808 cm³ **(b)** 19404 cm³ **(c)** 9702 cm³ **(d)** 2772 cm³

Q26. ($\pi = \frac{22}{7}$) A cylinder has volume 1540 cm³ and radius 7 cm. Its height is
(a) 7 cm **(b)** 14 cm **(c)** 10 cm **(d)** 20 cm

Q27. A pyramid has a square base of side 6 cm and height 10 cm. Its volume is
(a) 360 cm³ **(b)** 120 cm³ **(c)** 180 cm³ **(d)** 60 cm³

Q28. ($\pi = \frac{22}{7}$) A conical tent has radius 7 m and slant height 25 m. The canvas needed is
(a) 1100 m² **(b)** 550 m² **(c)** 154 m² **(d)** 704 m²

Q29. A cylinder and a cone have the same radius and height. The ratio of their volumes is
(a) 3 : 1 **(b)** 1 : 3 **(c)** 2 : 1 **(d)** 1 : 1

Q30. The longest rod that fits in a box 12 cm × 4 cm × 3 cm is
(a) 12 cm **(b)** 19 cm **(c)** 13 cm **(d)** 15 cm

Tough (10 questions)

Q31. A solid sphere of radius 6 cm is melted into a cylinder of radius 4 cm. The height of the cylinder is
(a) 9 cm **(b)** 24 cm **(c)** 12 cm **(d)** 18 cm

Q32. A cylinder, a cone and a hemisphere have the same radius r, and the cylinder and cone have height r. Their volumes are in the ratio
(a) 2 : 1 : 3 **(b)** 1 : 2 : 3 **(c)** 3 : 1 : 2 **(d)** 3 : 2 : 1

Q33. How many balls of radius 1 cm can be made from a solid sphere of radius 4 cm?
(a) 64 **(b)** 16 **(c)** 4 **(d)** 32

Q34. A cube has total surface area 150 cm². Its volume is
(a) 150 cm³ **(b)** 125 cm³ **(c)** 25 cm³ **(d)** 216 cm³

Q35. A cone has radius 3 cm and height 4 cm. Its total surface area is
(a) 15π cm² **(b)** 33π cm² **(c)** 12π cm² **(d)** 24π cm²

Q36. ($\pi = \frac{22}{7}$) 2 cm of rain falls on a flat roof 22 m × 20 m and is collected in a cylindrical tank of radius 1 m. The water rises by
(a) 1.4 m **(b)** 2.8 m **(c)** 4.4 m **(d)** 8.8 m

Q37. If the radius of a cylinder increases by 10% and its height is unchanged, its volume increases by
(a) 21% **(b)** 20% **(c)** 10% **(d)** 33.1%

Q38. ($\pi = \frac{22}{7}$) A cylinder has curved surface area 88 cm² and height 2 cm. Its radius is
(a) 7 cm **(b)** 3.5 cm **(c)** 14 cm **(d)** 2 cm

Q39. ($\pi = \frac{22}{7}$) A hollow cylinder has outer radius 7 cm, inner radius 5 cm and height 14 cm. The volume of material is
(a) 2156 cm³ **(b)** 1056 cm³ **(c)** 1100 cm³ **(d)** 528 cm³

Q40. A cone has slant height 10 cm and curved surface area 188.4 cm² (π = 3.14). Its radius is
(a) 5 cm **(b)** 3 cm **(c)** 8 cm **(d)** 6 cm

Solution for Multiple Choice Questions

Level 1: Standard

Easy (15 questions)

1. Ans: (b) 125 cm³
Formula: Cube: volume $= a^3$, TSA $= 6a^2$
Solution: $V = a^3 = 5^3 = 125$ cm³

2. Ans: (c) 96 cm²
Formula: Cube: volume $= a^3$, TSA $= 6a^2$
Solution: 6×16

3. Ans: (b) 240 cm³
Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³
Solution: $V = l \times b \times h = 10 \times 6 \times 4 = 240$ cm³

4. Ans: (c) 1540 cm³
Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$
Solution: $\frac{22}{7} \times 49 \times 10$

5. Ans: (a) Both A and R are true, and R is the correct explanation of A.
Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$
Solution: $V_{\text{cone}} = \frac{1}{3}\pi r^2 h = \frac{1}{3} \times$ the cylinder's $\pi r^2 h$ — R explains A.

6. Ans: (d) 440 cm²
Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$
Solution: $2 \times \frac{22}{7} \times 7 \times 10$

7. Ans: (a) Only Statement I is true.
Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$
Solution: TSA of a solid hemisphere $= 3\pi r^2$.

8. Ans: (d) (i)-(q), (ii)-(s), (iii)-(p), (iv)-(r)
Formula: Volumes: cube a^3, cuboid lbh, cylinder $\pi r^2 h$, cone $\frac{1}{3}\pi r^2 h$, sphere $\frac{4}{3}\pi r^3$
Solution: Recall each volume formula and match.

9. Ans: (b) 248 cm²
Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: TSA $= 2(lb + bh + hl) = 2(10 \times 6 + 6 \times 4 + 4 \times 10) = 2(60 + 24 + 40) = 248$ cm²

10. Ans: (c) 10 cm
Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$
Solution: $l = \sqrt{r^2 + h^2} = \sqrt{36 + 64} = 10$ cm

11. Ans: (a) 1000 L
Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³
Solution: 1 m³ $= 100 \times 100 \times 100$ cm³ $= 10^6$ cm³ $= 1000$ L

12. Ans: (b) 36π cm³
Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$
Solution: $\frac{4}{3}\pi \times 27$

13. Ans: (d) 4 cm
Formula: Cube: volume $= a^3$, TSA $= 6a^2$
Solution: $a^3 = 64 \Rightarrow a = 4$ cm

14. Ans: (d) 54 m²
Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $2(5 + 4) \times 3$

15. Ans: (c) 220 cm²

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = πrl, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$

Solution: $\frac{22}{7} \times 7 \times 10$

Medium (15 questions)

16. Ans: (c) 880 cm²

Formula: Cylinder: CSA = $2\pi rh$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$

Solution: $2\pi r(r + h) = 2 \times \frac{22}{7} \times 7 \times 20$

17. Ans: (a) 616 cm³

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = πrl, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$

Solution: $\frac{1}{3} \times \frac{22}{7} \times 49 \times 12$

18. Ans: (a) Both A and R are true, and R is the correct explanation of A.

Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: $2^3 = 8$

19. Ans: (d) A is false but R is true.

Formula: Hemisphere: volume = $\frac{2}{3}\pi r^3$, CSA = $2\pi r^2$, TSA = $3\pi r^2$

Solution: The curved surface of a hemisphere is $2\pi r^2$.

20. Ans: (c) Both statements are true.

Formula: Cube: volume = a^3, TSA = $6a^2$

Solution: Area $\propto a^2$: $2^2 = 4$ times ✓; volume $\propto a^3$: $2^3 = 8$ times ✓

21. Ans: (a) Only Statement I is true.

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = πrl, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$

Solution: TSA of a cone = $\pi rl + \pi r^2$.

22. Ans: (a) Only Statement I is true.

Formula: 1 m³ = 1000 L; 1 L = 1000 cm³

Solution: 3 m³ = 3000 L; 1 L = 1000 cm³.

23. Ans: (d) (i)-(q), (ii)-(s), (iii)-(p), (iv)-(r)

Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: $4\pi r^2$ for each radius, then match.

