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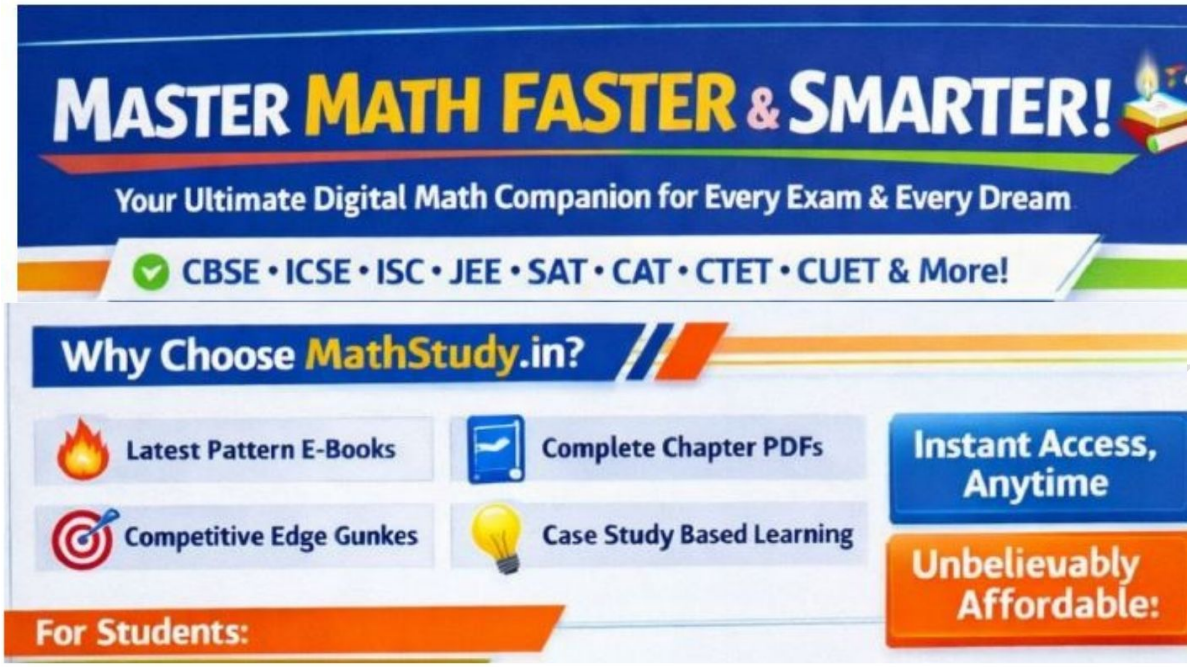


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# CHAPTER TEST: SURFACE AREAS AND VOLUMES (HOTS)

**Mathematics | Class IX | (2026/SAV-HOTS/09/001)**

## Section A: Multiple Choice Questions

1. **(b) 33.1%**
   Let original radius be $r$. New radius $R = 1.1r$.
   Volume $V \propto r^3$. Ratio $= (1.1)^3 = 1.331$. Increase $= 0.331 = 33.1\%$.

2. **(b) 2:1**
   $V_{cone} = V_{hemi} \implies \frac{1}{3}\pi r^2 h = \frac{2}{3}\pi r^3$. Since bases are equal ($r$ is same), $h = 2r$.
   Ratio $h : r = 2 : 1$.

3. **(b) 1920**
   Vol. of pit $= 1600 \times 1200 \times 400\,\text{cm}^3$. Vol. of plank $= 400 \times 50 \times 20\,\text{cm}^3$.
   $n = \frac{16\times12\times4}{4\times0.5\times0.2} = 1920$.

4. **(a) 179.67 cm$^3$**
   $4\pi r^2 = 154 \implies r = 3.5$ cm. $V = \frac{4}{3} \times \frac{22}{7} \times (3.5)^3 \approx 179.67$ cm$^3$.

5. **(b)** $4\pi r^2$
   Cylinder height $h = 2r$, radius $= r$. CSA $= 2\pi rh = 2\pi r(2r) = 4\pi r^2$.

6. **(a) 1:4**
   $S \propto r^2$. Ratio $= 6^2 : 12^2 = 36 : 144 = 1 : 4$.

7. **(c) 2:3:1**
   Let $h = 2r$ (to fit sphere). $V_s = \frac{4}{3}\pi r^3$, $V_{cyl} = \pi r^2(2r) = 2\pi r^3$, $V_{cone} = \frac{1}{3}\pi r^2(2r) = \frac{2}{3}\pi r^3$.
   Ratio: $\frac{4}{3} : 2 : \frac{2}{3} \implies 4 : 6 : 2 \implies 2 : 3 : 1$.

8. **(a) 512 cm$^3$**
   $4a^2 = 256 \implies a^2 = 64 \implies a = 8$. $V = a^3 = 8^3 = 512$ cm$^3$.

## Section B: Short Answer Questions

1. Ratio $= \frac{1}{3}\pi r^2 h : \frac{2}{3}\pi r^3 : \pi r^2 h$. Since $h = r$ (height of hemisphere),
   Ratio $= \frac{1}{3} : \frac{2}{3} : 1 \implies \mathbf{1 : 2 : 3}$.

