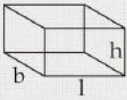
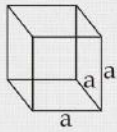
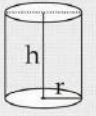

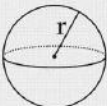
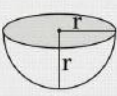


## Volume and Surface Area

### Exercise 13A

Name of the solid	Figure	Volume	Lateral/Curved Surface Area	Total Surface Area
Cuboid		$lbh$	$2lh + 2bh$ or $2h(l+b)$	$2lh+2bh+2lb$ or $2(lh+bh+lb)$
Cube		$a^3$	$4a^2$	$4a^2+2a^2$ or $6a^2$
Right circular cylinder		$\pi r^2 h$	$2\pi rh$	$2\pi rh + 2\pi r^2$ or $2\pi r(h+r)$
Right circular cone		$\frac{1}{3}\pi r^2 h$	$\pi rl$	$\pi rl + \pi r^2$ or $\pi r(l+r)$
Sphere		$\frac{4}{3}\pi r^3$	$4\pi r^2$	$4\pi r^2$
Hemisphere		$\frac{2}{3}\pi r^3$	$2\pi r^2$	$2\pi r^2 + \pi r^2$ or $3\pi r^2$

#### Question 1: <sup>3</sup>

(i) length = 12cm, breadth = 8 cm and height = 4.5 cm

$\therefore$  Volume of cuboid =  $l \times b \times h$

$$= (12 \times 8 \times 4.5) \text{ cm}^3 = 432 \text{ cm}^3$$

$\therefore$  Lateral surface area of a cuboid =  $2(l + b) \times h$

$$= [2(12 + 8) \times 4.5] \text{ cm}^2$$

$$= (2 \times 20 \times 4.5) \text{ cm}^2 = 180 \text{ cm}^2$$

$\therefore$  Total surface area cuboid =  $2(lb + bh + lh)$

$$= 2(12 \times 8 + 8 \times 4.5 + 12 \times 4.5) \text{ cm}^2$$

$$= 2(96 + 36 + 54) \text{ cm}^2$$

$$= (2 \times 186) \text{ cm}^2$$

$$= 372 \text{ cm}^2$$

(ii) Length = 26 m, breadth = 14 m and height = 6.5 m

$\therefore$  Volume of a cuboid =  $l \times b \times h$

$$= (26 \times 14 \times 6.5) \text{ m}^3$$

$$= 2366 \text{ m}^3$$

$\therefore$  Lateral surface area of a cuboid =  $2(l + b) \times h$

$$= [2(26 + 14) \times 6.5] \text{ m}^2$$

$$= 520 \text{ m}^2$$

$$\begin{aligned}\therefore \text{Total surface area} &= 2(lb + bh + lh) \\ &= 2(26 \times 14 + 14 \times 6.5 + 26 \times 6.5) \\ &= 2(364 + 91 + 169) \text{ m}^2 \\ &= (2 \times 624) \text{ m}^2 = 1248 \text{ m}^2.\end{aligned}$$

(iii) Length = 15 m, breadth = 6 m and height = 5 dm = 0.5 m

$$\begin{aligned}\therefore \text{Volume of a cuboid} &= l \times b \times h \\ &= (15 \times 6 \times 0.5) \text{ m}^3 = 45 \text{ m}^3. \\ \therefore \text{Lateral surface area} &= 2(l + b) \times h \\ &= [2(15 + 6) \times 0.5] \text{ m}^2 \\ &= (2 \times 21 \times 0.5) \text{ m}^2 = 21 \text{ m}^2 \\ \therefore \text{Total surface area} &= 2(lb + bh + lh) \\ &= 2(15 \times 6 + 6 \times 0.5 + 15 \times 0.5) \text{ m}^2 \\ &= 2(90 + 3 + 7.5) \text{ m}^2 \\ &= (2 \times 100.5) \text{ m}^2 \\ &= 201 \text{ m}^2\end{aligned}$$