24. Ans: (c) 72

Formula: Number of pieces = $\frac{\text{total volume}}{\text{volume of one piece}}$

Solution: $6 \times 4 \times 3$

25. Ans: (b) 19404 cm³

Formula: Hemisphere: volume = $\frac{2}{3}\pi r^3$, CSA = $2\pi r^2$, TSA = $3\pi r^2$

Solution: $\frac{2}{3} \times \frac{22}{7} \times 9261$

26. Ans: (c) 10 cm

Formula: Cylinder: CSA = $2\pi rh$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$

Solution: $\frac{22}{7} \times 49 \times h = 1540 \Rightarrow 154h = 1540 \Rightarrow h = 10$ cm

27. Ans: (b) 120 cm³

Formula: Pyramid: volume = $\frac{1}{3}$ × base area × h; slant height = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $\frac{1}{3} \times 36 \times 10$

28. Ans: (b) 550 m²

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = πrl, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$

Solution: CSA = $\pi rl = \frac{22}{7} \times 7 \times 25 = 550$ m²

29. Ans: (a) 3 : 1

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = πrl, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$

Solution: $\pi r^2 h : \frac{1}{3}\pi r^2 h = 3:1$

30. Ans: (c) 13 cm

Formula: Diagonal of a cuboid = $\sqrt{l^2 + b^2 + h^2}$

Solution: Diagonal = $\sqrt{12^2 + 4^2 + 3^2} = \sqrt{169} = 13$ cm

Tough (10 questions)

31. Ans: (d) 18 cm

Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$; Cylinder: CSA = $2\pi rh$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$

Solution: $\frac{4}{3}\pi(216) = \pi(16)h \Rightarrow 288 = 16h$

32. Ans: (c) 3 : 1 : 2

Formula: Hemisphere: volume = $\frac{2}{3}\pi r^3$, CSA = $2\pi r^2$, TSA = $3\pi r^2$

Solution: $\pi r^3 : \frac{1}{3}\pi r^3 : \frac{2}{3}\pi r^3$

33. Ans: (a) 64

Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: $\left(\frac{4}{1}\right)^3$

34. Ans: (b) 125 cm³

Formula: Cube: volume = a^3, TSA = $6a^2$

Solution: $6a^2 = 150 \Rightarrow a = 5$

35. Ans: (d) 24π cm²

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi r l$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $l = 5$: $15\pi + 9\pi$

36. Ans: (b) 2.8 m

Formula: Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $22 \times 20 \times 0.02 = 8.8$ m³ $= \frac{22}{7} \times 1 \times h$

37. Ans: (a) 21%

Formula: Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $1.1^2 = 1.21$

38. Ans: (a) 7 cm

Formula: Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $2 \times \frac{22}{7} \times r \times 2 = 88$

39. Ans: (b) 1056 cm³

Formula: Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{22}{7}(49 - 25) \times 14$

40. Ans: (d) 6 cm

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi r l$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{188.4}{3.14 \times 10}$

Very Short Answer Questions

Level 1: Standard

Easy (10 questions)

Q1. Find the volume and total surface area of a cube of side 6 cm.

Q2. Find the volume of a cuboid 8 cm × 5 cm × 3 cm.

Q3. Find the total surface area of a cuboid 8 cm × 5 cm × 3 cm.

Q4. (Take π = $\frac{22}{7}$.) Find the curved surface area of a cylinder of radius 7 cm and height 5 cm.

Q5. (Take π = $\frac{22}{7}$.) Find the volume of a cylinder of radius 14 cm and height 10 cm.

Q6. Find the slant height of a cone of radius 5 cm and height 12 cm.

Q7. (Take π = $\frac{22}{7}$.) Find the surface area of a sphere of radius 7 cm.

Q8. How many litres does a tank of 2.5 m³ hold?

Q9. (Take π = $\frac{22}{7}$.) Find the curved surface area of a hemisphere of radius 7 cm.

Q10. Find the volume of a pyramid with base area 30 cm² and height 9 cm.

Medium (5 questions)

Q11. (Take π = $\frac{22}{7}$.) Find the volume of a cone of radius 7 cm and height 9 cm.

Q12. (Take π = $\frac{22}{7}$.) Find the total surface area of a cone of radius 7 cm and slant height 15 cm.

Q13. (Take π = $\frac{22}{7}$.) Find the volume of a sphere of radius 3.5 cm.

Q14. A cube has volume 343 cm³. Find its surface area.

Q15. Find the length of the longest rod that fits in a box 3 cm × 4 cm × 12 cm.

Tough (5 questions)

Q16. (Take π = $\frac{22}{7}$.) A cylinder has CSA 264 cm² and height 6 cm. Find its radius.

Q17. (Take π = $\frac{22}{7}$.) Find the total surface area of a solid hemisphere of radius 14 cm.

Q18. A cone and a cylinder have the same base and height. The cylinder holds 90 mL. How much does the cone hold?

Q19. How many cubes of side 3 cm can be cut from a cube of side 9 cm?

Q20. If the radius of a sphere is halved, what happens to its surface area?

Solution for Very Short Answer Questions

Level 1: Standard

Easy (10 questions)

1. Formula: Cube: volume $= a^3$, TSA $= 6a^2$
Solution: $V = 6^3 = 216$ cm³; TSA $= 6 \times 6^2 = 216$ cm²

2. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $8 \times 5 \times 3 = 120$ cm³

3. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $2(40 + 15 + 24) = 158$ cm²

4. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$
Solution: $2\pi rh = 2 \times \frac{22}{7} \times 7 \times 5 = 220$ cm²

5. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$
Solution: $\pi r^2 h = \frac{22}{7} \times 196 \times 10 = 6160$ cm³

6. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$
Solution: $\sqrt{25 + 144} = 13$ cm

7. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$
Solution: $4\pi r^2 = 4 \times \frac{22}{7} \times 49 = 616$ cm²

8. Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³
Solution: $2.5 \times 1000 = 2500$ L

9. Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$
Solution: $2\pi r^2 = 2 \times \frac{22}{7} \times 49 = 308$ cm²

10. Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$
Solution: $\frac{1}{3} \times 30 \times 9 = 90$ cm³

Medium (5 questions)

11. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$
Solution: $\frac{1}{3} \times \frac{22}{7} \times 49 \times 9 = 462$ cm³

12. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$
Solution: $330 + 154 = 484$ cm²

13. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$
Solution: $\frac{539}{3} \approx 179.7$ cm³

14. Formula: Cube: volume $= a^3$, TSA $= 6a^2$
Solution: Side 7 ⟹294 cm²

15. Formula: Diagonal of a cuboid $= \sqrt{l^2 + b^2 + h^2}$
Solution: $\sqrt{3^2 + 4^2 + 12^2} = \sqrt{169} = 13$ cm

Tough (5 questions)

16. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$
Solution: $2 \times \frac{22}{7} \times r \times 6 = 264 \Rightarrow r = 7$ cm

17. Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$
Solution: $3\pi r^2 = 3 \times 616 = 1848$ cm²

18. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$
Solution: Cone $= \frac{1}{3}$ cylinder $= \frac{90}{3} = 30$ mL

19. Formula: Number of pieces $= \frac{\text{total volume}}{\text{volume of one piece}}$
Solution: $\frac{9^3}{3^3} = \frac{729}{27} = 27$

20. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$
Solution: $4\pi\left(\frac{r}{2}\right)^2 = \frac{1}{4} \times 4\pi r^2$ ⟹one-quarter

Short Answer Questions

Level 1: Standard

Easy (10 questions)

Q1. A box is 30 cm × 20 cm × 15 cm. Find its volume and the cardboard needed for a closed box.

Q2. A room is 6 m × 4 m × 3 m. Find the cost of painting the four walls at ₹20 per m².

Q3. (Take π = $\frac{22}{7}$.) A closed cylindrical tank has radius 7 m and height 10 m. Find its total surface area and volume.

Q4. (Take π = $\frac{22}{7}$.) A cone has radius 7 cm and height 24 cm. Find its slant height and curved surface area.

Q5. (Take π = $\frac{22}{7}$.) Find the surface area and volume of a ball of radius 10.5 cm.