2. Vol. Sphere $= \frac{4}{3}\pi(2r)^3 = \frac{32}{3}\pi r^3$.
   Vol. Cone $= \frac{1}{3}\pi R^2 r$. Equating volumes: $\frac{1}{3}\pi R^2 r = \frac{32}{3}\pi r^3 \implies R^2 = 32r^2 \implies \mathbf{R = 4\sqrt{2}r}$.

3. $\frac{4}{3}\pi r^3 = 4\pi r^2 \implies \frac{r}{3} = 1 \implies r = 3$ units.
   Diameter $= 2r = \mathbf{6}$ units.

4. $V_{cone} = \frac{1}{3}\pi(2.1)^2(8.4)$. $V_{sphere} = \frac{4}{3}\pi R^3$.
   $\frac{4}{3}\pi R^3 = \frac{1}{3}\pi(2.1 \times 2.1 \times 8.4) \implies 4R^3 = 37.044 \implies R^3 = 9.261 \implies \mathbf{R = 2.1}$ cm.

## Section C: Short Answer Questions

1. $r = 14$ cm. $V = \frac{1}{3}\pi r^2 h = 9856 \implies \frac{1}{3} \times \frac{22}{7} \times 196 \times h = 9856 \implies \mathbf{h = 48}$ cm.
   $l = \sqrt{48^2 + 14^2} = \sqrt{2304 + 196} = \sqrt{2500} = \mathbf{50}$ cm.
   CSA $= \pi rl = \frac{22}{7} \times 14 \times 50 = \mathbf{2200}\,\text{cm}^\mathbf{2}$.

2. Circumference of semi-circle $= \pi r = \frac{22}{7} \times 14 = 44$ cm.
   This becomes the base circumference of the cone: $2\pi R = 44 \implies R = 7$ cm.
   The radius of the sheet is the slant height: $l = 14$ cm.
   $H = \sqrt{14^2 - 7^2} = 7\sqrt{3}$ cm. $V = \frac{1}{3} \times \frac{22}{7} \times 49 \times 7\sqrt{3} = \mathbf{\frac{343\sqrt{3}}{3}}\,\mathbf{cm^3} \approx 198.03\,\text{cm}^3$.

3. Inner $r = 100$ cm, Outer $R = 101$ cm.
   $V_{iron} = \frac{2}{3}\pi(R^3 - r^3) = \frac{2}{3} \times \frac{22}{7} \times (101^3 - 100^3) = \frac{44}{21} \times (1030301 - 1000000)$
   $V = \frac{44 \times 30301}{21} = \mathbf{63487.81}\,\mathbf{cm^3} \approx 0.0635\,\text{m}^3$.

## Section D: Long Answer / HOTS Questions

1. **Step 1: Find third edge $a_3$.**
   $V_{big} = V_1 + V_2 + V_3 \implies 12^3 = 6^3 + 8^3 + a_3^3$
   $1728 = 216 + 512 + a_3^3 \implies a_3^3 = 1000 \implies \mathbf{a_3 = 10}$ cm.
   **Step 2: Surface Area verification.**
   $SA_{big} = 6(12^2) = 864\,\text{cm}^2$.
   Sum $SA_{small} = 6(6^2 + 8^2 + 10^2) = 6(36 + 64 + 100) = 6(200) = 1200\,\text{cm}^2$.
   Verification: $1200 \neq 864$. The sum of surface areas is **not equal** to the original.

2. **Method:** Volume of water displaced = Volume of ball.
   Rise in level $h = 6.75$ cm, Cylinder radius $R = 12$ cm.
   $V_{displaced} = \pi R^2 h = \frac{22}{7} \times 12 \times 12 \times 6.75$.
   $V_{ball} = \frac{4}{3}\pi r^3$.
   $\frac{4}{3}r^3 = 144 \times 6.75 \implies r^3 = \frac{3 \times 144 \times 6.75}{4} = 3 \times 36 \times 6.75 = 729$.
   $r = \sqrt[3]{729} = \mathbf{9}$ cm.

3. **Case 1 (Revolved about 8 cm):** $h_1 = 8, r_1 = 6, l_1 = 10$.
   $V_1 = \frac{1}{3}\pi(6^2)(8) = \mathbf{96}\pi\,\text{cm}^3$. $CSA_1 = \pi(6)(10) = 60\pi$.
   **Case 2 (Revolved about 6 cm):** $h_2 = 6, r_2 = 8, l_2 = 10$.
   $V_2 = \frac{1}{3}\pi(8^2)(6) = \mathbf{128}\pi\,\text{cm}^3$. $CSA_2 = \pi(8)(10) = 80\pi$.
   **Difference:** $128\pi - 96\pi = \mathbf{32}\pi\,\text{cm}^3 \approx 100.48\,\text{cm}^3$.
   **Ratio of CSA:** $60\pi : 80\pi = \mathbf{3} : \mathbf{4}$.