(iv) Length = 24 m, breadth = 25 cm = 0.25 m, height = 6 m.

$$\begin{aligned}\therefore \text{Volume of cuboid} &= l \times b \times h \\ &= (24 \times 0.25 \times 6) \text{ m}^3. \\ &= 36 \text{ m}^3. \\ \therefore \text{Lateral surface area} &= 2(l + b) \times h \\ &= [2(24 + 0.25) \times 6] \text{ m}^2 \\ &= (2 \times 24.25 \times 6) \text{ m}^2 \\ &= 291 \text{ m}^2. \\ \therefore \text{Total surface area} &= 2(lb + bh + lh) \\ &= 2(24 \times 0.25 + 0.25 \times 6 + 24 \times 6) \text{ m}^2 \\ &= 2(6 + 1.5 + 144) \text{ m}^2 \\ &= (2 \times 151.5) \text{ m}^2 \\ &= 303 \text{ m}^2.\end{aligned}$$

### Question 2:

Length of Cistern = 8 m

Breadth of Cistern = 6 m

And Height (depth) of Cistern = 2.5 m

$\therefore$  Capacity of the Cistern = Volume of cistern

$$\begin{aligned}\therefore \text{Volume of Cistern} &= (l \times b \times h) \\ &= (8 \times 6 \times 2.5) \text{ m}^3 \\ &= 120 \text{ m}^3\end{aligned}$$

Area of the iron sheet required = Total surface area of the cistern.

$$\begin{aligned}\therefore \text{Total surface area} &= 2(lb + bh + lh) \\ &= 2(8 \times 6 + 6 \times 2.5 + 2.5 \times 8) \text{ m}^2 \\ &= 2(48 + 15 + 20) \text{ m}^2 \\ &= (2 \times 83) \text{ m}^2 = 166 \text{ m}^2\end{aligned}$$

**Question 3:**

Length of a room = 9m,

Breadth of a room = 8m

And height of room = 6.5 m

∴ Area of 4 walls = Lateral surface area

$$= 2(l + b) \times h$$

$$= [2(9+8) \times 6.5] \text{ m}^2$$

$$= (2 \times 17 \times 6.5) \text{ m}^2$$

$$= 221 \text{ m}^2$$

∴ Area not to be whitewashed = (area of 1 door) + (area of 2 windows)

$$= (2 \times 1.5) \text{ m}^2 + (2 \times 1.5 \times 1) \text{ m}^2$$

$$= 3 \text{ m}^2 + 3 \text{ m}^2 = 6 \text{ m}^2$$

∴ Area to be whitewashed =  $(221 - 6) \text{ m}^2 = 215 \text{ m}^2$

∴ Cost of whitewashing the walls at the rate of Rs.6.40 per

Square meter = Rs. (6.40 × 215) = Rs. 1376

**Question 4:**

Length of plank = 5m = 500 cm

Breadth of plank = 25 cm

Height of plank = 10 cm

$$\therefore \text{Volume of plank} = l \times b \times h$$
$$= (500 \times 25 \times 10) \text{ cm}^3$$

Now,

Length of pit = 20 m = 2000 cm

Breadth of pit = 6m = 600cm

Height of pit = 80 cm

$$\therefore \text{Volume of one pit} = (2000 \times 600 \times 80) \text{ cm}^3$$

$$\therefore \text{Number of planks that can be stored} = \frac{\text{Volume of pit}}{\text{Volume of plank}}$$
$$= \frac{(2000 \times 600 \times 80)}{(500 \times 25 \times 10)} = 768$$

**Question 5:**

Length of wall = 8m = 800cm

Breadth of wall = 6m = 600 cm

Height of wall = 22.5 cm

$$\therefore \text{Volume of wall} = l \times b \times h$$
$$= (800 \times 600 \times 22.5) \text{ cm}^3$$