Q6. A water tank is 3 m × 2 m × 1.5 m. How many litres does it hold?

Q7. Compare the volumes of a cube of side 6 cm and a cuboid 9 cm × 6 cm × 4 cm.

Q8. (Take π = $\frac{22}{7}$.) A hemispherical bowl has radius 7 cm. Find its capacity and inner curved surface area.

Q9. A square pyramid has base side 10 cm and height 12 cm. Find its volume.

Q10. A cube of side 4 cm is cut into cubes of side 1 cm. Find the number of cubes and the total surface area of all small cubes.

Medium (5 questions)

Q11. (Take π = $\frac{22}{7}$.) A road roller has diameter 1.4 m and length 2 m. Find the area it levels in 500 revolutions.

Q12. (Take π = $\frac{22}{7}$.) A conical tent is 10 m high with base radius 24 m. Find its slant height and the canvas needed.

Q13. Find the radius of a sphere whose volume is 36π cm³, and its surface area.

Q14. A cylinder and a cone have equal radii and heights. The cylinder's volume is 600 cm³. Find the cone's volume, and the volume of a hemisphere of the same radius if the height equals the radius.

Q15. (Take π = $\frac{22}{7}$.) How many litres of milk can a cylindrical can of diameter 14 cm and height 30 cm hold?

Tough (5 questions)

Q16. A sphere of radius 6 cm is melted and recast into a cone of base radius 6 cm. Find the height of the cone.

Q17. (Take π = $\frac{22}{7}$.) A hollow pipe is 21 m long with outer diameter 10 cm and inner diameter 6 cm. Find the volume of metal.

Q18. The radius of a cylinder is doubled and its height halved. What happens to its volume and curved surface area?

Q19. (Take π = $\frac{22}{7}$.) Water from a full cylindrical tank of radius 1 m is used to fill a cuboid tank 4 m × 3 m × 2 m. By how much does the water level in the cylinder fall?

Q20. (Take π = $\frac{22}{7}$.) A tent is a cylinder of radius 7 m and height 3 m with a cone of slant height 10 m on top. Find the canvas needed.

Solution for Short Answer Questions

Level 1: Standard

Easy (10 questions)

1. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: Volume $= 30 \times 20 \times 15 = 9000$ cm³

Cardboard $= 2(30 \times 20 + 20 \times 15 + 15 \times 30) = 2(600 + 300 + 450) = 2700$ cm²

2. Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³

Solution: Walls $= 2(l + b)h = 2(6 + 4) \times 3 = 60$ m²

Cost $= 60 \times 20 = ₹1200$

3. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: TSA $= 2 \times \frac{22}{7} \times 7 \times 17 = 748$ m²; volume 1540 m³

4. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $l = \sqrt{7^2 + 24^2} = \sqrt{625} = 25$ cm

CSA $= \pi rl = \frac{22}{7} \times 7 \times 25 = 550$ cm²

5. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $4\pi r^2 = 4 \times \frac{22}{7} \times 10.5^2 = 1386$ cm²

$\frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times 10.5^3 = 4851$ cm³

6. Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³

Solution: $3 \times 2 \times 1.5 = 9$ m³ $= 9 \times 1000 = 9000$ L

7. Formula: Cube: volume $= a^3$, TSA $= 6a^2$

Solution: Cube: $6^3 = 216$ cm³; cuboid: $9 \times 6 \times 4 = 216$ cm³ — equal.

8. Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: Capacity $\frac{2156}{3} \approx 718.7$ cm³; inner CSA 308 cm²

9. Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $\frac{1}{3} \times 10^2 \times 12 = 400$ cm³

10. Formula: Number of pieces $= \frac{\text{total volume}}{\text{volume of one piece}}$; Cube: volume $= a^3$, TSA $= 6a^2$

Solution: $\frac{4^3}{1^3} = 64$ cubes; each has area $6 \times 1^2 = 6$ $\Rightarrow 64 \times 6 = 384$ cm²

Medium (5 questions)

11. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: One revolution: $2 \times \frac{22}{7} \times 0.7 \times 2 = 8.8$ m² $\Rightarrow$4400 m²

12. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $l = \sqrt{10^2 + 24^2} = \sqrt{676} = 26$ m

Canvas $= \pi rl = \frac{22}{7} \times 24 \times 26 \approx 1961.1$ m²

13. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{4}{3}r^3 = 36 \Rightarrow r = 3$ cm; area 36π cm²

14. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$; Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: Cone 200 cm³; with $h = r$, $\pi r^3 = 600 \Rightarrow$ hemisphere $= \frac{2}{3} \times 600 = 400$ cm³

15. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\pi r^2 h = \frac{22}{7} \times 7^2 \times 30 = 4620$ cm³ $= 4.62$ L

Tough (5 questions)

16. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{4}{3}\pi(216) = \frac{1}{3}\pi(36)h \Rightarrow h = 24$ cm

17. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $R = 0.05$ m, $r = 0.03$ m: $\pi(R^2 - r^2)h = \frac{22}{7}(0.0025 - 0.0009) \times 21 = 0.1056$ m³

18. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $V = \pi(2r)^2\left(\frac{h}{2}\right) = 2\pi r^2 h \Rightarrow$doubles

CSA $= 2\pi(2r)\left(\frac{h}{2}\right) = 2\pi rh \Rightarrow$unchanged

19. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$; Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: Water $= 4 \times 3 \times 2 = 24$ m³; level fall $= \frac{24}{\pi \times 1^2} = \frac{24 \times 7}{22} \approx 7.64$ m

20. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$; Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: Cylinder CSA $= 2 \times \frac{22}{7} \times 7 \times 3 = 132$ m²; cone CSA $= \frac{22}{7} \times 7 \times 10 = 220$ m²

Total $= 352$ m²

Long Answer Questions

Level 1: Standard

Easy (5 questions)

Q1. A closed wooden box is 50 cm × 40 cm × 30 cm externally, made of wood 1 cm thick.

(i) Find the external volume.

(ii) Find the internal volume.

(iii) Find the volume of wood.

(iv) Find the external surface area.

Q2. (Take $\pi = \frac{22}{7}$.) A cylindrical drum has radius 35 cm and height 1 m.

(i) Find its curved surface area.

(ii) Find its total surface area.

(iii) Find its volume.

(iv) How many litres does it hold?

Q3. (Take $\pi = \frac{22}{7}$.) A cone has radius 7 cm and height 24 cm.

(i) Find its slant height.

(ii) Find its curved surface area.

(iii) Find its total surface area.

(iv) Find its volume.

Q4. (Take $\pi = \frac{22}{7}$.) A sphere has radius 21 cm.

(i) Find its surface area.

(ii) Find its volume.

(iii) Find the CSA and TSA of a hemisphere of the same radius.

(iv) Find the volume of the hemisphere.

Q5. A room is 8 m long, 6 m wide and 4 m high.

(i) Find its volume.

(ii) Find the area of the four walls.

(iii) Find the area of walls and ceiling.

(iv) Find the cost of painting them at ₹25 per m².

Medium (5 questions)

Q6. (Take $\pi = \frac{22}{7}$.) A tent is a cylinder of radius 14 m and height 3 m with a cone of height 10.5 m on top.

(i) Find the slant height of the cone.

(ii) Find the CSA of the cylinder.

(iii) Find the CSA of the cone.

(iv) Find the canvas needed.

Q7. Melting and recasting.

(i) Find the volume of a sphere of radius 8 cm.

(ii) Find the volume of a ball of radius 2 cm.

(iii) How many balls can be made?

(iv) Compare the total surface areas.

Q8. (Take $\pi = \frac{22}{7}$.) A hemispherical bowl of radius 9 cm is full of liquid, which is poured into cylindrical bottles of radius 1.5 cm and height 4 cm.