Length of brick = 25cm

Breadth of brick = 11.25cm

Height of brick = 6cm

$$\therefore \text{Volume of brick} = (25 \times 11.25 \times 6) \text{ cm}^3$$

$$\therefore \text{Number of bricks required} = \frac{\text{Volume of the wall}}{\text{Volume of brick}}$$
$$= \frac{(800 \times 600 \times 22.5)}{(25 \times 11.25 \times 6)} = 6400$$

**Question 6:**

$$\begin{aligned}
 \text{Length of wall} &= 15\text{m} \\
 \text{Breadth of wall} &= 0.3\text{m} \\
 \text{Height of wall} &= 4\text{m} \\
 \therefore \text{Volume of the wall} &= (15 \times 0.3 \times 4) \text{m}^3 = 18\text{m}^3 \\
 \text{Volume of mortar} &= \left(\frac{1}{12} \times 18\right) = 1.5 \text{m}^3 \\
 \text{Volume of wall} &= (18 - 1.5)\text{m}^3 = 16.5 = \frac{33}{2} \text{m}^3
 \end{aligned}$$

$$\begin{aligned}
 \text{Length of brick} &= 22 \text{ cm} \\
 \text{Breadth of brick} &= 12.5 \text{ cm} \\
 \text{Height of brick} &= 7.5 \text{ cm} \\
 \therefore \text{Volume of 1 brick} &= \left(\frac{22}{100} \times \frac{12.5}{100} \times \frac{7.5}{100}\right) \text{m}^3 \\
 &= \left(\frac{33}{16000}\right) \text{m}^3
 \end{aligned}$$

$$\begin{aligned}
 \therefore \text{Number of bricks} &= \frac{\text{Volume of bricks}}{\text{Volume of 1brick}} \\
 &= \left(\frac{33}{2} \times \frac{16000}{33}\right) = 8000
 \end{aligned}$$

**Question 7:**

$$\begin{aligned}
 \text{External length of cistern} &= 1.35 \text{ m} = 135 \text{ cm} \\
 \text{External breadth of cistern} &= 1.08 \text{ m} = 108 \text{ cm} \\
 \text{External height of cistern} &= 90\text{cm} \\
 \therefore \text{External volume of cistern} &= (135 \times 108 \times 90) \text{cm}^3 \\
 &= 1312200 \text{cm}^3 \\
 \text{Internal length of cistern} &= (135 - 2 \times 2.5) \text{ cm} \\
 &= (135 - 5) \text{ cm} = 130 \text{ cm} \\
 \text{Internal breadth of cistern} &= (108 - 2 \times 2.5) \text{ cm} \\
 &= (108 - 5) \text{ cm} = 103 \text{ cm} \\
 \text{Internal height of cistern} &= (90 - 2.5) \text{ cm} = 87.5 \text{ cm} \\
 \therefore \text{Capacity of the cistern} &= \text{Internal volume of} \\
 \text{cistern} &= (130 \times 103 \times 87.5) \text{cm}^3 \\
 &= 1171625 \text{cm}^3 \\
 \text{Volume of the iron used} &= \text{External volume of the} \\
 \text{cistern} &\quad \quad \quad - \text{Internal volume of the} \\
 \text{cistern} &= (1312200 - 1171625) \text{cm}^3 \\
 &= 140575 \text{cm}^3
 \end{aligned}$$

**Question 8:**

$$\begin{aligned} \text{Depth of the river} &= 2 \text{ m} \\ \text{Breadth of the river} &= 45 \text{ m} \\ \text{Length of the river} &= 3 \text{ K M / h} = \left( \frac{3 \times 1000}{60} \right) \text{ m/min} \\ &= 50 \text{ m / min.} \end{aligned}$$

$$\begin{aligned} \therefore \text{Volume of water running into the sea per minute} &= (50 \times 45 \times 2) \text{ m}^3 \\ &= 4500 \text{ m}^3 \end{aligned}$$