(i) Find the volume of liquid.

(ii) Find the volume of one bottle.

(iii) How many bottles are filled?

Q9. Ratios of solids with the same radius r and height r.
(i) Write the volumes of the cylinder, cone and hemisphere.
(ii) Find their ratio.
(iii) Interpret the ratio.

Q10. A square pyramid has base side 10 cm and slant height 13 cm.
(i) Find its height.
(ii) Find the area of its four faces.
(iii) Find its total surface area.
(iv) Find its volume.

Tough (5 questions)

Q11. (Take π = $\frac{22}{7}$.) Rainwater harvesting: a roof 22 m × 20 m receives 2 cm of rain, collected in a cylindrical tank of diameter 2 m and height 3.5 m.
(i) Find the volume of rain.
(ii) Find the tank capacity.
(iii) Will the tank overflow?
(iv) Find the height of water in it.

Q12. (Take π = $\frac{22}{7}$.) A pipe of inner radius 1 cm carries water at 7 m per second into a cylindrical tank of radius 70 cm.
(i) Find the water flowing per second.
(ii) Write the volume of water in the tank for depth h.
(iii) Find the water in 1 hour.
(iv) Find the rise in level in 1 hour.

Q13. Cone from a sector.
(i) A 216° sector of radius 25 cm is folded into a cone. Find the arc length.
(ii) Find the base radius.
(iii) Find the height.
(iv) Find the volume.

Q14. Changing dimensions.
(i) A cylinder's radius is doubled, height unchanged. How does the volume change?
(ii) A sphere's radius is increased by 50%. How does its volume change?
(iii) A cone's radius grows 10%, height unchanged: % change in volume?

Q15. (Take π = $\frac{22}{7}$.) An ice-cream cone is a cone of radius 3.5 cm and height 12 cm filled and topped with a hemisphere.
(i) Find the cone's volume.
(ii) Find the hemisphere's volume.
(iii) Find the total ice cream.
(iv) How much is needed for 10 cones?

Solution for Long Answer Questions

Level 1: Standard

Easy (5 questions)

1. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $50 \times 40 \times 30 = 60{,}000$ cm³
(ii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $48 \times 38 \times 28 = 51{,}072$ cm³
(iii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $60000 - 51072 = 8928$ cm³
(iv) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$
Solution: $2(2000 + 1200 + 1500) = 9400$ cm²

2. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r+h)$, volume $= \pi r^2 h$

Solution: $2\pi rh = 2 \times \frac{22}{7} \times 35 \times 100 = 22{,}000$ cm²

(ii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r+h)$, volume $= \pi r^2 h$

Solution: $2\pi r(r+h) = 2 \times \frac{22}{7} \times 35 \times 135 = 29{,}700$ cm²

(iii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r+h)$, volume $= \pi r^2 h$

Solution: $\pi r^2 h = \frac{22}{7} \times 35^2 \times 100 = 3{,}85{,}000$ cm³

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r+h)$, volume $= \pi r^2 h$

Solution: $\frac{385000}{1000} = 385$ L

3. (i) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $l = \sqrt{7^2 + 24^2} = 25$ cm

(ii) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\pi rl = \frac{22}{7} \times 7 \times 25 = 550$ cm²

(iii) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\pi r(l+r) = \frac{22}{7} \times 7 \times 32 = 704$ cm²

(iv) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{1}{3} \times \frac{22}{7} \times 49 \times 24 = 1232$ cm³

4. (i) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $4\pi r^2 = 4 \times \frac{22}{7} \times 441 = 5544$ cm²

(ii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times 9261 = 38{,}808$ cm³

(iii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: CSA $= 2\pi r^2 = 2772$ cm²; TSA $= 3\pi r^2 = 4158$ cm²

(iv) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{2}{3}\pi r^3 = 19{,}404$ cm³

5. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l+b)h$

Solution: $8 \times 6 \times 4 = 192$ m³

(ii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l+b)h$

Solution: $2(8+6) \times 4 = 112$ m²

(iii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l+b)h$

Solution: $112 + 8 \times 6 = 160$ m²

(iv) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l+b)h$

Solution: $160 \times 25 = ₹4000$

Medium (5 questions)

6. (i) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\sqrt{196 + 110.25} = 17.5$ m

(ii) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $2\pi rh = 2 \times \frac{22}{7} \times 14 \times 3 = 264$ m²

(iii) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\pi rl = \frac{22}{7} \times 14 \times 17.5 = 770$ m²

(iv) Formula: Cone: $l = \sqrt{r^2+h^2}$, CSA $= \pi rl$, TSA $= \pi r(l+r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $264 + 770 = 1034$ m²

7. (i) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{2048\pi}{3}$ cm³

(ii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{32\pi}{3}$ cm³

(iii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{8^3}{2^3} = \frac{512}{8} = 64$

(iv) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: 256π against $64 \times 16\pi = 1024\pi$ — four times as much.

8. (i) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{2}{3}\pi(9)^3 = 486\pi \approx 1527.4$ cm³

(ii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\pi(1.5)^2(4) = 9\pi \approx 28.3$ cm³

(iii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{486\pi}{9\pi} = 54$

9. (i) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: πr^3, $\frac{1}{3}\pi r^3$, $\frac{2}{3}\pi r^3$

(ii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $\pi r^3 : \frac{1}{3}\pi r^3 : \frac{2}{3}\pi r^3 = 3:1:2$

(iii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: The cone holds one-third of the cylinder and the hemisphere two-thirds.

10. (i) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $h = \sqrt{13^2 - 5^2} = 12$ cm

(ii) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $4 \times \frac{1}{2} \times 10 \times 13 = 260$ cm²

(iii) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $260 + 10^2 = 360$ cm²

(iv) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $\frac{1}{3} \times 100 \times 12 = 400$ cm³

Tough (5 questions)

11. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $22 \times 20 \times 0.02 = 8.8$ m³

(ii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{22}{7} \times 1^2 \times 3.5 = 11$ m³

(iii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $8.8 < 11 \Longrightarrow$no

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $h = \frac{8.8}{22/7} = 2.8$ m

12. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{22}{7} \times 0.0001 \times 7 = 0.0022$ m³ (2.2 L)

(ii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{22}{7} \times 0.49 \times h$

(iii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $0.0022 \times 3600 = 7.92$ m³

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{7.92}{1.54} \approx 5.14$ m

13. (i) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: Arc $= \frac{216}{360} \times 2\pi \times 25 = 30\pi \approx 94.3$ cm

(ii) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: $2\pi r = 30\pi \Rightarrow r = 15$ cm

(iii) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: $h = \sqrt{25^2 - 15^2} = 20$ cm

(iv) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: $\frac{1}{3}\pi(15)^2(20) = 1500\pi$ cm³

14. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\pi(2r)^2 h = 4\pi r^2 h \Longrightarrow$4 times

(ii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $1.5^3 = 3.375$ times

(iii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $1.1^2 = 1.21 \Longrightarrow$21% increase

15. (i) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{1}{3} \times \frac{22}{7} \times 3.5^2 \times 12 = 154$ cm³

(ii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{2}{3} \times \frac{22}{7} \times 3.5^3 \approx 89.8$ cm³

(iii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $154 + 89.8 \approx 243.8$ cm³

(iv) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $10 \times 243.8 \approx 2438$ cm³

Case-Based Questions

Level 1: Standard

Easy (5 questions)

Q1. Gift box

A gift box is a cuboid 20 cm × 15 cm × 10 cm.

(i) Find its volume.

(ii) Find the wrapping paper needed (TSA).

(iii) How many 5 cm cubes fit inside?

(iv) Find the length of ribbon along its longest diagonal.

Q2. Water tank

A rectangular water tank on a roof is 2 m × 1.5 m × 1 m.

(i) Find its volume.

(ii) How many litres does it hold?

(iii) A family uses 600 L per day. How long does a full tank last?

(iv) Find the area of sheet needed for an open tank.

Q3. Pencil holder

A cylindrical pencil holder has radius 3.5 cm and height 10 cm and is open at the top. ($\pi = \frac{22}{7}$)

(i) Find its curved surface area.

(ii) Find the area of its base.

(iii) Find the material needed.

(iv) Find its volume.

Q4. Birthday cap

A conical birthday cap has base radius 7 cm and height 24 cm. ($\pi = \frac{22}{7}$)

(i) Find its slant height.

(ii) Find the paper needed (CSA).

(iii) Find the paper for 10 caps.

(iv) Find the volume of air inside one cap.

Q5. Football

A football has a diameter of 21 cm. ($\pi = \frac{22}{7}$)

(i) Find its radius.

(ii) Find the leather needed.

(iii) Find the volume of air inside.

(iv) If the radius were doubled, how would the leather change?

Medium (2 questions)

Q6. Road roller

A road roller is a cylinder of diameter 1.4 m and length 2 m. ($\pi = \frac{22}{7}$)

(i) Find the area pressed in one revolution.

(ii) Find the area pressed in 500 revolutions.

(iii) Find the cost of levelling at ₹2 per m².

(iv) How many revolutions level 1760 m²?

Q7. Ice-cream cone

An ice-cream cone has radius 3.5 cm and height 12 cm and is filled, with a hemispherical scoop on top. ($\pi = \frac{22}{7}$)

(i) Find the cone's volume.

(ii) Find the hemisphere's volume.

(iii) Find the total ice cream.

(iv) How many cones can a 5 L tub fill?

Tough (3 questions)

Q8. Rainwater harvesting

A school roof 22 m × 20 m collects 2 cm of rain into a cylindrical tank of radius 1 m. ($\pi = \frac{22}{7}$)

(i) Find the volume of rainwater.

(ii) How many litres is this?

(iii) Find the height of water in the tank.

(iv) If the tank is 3 m tall, will it overflow?

Q9. Recasting metal

A solid metal sphere of radius 6 cm is melted.

(i) Find its volume in terms of π.

(ii) How many balls of radius 2 cm can be made?

(iii) If recast into a cylinder of radius 4 cm, find its height.

(iv) If recast into a cone of radius 6 cm, find its height.

Q10. Tent making

A circus tent is a cylinder of radius 14 m and height 3 m with a cone of slant height 17.5 m on top. ($\pi = \frac{22}{7}$)

(i) Find the canvas for the cylinder part.

(ii) Find the canvas for the cone part.

(iii) Find the total canvas.

(iv) Find the cost at ₹50 per m².

Solution for Case-Based Questions

Level 1: Standard

Easy (5 questions)

1. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $20 \times 15 \times 10 = 3000$ cm³

(ii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $2(300 + 150 + 200) = 1300$ cm²

(iii) Formula: Number of pieces $= \frac{\text{total volume}}{\text{volume of one piece}}$

Solution: $\frac{20}{5} \times \frac{15}{5} \times \frac{10}{5} = 4 \times 3 \times 2 = 24$

(iv) Formula: Diagonal of a cuboid $= \sqrt{l^2 + b^2 + h^2}$

Solution: $\sqrt{20^2 + 15^2 + 10^2} = \sqrt{725} \approx 26.9$ cm

2. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $2 \times 1.5 \times 1 = 3$ m³

(ii) Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³

Solution: $3 \times 1000 = 3000$ L

(iii) Formula: Days $= \frac{\text{capacity}}{\text{daily use}}$

Solution: $\frac{3000}{600} = 5$ days

(iv) Formula: Open tank: area = base + four walls $= lb + 2(l + b)h$

Solution: $3 + 7 = 10$ m²

3. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $2\pi rh = 2 \times \frac{22}{7} \times 3.5 \times 10 = 220$ cm²

(ii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\pi r^2 = \frac{22}{7} \times 3.5^2 = 38.5$ cm²

(iii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $220 + 38.5 = 258.5$ cm²

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\pi r^2 h = 38.5 \times 10 = 385$ cm³

4. (i) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\sqrt{7^2 + 24^2} = 25$ cm

(ii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{22}{7} \times 7 \times 25 = 550$ cm²

(iii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $10 \times 550 = 5500$ cm²

(iv) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{1}{3} \times \frac{22}{7} \times 49 \times 24 = 1232$ cm³

5. (i) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{21}{2} = 10.5$ cm

(ii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $4 \times \frac{22}{7} \times 10.5^2 = 1386$ cm²

(iii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{4}{3} \times \frac{22}{7} \times 10.5^3 = 4851$ cm³

(iv) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: Area $\propto r^2 \Rightarrow 2^2 = 4$ times as much

Medium (2 questions)

6. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $2\pi rh = 2 \times \frac{22}{7} \times 0.7 \times 2 = 8.8$ m²

(ii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $500 \times 8.8 = 4400$ m²

(iii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $4400 \times 2 = ₹8800$

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{1760}{8.8} = 200$

7. (i) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{1}{3} \times \frac{22}{7} \times 3.5^2 \times 12 = 154$ cm³

(ii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $\frac{2}{3} \times \frac{22}{7} \times 3.5^3 \approx 89.8$ cm³

(iii) Formula: Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: $154 + 89.8 \approx 243.8$ cm³

(iv) Formula: Number of pieces $= \frac{\text{total volume}}{\text{volume of one piece}}$

Solution: $5000 \div 243.8 \approx 20.5 \Rightarrow$20 cones

Tough (3 questions)

8. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $22 \times 20 \times 0.02 = 8.8$ m³

(ii) Formula: 1 m³ $= 1000$ L; 1 L $= 1000$ cm³

Solution: $8.8 \times 1000 = 8800$ L

(iii) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{8.8}{\frac{22}{7} \times 1^2} = 2.8$ m

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $2.8 < 3 \Rightarrow$no

9. (i) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{4}{3}\pi(6)^3 = 288\pi$ cm³

(ii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Number of pieces $= \frac{\text{total volume}}{\text{volume of one piece}}$

Solution: $\frac{6^3}{2^3} = 27$

(iii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\pi(4)^2 h = 288\pi \Rightarrow h = 18$ cm

(iv) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{1}{3}\pi(6)^2 h = 288\pi \Rightarrow 12h = 288 \Rightarrow h = 24$ cm

10. (i) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $2 \times \frac{22}{7} \times 14 \times 3 = 264$ m²

(ii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{22}{7} \times 14 \times 17.5 = 770$ m²

(iii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $264 + 770 = 1034$ m²

(iv) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $1034 \times 50 = ₹51{,}700$

IIT Foundation Questions & its Answers

Multiple Choice Questions

Level 2: IIT Foundation (Medium)

Q41. ($\pi = \frac{22}{7}$) A sphere has surface area 616 cm². Its volume is

(a) 1078 cm³ **(b)** $\frac{4312}{3}$ cm³ **(c)** 2156 cm³ **(d)** 616 cm³

Q42. ($\pi = \frac{22}{7}$) A toy is a cone of radius 7 cm and height 24 cm on a hemisphere of the same radius. Its volume is

(a) $\frac{5852}{3}$ cm³ **(b)** 1232 cm³ **(c)** 1950 cm³ **(d)** 2156 cm³

Q43. The largest sphere carved from a cube of side 10 cm has volume ($\pi = 3.14$)

(a) 4186.67 cm³ **(b)** 523.33 cm³ **(c)** 314 cm³ **(d)** 1000 cm³

Q44. ($\pi = \frac{22}{7}$) The largest cone carved from a cube of side 14 cm has volume