**Question 9:**

$$\begin{aligned} \text{Total cost of sheet} &= \text{Rs. } 1620 \\ \text{Cost of metal sheet per square meter} &= \text{Rs. } 30 \end{aligned}$$

$$\begin{aligned} \therefore \text{Area of the sheet required} &= \left( \frac{\text{Total cost}}{\text{rate / m}^2} \right) \text{ sq.m.} \\ &= \left( \frac{1620}{30} \right) \text{ sq.m} = 54 \text{ sq.m.} \end{aligned}$$

$$\begin{aligned} \text{Length of box} &= 5 \text{ m} \\ \text{Breadth of box} &= 3 \text{ m} \end{aligned}$$

Now, Let the height of the box be  $x$  meters.

$$\begin{aligned} \therefore \text{Area of the sheet} &= \text{Total surface area of the box.} \\ &= 2(lb + bh + lh) \\ 54 &= 2(5 \times 3 + 3 \times x + 5 \times x) \\ 54 &= 2(15 + 3x + 5x) \\ 54 &= 2(15 + 8x) \end{aligned}$$

$$\begin{aligned} \therefore 2(15 + 8x) &= 54 \\ \Rightarrow 30 + 16x &= 54 \\ \Rightarrow 16x &= 54 - 30 \end{aligned}$$

$$\Rightarrow x = \frac{24}{16} = 1.5 \text{ m}$$

$\therefore$  The height of the box = 1.5 m.

**Question 10:**

$$\begin{aligned} \text{Length of room} &= 10 \text{ m} \\ \text{Breadth of room} &= 10 \text{ m} \\ \text{Height of room} &= 5 \text{ m} \end{aligned}$$

$$\begin{aligned} \therefore \text{Length of the longest pole} &= \text{length of diagonal} \\ &= \sqrt{l^2 + b^2 + h^2} \\ &= \sqrt{10^2 + 10^2 + 5^2} \\ &= \sqrt{100 + 100 + 25} = \sqrt{225} = 15 \text{ m} \end{aligned}$$

$\therefore$  The length of the longest pole that can be put in a room with given Dimensions = 15 m.

**Question 11:**

$$\begin{aligned} \text{Length of hall} &= 20 \text{ m} \\ \text{Breadth of hall} &= 16 \text{ m} \\ \text{Height of hall} &= 4.5 \text{ m} \end{aligned}$$

$$\begin{aligned} \therefore \text{Volume of hall} &= l \times b \times h \\ &= (20 \times 16 \times 4.5) \text{ m}^3 \\ \text{Volume of air needed per person} &= 5 \text{ m}^3 \end{aligned}$$

$$\begin{aligned} \therefore \text{Number of persons} &= \left( \frac{\text{Volume of the hall}}{\text{Volume of air needed per person}} \right) \\ &= \left( \frac{20 \times 16 \times 4.5}{5} \right) = 288. \end{aligned}$$

**Question 12:**

Length of classroom = 10m  
 Breadth of classroom = 6.4 m  
 Height of classroom = 5 m  
 Each student is given  $1.6 \text{ m}^2$  of the floor area.

$$\begin{aligned} \text{Number of students} &= \frac{(\text{area of the room})}{1.6} \\ &= \frac{(10 \times 6.4)}{1.6} = \frac{64}{1.6} = 40 \end{aligned}$$

$\therefore$  Number of students = 40

$$\begin{aligned} \therefore \text{Air required by each student} &= \left( \frac{\text{Volume of the room}}{\text{number of students}} \right) \text{m}^3 \\ &= \left( \frac{10 \times 6.4 \times 5}{40} \right) \text{m}^3 = \left( \frac{320}{40} \right) \text{m}^3 \\ &= 8 \text{m}^3 \end{aligned}$$

**Question 13:**

Volume of a cuboid =  $1536 \text{ m}^3$   
 Length of the cuboid = 16 m  
 Let the breadth and height of the cuboid be  $3x$  and  $2x$ .  
 $\therefore$  Volume of cuboid =  $l \times b \times h$

$$\Rightarrow 1536 = (16 \times 3x \times 2x)$$

$$\Rightarrow 1536 = 96x^2$$

$$\Rightarrow x^2 = \frac{1536}{96} = 16$$

$$\therefore x = \sqrt{16} = 4 \text{ m.}$$

$$\therefore \text{Breadth of the cuboid} = 3x = 3 \times 4 = 12 \text{ m}$$

$$\text{And height of the cuboid} = 2x = 2 \times 4 = 8 \text{ m}$$

**Question 14:**

Surface area of a cuboid =  $758 \text{ cm}^2$   
 Length = 14 cm  
 Breadth = 11 cm  
 Let the height of the cuboid =  $h$  cm

$$\therefore \text{Surface area of cuboid} = 2(lb + bh + lh)$$

$$\Rightarrow 758 = 2(14 \times 11 + 11 \times h + 14 \times h)$$

$$\Rightarrow 758 = 2(154 + 11h + 14h)$$

$$\Rightarrow 758 = 2(154 + 25h)$$

$$\Rightarrow 758 = 308 + 50h$$

$$\Rightarrow 50h = 758 - 308$$

$$\therefore h = \frac{450}{50} = 9 \text{ cm.}$$

$\therefore$  The height of the cuboid = 9 cm

**Question 15:**

(a) Each edge of a cube = 9m  
 $\therefore$  Volume of a cube =  $a^3$   
 $= (9)^3 \text{ m}^3 = 729 \text{ m}^3$   
 $\therefore$  Lateral surface area of cube =  $4a^2$   
 $= 4 \times (9)^2$   
 $= (4 \times 81) \text{ m}^2$   
 $= 324 \text{ m}^2$   
 $\therefore$  Total surface area of a cube =  $6a^2$   
 $= 6 \times (9)^2$   
 $= (6 \times 81) \text{ m}^2$   
 $= 486 \text{ m}^2$   
 $\therefore$  Diagonal of cube =  $\sqrt{3} a$   
 $= \sqrt{3} \times 9$   
 $= (1.73 \times 9) \text{ m} = 15.57 \text{ m}$

(b)  $\therefore$  Each edge of a cube = 6.5 cm  
 Volume of a cube =  $a^3 = (6.5)^3 \text{ cm}^3$   
 $= 274.625 \text{ cm}^3$   
 $\therefore$  Lateral surface area of a cube =  $4a^2$   
 $= 4 \times (6.5)^2 \text{ cm}^2$   
 $= (4 \times 42.25) \text{ cm}^2$   
 $= 169 \text{ cm}^2$   
 Total surface area of a cube =  $6a^2$   
 $= 6 \times (6.5)^2 \text{ cm}^2$   
 $= (6 \times 42.25) \text{ cm}^2$   
 $= 253.5 \text{ cm}^2$   
 $\therefore$  Diagonal of cube =  $\sqrt{3} a$   
 $= \sqrt{3} \times 6.5$   
 $= (1.73 \times 6.5) \text{ cm}$   
 $= 11.245 \text{ cm}$ .

**Question 16:**

Let each side of the cube be a cm.

Then, the total surface area of the cube =  $(6a^2) \text{ cm}^2$

$$\therefore 6a^2 = 1176$$

$$\Rightarrow a^2 = \frac{1176}{6} = 196$$

$$\Rightarrow a = \sqrt{196} = 14 \text{ cm}$$

$$\therefore \text{Volume of the cube} = a^3$$

$$= (14)^3 = (14 \times 14 \times 14) \text{ cm}^3$$

$$= 2744 \text{ cm}^3.$$

**Question 17:**

Let each side of the cube be a cm

Then, the lateral surface area of the cube =  $(4a^2) \text{ cm}^2$

$$\therefore 4a^2 = 900$$

$$\Rightarrow a^2 = \frac{900}{4} = 225$$

$$\therefore a = \sqrt{225} = 15 \text{ cm}$$

$$\therefore \text{Volume of the cube} = a^3$$

$$= (15)^3 = (15 \times 15 \times 15) \text{ cm}^3$$

$$= 3375 \text{ cm}^3.$$

**Question 18:**

Volume of the cube =  $512 \text{ cm}^3$  [Volume =  $a^3$ ]