(a) 2744 cm³ **(b)** 2156 cm³ **(c)** 1078 cm³ **(d)** $\frac{2156}{3}$ cm³

Q45. A cylinder of radius 3 cm and height 8 cm is melted into cones of radius 3 cm and height 2 cm. The number of cones is

(a) 4 **(b)** 8 **(c)** 6 **(d)** 12

Q46. ($\pi = \frac{22}{7}$) A cylindrical tank of diameter 1.4 m and height 2 m holds

(a) 30.8 L **(b)** 3080 L **(c)** 308 L **(d)** 1540 L

Q47. ($\pi = \frac{22}{7}$) Earth from a well of diameter 7 m and depth 20 m is spread evenly over a field 22 m × 14 m. The height of the layer is

(a) 1.25 m **(b)** 2 m **(c)** 5 m **(d)** 2.5 m

Q48. If each edge of a cube increases by 50%, its surface area increases by

(a) 50% **(b)** 225% **(c)** 150% **(d)** 125%

Q49. A sphere fits exactly inside a cylinder (touching top, bottom and side). The ratio of their volumes is

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

Q50. A sector of angle 216° cut from a circle of radius 25 cm is folded into a cone. Its volume is

(a) 1500π cm³ **(b)** 4500π cm³ **(c)** 750π cm³ **(d)** 3000π cm³

Q51. A square pyramid has base side 10 cm and slant height (of each face) 13 cm. Its total surface area is

(a) 260 cm² **(b)** 520 cm² **(c)** 460 cm² **(d)** 360 cm²

Q52. The same pyramid has volume

(a) 433 cm³ **(b)** 1300 cm³ **(c)** 400 cm³ **(d)** 1200 cm³

Q53. A cuboid has edges in the ratio 3 : 2 : 1 and volume 384 cm³. Its total surface area is

(a) 384 cm² **(b)** 176 cm² **(c)** 288 cm² **(d)** 352 cm²

Q54. ($\pi = \frac{22}{7}$) A hemispherical bowl of inner radius 10.5 cm holds about

(a) 4.85 L **(b)** 2.43 L **(c)** 1.21 L **(d)** 24.3 L

Q55. ($\pi = \frac{22}{7}$) A capsule is a cylinder of radius 7 mm and length 20 mm with a hemisphere at each end. Its volume is

(a) $\frac{13552}{3}$ mm³ **(b)** 3080 mm³ **(c)** 4312 mm³ **(d)** 1437 mm³

Q56. 12 matchboxes each 4 cm × 2.5 cm × 1.5 cm are packed. Their total volume is

(a) 120 cm³ **(b)** 15 cm³ **(c)** 180 cm³ **(d)** 150 cm³

Q57. ($\pi = \frac{22}{7}$) Painting a sphere of radius 7 cm costs ₹10 per 100 cm². The cost is

(a) ₹61.60 **(b)** ₹616 **(c)** ₹6.16 **(d)** ₹154

Q58. ($\pi = \frac{22}{7}$) A sheet 44 cm × 20 cm is rolled along its 44 cm side into a hollow cylinder. Its volume is
(a) 1540 cm³ **(b)** 880 cm³ **(c)** 3080 cm³ **(d)** 6160 cm³

Q59. A right triangle with legs 6 cm and 8 cm is rotated about the 6 cm leg. The cone formed has volume
(a) 96π cm³ **(b)** 72π cm³ **(c)** 128π cm³ **(d)** 384π cm³

Q60. A cube has a diagonal of $6\sqrt{3}$ cm. Its volume is
(a) 108 cm³ **(b)** 216 cm³ **(c)** 648 cm³ **(d)** 36 cm³

Solution for Level 2: IIT Foundation (Medium)

41. Ans: (b) 4312/3 cm³
Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$
Solution: $4\pi r^2 = 616 \Rightarrow r = 7$

42. Ans: (a) 5852/3 cm³
Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = $\pi r l$, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$; Hemisphere: volume = $\frac{2}{3}\pi r^3$, CSA = $2\pi r^2$, TSA = $3\pi r^2$
Solution: Cone 1232 + hemisphere $\frac{2156}{3}$

43. Ans: (b) 523.33 cm³
Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$
Solution: $r = 5$

44. Ans: (d) 2156/3 cm³
Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = $\pi r l$, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$
Solution: $r = 7$, $h = 14$

45. Ans: (d) 12
Formula: Cylinder: CSA = $2\pi r h$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$; Cone: $l = \sqrt{r^2 + h^2}$, CSA = $\pi r l$, TSA = $\pi r(l + r)$, volume = $\frac{1}{3}\pi r^2 h$
Solution: $\frac{\pi \times 9 \times 8}{\frac{1}{3}\pi \times 9 \times 2} = 12$

46. Ans: (b) 3080 L
Formula: Cylinder: CSA = $2\pi r h$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$
Solution: $\frac{22}{7} \times 0.49 \times 2 = 3.08$ m³

47. Ans: (d) 2.5 m
Formula: Height = $\frac{\text{volume}}{\text{base area}}$
Solution: $\frac{770}{308}$

48. Ans: (d) 125%
Formula: Surface area varies as r^2: new area = $(1.5)^2 \times$ old area
Solution: $1.5^2 = 2.25$

49. Ans: (c) 2 : 3
Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$; Cylinder: CSA = $2\pi r h$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$
Solution: $\frac{4}{3}\pi r^3 : 2\pi r^3$

50. Ans: (a) 1500π cm³
Formula: Cone from a sector: slant height = sector radius; $2\pi r$ = arc length
Solution: Arc = $\frac{216}{360} \times 50\pi = 30\pi \Rightarrow r = 15$, $h = 20$

51. Ans: (d) 360 cm²
Formula: Pyramid: volume = $\frac{1}{3}$ × base area × h; slant height = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$
Solution: $100 + 4 \times \frac{1}{2} \times 10 \times 13$

52. Ans: (c) 400 cm³
Formula: Pyramid: volume = $\frac{1}{3}$ × base area × h; slant height = $\sqrt{h^2 + \left(\frac{a}{2}\right)^2}$
Solution: Height = $\sqrt{169 - 25} = 12$

53. Ans: (d) 352 cm²
Formula: Cuboid: volume = lbh, TSA = $2(lb + bh + hl)$, four walls = $2(l + b)h$
Solution: $6k^3 = 384 \Rightarrow k = 4$: edges 12, 8, 4

54. Ans: (b) 2.43 L
Formula: Hemisphere: volume = $\frac{2}{3}\pi r^3$, CSA = $2\pi r^2$, TSA = $3\pi r^2$
Solution: $\frac{2}{3} \times \frac{22}{7} \times 10.5^3 \approx 2425.5$ cm³

55. Ans: (a) 13552/3 mm³
Formula: Cylinder: CSA = $2\pi r h$, TSA = $2\pi r(r + h)$, volume = $\pi r^2 h$; Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$
Solution: $3080 + \frac{4312}{3}$

56. Ans: (c) 180 cm³
Formula: Cuboid: volume = lbh, TSA = $2(lb + bh + hl)$, four walls = $2(l + b)h$
Solution: One box = $4 \times 2.5 \times 1.5 = 15$ cm³ $\Rightarrow$ $12 \times 15 = 180$ cm³

57. Ans: (a) ₹61.60

Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $4\pi r^2 = 4 \times \frac{22}{7} \times 49 = 616$ cm² $\Rightarrow \frac{616}{100} \times 10 = ₹61.60$

58. Ans: (c) 3080 cm³

Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $2\pi r = 44 \Rightarrow r = 7$, height 20

59. Ans: (c) 128π cm³

Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: About the 6 cm leg: radius 8, height 6 $\Rightarrow \frac{1}{3}\pi \times 64 \times 6 = 128\pi$ cm³

60. Ans: (b) 216 cm³

Formula: Diagonal of a cube $= a\sqrt{3}$

Solution: $a\sqrt{3} = 6\sqrt{3} \Rightarrow a = 6$

Very Short Answer Questions

Level 2: IIT Foundation (Medium)

Q21. A metal sphere of radius 3 cm is melted into a wire of radius 0.1 cm. Find the length of the wire.