$$\therefore \text{Each edge of the cube} = \sqrt[3]{512} = 8 \text{ cm}.$$

$$\therefore \text{Surface area of cube} = 6a^2$$

$$= 6 \times (8)^2 \text{ cm}^2$$

$$= (6 \times 64) \text{ cm}^2$$

$$= 384 \text{ cm}^2$$

**Question 19:**

$$\begin{aligned}\text{Volume of the new cube} &= [(3)^3 + (4)^3 + (5)^3] \text{ cm} \\ &= (27 + 64 + 125) \text{ cm}^3 \\ &= 216 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{Now edge of this cube} &= a \text{ cm} \\ \text{And,} \quad a^3 &= 216 \\ \therefore a &= 6 \text{ cm}\end{aligned}$$

$$\begin{aligned}\text{Lateral surface area of the new cube} &= 4a^2 \text{ cm}^2. \\ &= 4 \times (6)^2 \text{ cm}^2 \\ &= (4 \times 36) \text{ cm}^2 \\ &= 144 \text{ cm}^2\end{aligned}$$

$\therefore$  The lateral surface area of the new cube formed = 144 cm<sup>2</sup>.

**Question 20:**

$$1 \text{ hectare} = 10000 \text{ m}^2$$

$$\text{Area} = 2 \text{ hectares} = 2 \times 10000 \text{ m}^2$$

$$\text{Depth of the ground} = 5 \text{ cm} = \frac{5}{100} \text{ m}$$

$$\begin{aligned}\text{Volume of water} &= (\text{area} \times \text{depth}) \\ &= \left( 2 \times 10000 \times \frac{5}{100} \right) \text{ m}^3 \\ &= 1000 \text{ m}^3\end{aligned}$$

$\therefore$  Volume of water that falls = 1000 m<sup>3</sup>

**Exercise 13B**

**Question 1:**

$$\text{Here, } r = 5 \text{ cm and } h = 21 \text{ cm}$$

$$\begin{aligned}\therefore \text{ Volume of the cylinder} &= (\pi r^2 h) \\ &= \left( \frac{22}{7} \times 5^2 \times 21 \right) \text{ cm}^3 \\ &= \left( \frac{22}{7} \times 25 \times 21 \right) \text{ cm}^3 \\ &= 1650 \text{ cm}^3.\end{aligned}$$

$$\begin{aligned}\therefore \text{ Curved surface area of a cylinder} &= (2\pi rh) \\ &= 2 \times \left( \frac{22}{7} \times 5 \times 21 \right) \text{ cm}^2 \\ &= 660 \text{ cm}^2\end{aligned}$$

**Question 2:**



Here, diameter = 28 cm

$$\text{Radius} = \left(\frac{28}{2}\right) \text{ cm} = 14 \text{ cm and}$$

height = 40 cm

$$\therefore \text{Curved surface area} = (2\pi rh)$$

$$= \left(2 \times \frac{22}{7} \times 14 \times 40\right) \text{ cm}^2$$

$$= 3520 \text{ cm}^2$$

$$\therefore \text{Total surface area} = (2\pi rh + 2\pi r^2)$$

$$= \left(2 \times \frac{22}{7} \times 14 \times 40 + 2 \times \frac{22}{7} \times 14^2\right)$$

$$= (3520 + 1232) = 4752 \text{ cm}^2$$

$$\therefore \text{Volume of the cylinder} = (\pi r^2 h)$$

$$= \left(\frac{22}{7} \times 14^2 \times 40\right) \text{ cm}^3$$

$$= \left(\frac{22}{7} \times 14 \times 14 \times 40\right) \text{ cm}^3$$

$$= 24640 \text{ cm}^3.$$

### Question 3:

Here, radius (r) = 10.5 cm and height = 60 cm.