Q22. How many spheres of radius 2 cm can be made from a sphere of radius 6 cm?

Q23. (Take π = $\frac{22}{7}$.) Find the volume of the largest cone that fits in a cube of side 7 cm.

Q24. A cuboid has edges in the ratio 4 : 3 : 2 and total surface area 208 cm². Find its volume.

Q25. A sphere fits exactly in a cube of side 10 cm. Find the ratio of their volumes (π = 3.14).

Q26. (Take π = $\frac{22}{7}$.) A sheet 22 cm × 10 cm is rolled along the 22 cm side into a cylinder. Find its volume.

Q27. A cone is formed by rotating a right triangle with legs 5 cm and 12 cm about the 12 cm leg. Find its volume.

Q28. A cube's diagonal is 9√3 cm. Find its volume.

Q29. If each dimension of a cuboid is doubled, by what factor does its volume change?

Q30. A square pyramid has base side 12 cm and height 8 cm. Find its slant height.

Solution for Level 2: IIT Foundation (Medium)

21. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $36\pi = \pi(0.01)L \Rightarrow L = 3600$ cm $= 36$ m

22. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Number of pieces $= \frac{\text{total volume}}{\text{volume of one piece}}$

Solution: $\frac{\frac{4}{3}\pi(6)^3}{\frac{4}{3}\pi(2)^3} = \frac{216}{8} = 27$

23. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{539}{6} \approx 89.8$ cm³

24. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $52k^2 = 208 \Rightarrow k = 2$: 8, 6, 4 ⟹192 cm³

25. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Cube: volume $= a^3$, TSA $= 6a^2$

Solution: Sphere $r = 5$: $\frac{4}{3} \times 3.14 \times 125 \approx 523.33$ cm³; cube $= 1000$ cm³

Ratio $523.33 : 1000$, i.e. $\pi : 6$

26. Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $r = 3.5$, $h = 10$ ⟹385 cm³

27. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $\frac{1}{3}\pi \times 25 \times 12 = 100\pi$ cm³

28. Formula: Diagonal of a cube $= a\sqrt{3}$

Solution: Side 9 ⟹729 cm³

29. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $(2l)(2b)(2h) = 8lbh$ ⟹8 times

30. Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $\sqrt{36 + 64} = 10$ cm

Short Answer Questions

Level 2: IIT Foundation (Medium)

Q21. (Take π = $\frac{22}{7}$.) A toy is a cone of radius 3.5 cm and height 12 cm on a hemisphere of the same radius. Find its volume.

Q22. A sector of angle 120° from a circle of radius 21 cm is folded into a cone. Find its base radius and height.

Q23. Show that a sphere fitting exactly inside a cylinder has volume $\frac{2}{3}$ of the cylinder and surface area equal to the cylinder's curved surface.

Q24. (Take π = $\frac{22}{7}$.) Earth from a well of diameter 3.5 m and depth 20 m is spread on a plot 22 m × 14 m. Find the height of the platform.

Q25. A square pyramid has base side 16 cm and height 6 cm. Find its slant height and total surface area.

Q26. Three metal cubes of sides 3, 4 and 5 cm are melted into one cube. Find its side.

Q27. The radius of a sphere increases by 20%. Find the percentage increase in its surface area and volume.

Q28. (Take π = $\frac{22}{7}$.) A capsule is a cylinder of length 14 mm and radius 3.5 mm with hemispheres at both ends. Find its surface area.

Q29. Guesstimate: about how many litres of water fill a bathtub 1.5 m × 0.7 m × 0.5 m to two-thirds?

Q30. A cylinder has the same volume as a cube of side 11 cm and radius 3.5 cm. Find its height.

Solution for Level 2: IIT Foundation (Medium)

21. Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi r l$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$; Hemisphere: volume $= \frac{2}{3}\pi r^3$, CSA $= 2\pi r^2$, TSA $= 3\pi r^2$

Solution: Cone $= \frac{1}{3} \times \frac{22}{7} \times 3.5^2 \times 12 = 154$ cm³

Hemisphere $= \frac{2}{3} \times \frac{22}{7} \times 3.5^3 \approx 89.8$ cm³ ⟹ total ≈ 243.8 cm³

22. Formula: Cone from a sector: slant height = sector radius; $2\pi r$ = arc length

Solution: Arc $= 14\pi \Rightarrow r = 7$ cm; $h = \sqrt{441 - 49} = 14\sqrt{2} \approx 19.8$ cm

23. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$; Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: Cylinder: $h = 2r$, volume $2\pi r^3$, CSA $4\pi r^2$. Sphere: $\frac{4}{3}\pi r^3 = \frac{2}{3} \times 2\pi r^3$, area $4\pi r^2$ ✓

24. Formula: Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$; Height $= \frac{\text{volume}}{\text{base area}}$

Solution: Earth $= \frac{22}{7} \times 1.75^2 \times 20 = 192.5$ m³

Height $= \frac{192.5}{22 \times 14} = \frac{192.5}{308} = 0.625$ m

25. Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: Slant $= \sqrt{64 + 36} = 10$ cm; TSA $= 256 + 320 = 576$ cm²

26. Formula: Cube: volume $= a^3$, TSA $= 6a^2$

Solution: $3^3 + 4^3 + 5^3 = 27 + 64 + 125 = 216 = 6^3 \Rightarrow$ side 6 cm

27. Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: New radius $1.2r$: area $\times 1.2^2 = 1.44 \Rightarrow$ +44%; volume $\times 1.2^3 = 1.728 \Rightarrow$ +72.8%

28. Formula: Cylinder: CSA $= 2\pi r h$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$; Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: Cylinder CSA $= 2 \times \frac{22}{7} \times 3.5 \times 14 = 308$ mm²

Two hemispheres = one sphere $= 4 \times \frac{22}{7} \times 3.5^2 = 154$ mm² ⟹ 462 mm²

29. Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$; 1 m³ = 1000 L; 1 L = 1000 cm³

Solution: $1.5 \times 0.7 \times 0.5 = 0.525$ m³; $\frac{2}{3} \times 0.525 = 0.35$ m³ ≈ 350 L

30. Formula: Cylinder: CSA = $2\pi rh$, TSA = $2\pi r(r+h)$, volume = $\pi r^2 h$; Cube: volume = a^3, TSA = $6a^2$

Solution: $\frac{22}{7} \times 3.5^2 \times h = 11^3 = 1331 \Rightarrow 38.5h = 1331 \Rightarrow h \approx 34.6$ cm

Long Answer Questions

Level 2: IIT Foundation (Medium)

Q16. Archimedes' sphere and cylinder.

(i) Write the volume and TSA of the cylinder enclosing a sphere of radius r.

(ii) Write the sphere's volume and area.

(iii) Find both ratios.

(iv) Compare the sphere's area with the cylinder's curved surface.

Q17. Largest solids in a cube of side 14 cm (π = $\frac{22}{7}$).

(i) Largest sphere volume

(ii) Largest cylinder volume

(iii) Largest cone volume

(iv) What fraction of the cube does the sphere fill?

Q18. A cuboid has edges in ratio 3 : 2 : 1 and volume 384 cm³.

(i) Find k.

(ii) Find the edges.

(iii) Find the total surface area.

(iv) Find the length of its diagonal.

Q19. Three solids rotate from the same right triangle with legs 6 cm and 8 cm (hypotenuse 10 cm).