$$\therefore \text{Volume of the cylinder} = (\pi r^2 h)$$

$$= \left(\frac{22}{7} \times 10.5 \times 10.5 \times 60\right) \text{ cm}^3$$

$$= 20790 \text{ cm}^3$$

$\therefore$  Weight of the solid cylinder if the material of the cylinder

$$\text{Weighs } 5 \text{ g per cm}^3 = (20790 \times 5) = 103950 \text{ g}$$

$$= \frac{103950}{1000} \quad [ \because 1000 \text{ g} = 1 \text{ kg} ]$$

$$= 103.95 \text{ kg}$$

### Question 4:

Here, curved surface area = 1210 cm<sup>2</sup>

$$\text{Diameter} = 20 \text{ cm} \Rightarrow \text{radius} = \frac{20}{2} = 10 \text{ cm}$$

$$\therefore \text{Curved surface area of the cylinder} = 2\pi rh$$

$$\Rightarrow 1210 = 2 \times \frac{22}{7} \times 10 \times h$$

$$\Rightarrow h = \left(\frac{1210 \times 7}{2 \times 22 \times 10}\right) \text{ cm} = 19.25 \text{ cm}$$

$$\therefore \text{Height} = 19.25 \text{ cm}$$

$$\therefore \text{Volume of the cylinder} = (\pi r^2 h)$$

$$= \left(\frac{22}{7} \times 10^2 \times 19.25\right) \text{ cm}^3$$

$$= \left(\frac{22}{7} \times 10 \times 10 \times 19.25\right) \text{ cm}^3$$

$$= 6050 \text{ cm}^3$$

$$\therefore \text{Volume of the cylinder} = 6050 \text{ cm}^3.$$

### Question 5:

Let base radius be  $r$  and height be  $h$

Then,  $2\pi rh = 4400 \text{ cm}^2$

And  $2\pi r = 110 \text{ cm}$

$$\Rightarrow \frac{2\pi rh}{2\pi r} = \frac{4400}{110}$$

$$\Rightarrow h = 40 \text{ cm}$$

$$\therefore 2 \times \frac{22}{7} \times r \times h \times 40 = 4400 \text{ cm.}$$

$$\Rightarrow r = \left( \frac{4400 \times 7}{44 \times 40} \right) \text{ cm} = \frac{35}{2} \text{ cm.}$$

$$\begin{aligned} \therefore \text{Volume of the cylinder} &= \pi r^2 h \\ &= \left( \frac{22}{7} \times \frac{35}{2} \times \frac{35}{2} \times 40 \right) \text{ cm}^3 \\ &= 38500 \text{ cm}^3. \end{aligned}$$

**Question 6:**

Let the radius ( $r$ ) =  $2x$  cm and height ( $h$ ) =  $3x$  cm

Then, Volume of cylinder =  $(\pi r^2 h)$

$$\text{Volume} = \left[ \frac{22}{7} \times (2x)^2 \times 3x \right]$$

$$\text{Volume} = \left[ \frac{22}{7} \times 4x^2 \times 3x \right]$$

$$\text{Volume} = \frac{22}{7} \times 12x^3$$

$$\Rightarrow 1617 = \frac{22}{7} \times 12x^3$$

[ $\because$  volume given =  $1617 \text{ cm}^3$ ]

$$\Rightarrow 12x^3 = \frac{1617 \times 7}{22}$$

$$\Rightarrow x^3 = \frac{1617 \times 7}{22 \times 12} = \left( \frac{7}{2} \right)^3$$

$$\Rightarrow x = \frac{7}{2}$$

$$\therefore \text{radius} = 2x = 2 \times \frac{7}{2} = 7 \text{ cm}$$

$$\text{and height} = 3x = 3 \times \frac{7}{2} = \frac{21}{2} \text{ cm}$$

Total surface area =  $2\pi r(h+r)$

$$= 2 \times \frac{22}{7} \times 7 \left( \frac{21}{2} + 7 \right) \text{ cm}^2$$