(i) Rotate about the 6 cm leg: find the volume.

(ii) Rotate about the 8 cm leg: find the volume.

(iii) Find both curved surface areas.

(iv) Which cone is larger?

Q20. Guesstimates.

(i) Estimate the volume of air in a classroom 8 m × 6 m × 3.5 m.

(ii) Estimate the air one person breathes in a minute.

(iii) Estimate the air breathed by 40 students in an hour.

(iv) Compare with the room's volume.

Solution for Level 2: IIT Foundation (Medium)

16. (i) Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: Cylinder: radius r, height $2r \Rightarrow V = 2\pi r^3$; TSA = $2\pi r(2r) + 2\pi r^2 = 6\pi r^2$

(ii) Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: $\frac{4}{3}\pi r^3$; $4\pi r^2$

(iii) Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: $\frac{4}{3}\pi r^3 : 2\pi r^3 = 2:3$ and $4\pi r^2 : 6\pi r^2 = 2:3$

(iv) Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: Cylinder CSA = $2\pi r \times 2r = 4\pi r^2$ — equal to the sphere's area.

17. (i) Formula: Sphere: surface area = $4\pi r^2$, volume = $\frac{4}{3}\pi r^3$

Solution: $r = 7$: $\frac{4}{3} \times \frac{22}{7} \times 343 \approx 1437.3$ cm³

(ii) Formula: Cylinder: CSA = $2\pi rh$, TSA = $2\pi r(r+h)$, volume = $\pi r^2 h$

Solution: $\frac{22}{7} \times 49 \times 14 = 2156$ cm³

(iii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA = πrl, TSA = $\pi r(l+r)$, volume = $\frac{1}{3}\pi r^2 h$

Solution: $\frac{1}{3} \times 2156 \approx 718.7$ cm³

(iv) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{11}{21} \approx 0.52$

18. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $3k \times 2k \times k = 6k^3 = 384 \Rightarrow k^3 = 64 \Rightarrow k = 4$

(ii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: 3×4,2×4,1×4 = 12, 8, 4 cm

(iii) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $2(12 \times 8 + 8 \times 4 + 4 \times 12) = 2(96 + 32 + 48) = 352$ cm²

(iv) Formula: Diagonal of a cuboid $= \sqrt{l^2 + b^2 + h^2}$

Solution: $\sqrt{224} = 4\sqrt{14} \approx 15$ cm

19. (i) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $r = 8$, $h = 6$: 128π cm³

(ii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $r = 6$, $h = 8$: 96π cm³

(iii) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: πrl: $\pi \times 8 \times 10 = 80\pi$ and $\pi \times 6 \times 10 = 60\pi$ cm²

(iv) Formula: Cone: $l = \sqrt{r^2 + h^2}$, CSA $= \pi rl$, TSA $= \pi r(l + r)$, volume $= \frac{1}{3}\pi r^2 h$

Solution: $128\pi > 96\pi \Rightarrow$ the one rotated about the 6 cm leg.

20. (i) Formula: Cuboid: volume $= lbh$, TSA $= 2(lb + bh + hl)$, four walls $= 2(l + b)h$

Solution: $8 \times 6 \times 3.5 = 168$ m³

(ii) Formula: Estimate: air breathed = breaths per minute × air per breath

Solution: About 15 breaths a minute of about 0.5 L each ⇒ about 6–8 L

(iii) Formula: Estimate: total air = rate × time × number of people

Solution: About $40 \times 7 \times 60 \approx 16{,}800$ L ≈ 17 m³

(iv) Formula: Compare as a fraction: $\frac{\text{air breathed}}{\text{room volume}}$

Solution: $\frac{16.8}{168} = \frac{1}{10}$ — about one-tenth of the room's air.

Case-Based Questions

Level 2: IIT Foundation (Medium)

Q11. Sphere in a cylinder

A ball of radius 7 cm fits exactly in a cylindrical can. (π = $\frac{22}{7}$)

(i) Find the can's height.

(ii) Find the volume of the can.

(iii) Find the volume of the ball.

(iv) Find the ratio of the volumes.

Q12. Folded cone

A 216° sector of a circle of radius 25 cm is folded into a cone.

(i) Find the slant height.

(ii) Find the base radius.

(iii) Find the height.

(iv) Find the volume.

Q13. Pyramid model

A model of a square pyramid has base side 16 cm and height 6 cm.

(i) Find the slant height of a face.

(ii) Find the area of the four faces.

(iii) Find the total surface area.

(iv) Find its volume.

Q14. Well digging

A well of diameter 7 m is dug 20 m deep and the earth is spread over a plot 22 m × 14 m. ($\pi = \frac{22}{7}$)

(i) Find the volume of earth.

(ii) Find the area of the plot.

(iii) Find the height of the raised platform.

(iv) Find the curved surface area of the well wall.

Q15. Melting cubes

Three metal cubes of sides 3 cm, 4 cm and 5 cm are melted into a single cube.

(i) Find the total volume.

(ii) Find the side of the new cube.

(iii) Find the total surface area of the three cubes.

(iv) Find the surface area of the new cube and compare.

Solution for Level 2: IIT Foundation (Medium)

11. (i) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: Height = diameter $= 14$ cm

(ii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{22}{7} \times 49 \times 14 = 2156$ cm³

(iii) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: $\frac{4}{3} \times \frac{22}{7} \times 343 \approx 1437.3$ cm³

(iv) Formula: Sphere: surface area $= 4\pi r^2$, volume $= \frac{4}{3}\pi r^3$

Solution: Can : ball $= 3:2$

12. (i) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: The radius of the sector becomes the slant height $\Rightarrow$25 cm

(ii) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: $2\pi r = \frac{216}{360} \times 2\pi \times 25 \Rightarrow r = 15$ cm

(iii) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: $\sqrt{25^2 - 15^2} = 20$ cm

(iv) Formula: Cone from a sector: slant height = sector radius; $2\pi r =$ arc length

Solution: $\frac{1}{3}\pi \times 225 \times 20 = 1500\pi$ cm³

13. (i) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $\sqrt{6^2 + 8^2} = 10$ cm

(ii) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $4 \times \frac{1}{2} \times 16 \times 10 = 320$ cm²

(iii) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $320 + 16^2 = 576$ cm²

(iv) Formula: Pyramid: volume $= \frac{1}{3} \times$ base area $\times h$; slant height $= \sqrt{h^2 + \left(\frac{a}{2}\right)^2}$

Solution: $\frac{1}{3} \times 256 \times 6 = 512$ cm³

14. (i) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $\frac{22}{7} \times 3.5^2 \times 20 = 770$ m³

(ii) Formula: Area of a rectangle $= l \times b$

Solution: $22 \times 14 = 308$ m²

(iii) Formula: Height $= \frac{\text{volume}}{\text{base area}}$

Solution: $\frac{770}{308} = 2.5$ m

(iv) Formula: Cylinder: CSA $= 2\pi rh$, TSA $= 2\pi r(r + h)$, volume $= \pi r^2 h$

Solution: $2\pi rh = 2 \times \frac{22}{7} \times 3.5 \times 20 = 440$ m²

15. (i) Formula: Cube: volume $= a^3$, TSA $= 6a^2$

Solution: $27 + 64 + 125 = 216$ cm³

(ii) Formula: Cube: volume $= a^3$, TSA $= 6a^2$

Solution: $\sqrt[3]{216} = 6$ cm

(iii) Formula: Cube: volume $= a^3$, TSA $= 6a^2$

Solution: $6(9 + 16 + 25) = 300$ cm²

(iv) Formula: Cube: volume $= a^3$, TSA $= 6a^2$

Solution: $6 \times 36 = 216$ cm² — less than 300 cm².