$$= 44 \times \left( \frac{21+14}{2} \right) \text{ cm}^2$$

$$= (22 \times 35) \text{ cm}^2 = 770 \text{ cm}^2$$

**Question 7:**

$$\begin{aligned} \text{Curved surface area} &= \frac{1}{3} \times (\text{total surface area}) \\ &= \left(\frac{1}{3} \times 462\right) \text{cm}^2 = 154 \text{cm}^2 \\ (\text{Total surface area}) - (\text{Curved surface area}) \\ &= (462 - 154) \text{cm}^2 = 308 \text{cm}^2 \end{aligned}$$

$$\Rightarrow 2\pi r^2 = 308$$

$$\Rightarrow 2 \times \frac{22}{7} \times r^2 = 308$$

$$\Rightarrow r^2 = \frac{308 \times 7}{44} = 49$$

$$\Rightarrow r = \sqrt{49} = 7 \text{cm}$$

$$\begin{aligned} \text{Now, curved surface area} &= 2\pi rh = 154 \text{cm}^2 \\ &= 2 \times \frac{22}{7} \times 7 \times h = 154 \text{cm}^2 \\ &= h = \frac{154}{44} = 3.5 \text{cm} \end{aligned}$$

Now,  $r = 7 \text{ cm}$  and  $h = 3.5 \text{ cm}$

$$\begin{aligned} \text{Volume of the cylinder} &= (\pi r^2 h) \\ &= \left(\frac{22}{7} \times 7 \times 7 \times 3.5\right) \text{cm}^3 \\ &= 539 \text{cm}^3 \end{aligned}$$

$\therefore$  The volume of the cylinder =  $539 \text{ cm}^3$ .

**Question 8:**

$$\begin{aligned} \text{Curved surface area} &= \frac{2}{3} \times (\text{total surface area}) \\ &= \left(\frac{2}{3} \times 231\right) \text{cm}^2 = 154 \text{cm}^2 \end{aligned}$$

$$\begin{aligned} (\text{Total surface area}) - (\text{Curved surface area}) \\ &= (231 - 154) \text{cm}^2 = 77 \text{cm}^2 \end{aligned}$$

$$2\pi r^2 = 77 \text{cm}^2$$

$$\Rightarrow 2 \times \frac{22}{7} \times r^2 = 77$$

$$\Rightarrow r^2 = \frac{77 \times 7}{44} = \frac{49}{4}$$

$$\Rightarrow r = \sqrt{\frac{49}{4}} = \frac{7}{2} \text{cm}$$

$$\text{Now, } 2\pi rh = 154 \text{cm}^2$$

$$\Rightarrow 2 \times \frac{22}{7} \times \frac{7}{2} \times h = 154 \text{cm}^2$$

$$\Rightarrow h = \frac{154}{22} = 7 \text{cm}$$

$$\text{Now, } r = \frac{7}{2} \text{cm and } h = 7 \text{cm}$$

$$\begin{aligned} \text{Volume of the cylinder} &= \pi r^2 h \\ &= \left(\frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times 7\right) \text{cm}^3 \\ &= 269.5 \text{cm}^3 \end{aligned}$$

$$\text{Volume of the cylinder} = 269.5 \text{cm}^3$$

**Question 9:**

Here,  $(r + h) = 37$  m [∵ given]  
And, total surface area =  $2\pi r(r + h) = 1628\text{m}^2$

$$\begin{aligned} \Rightarrow 2\pi r \times 37 &= 1628\text{m}^2 \\ \Rightarrow 2 \times \frac{22}{7} \times r \times 37 &= 1628 \\ \Rightarrow r &= \frac{1628 \times 7}{44 \times 37} = 7\text{m} \\ \text{And } (r+h) &= 37\text{m} \\ \Rightarrow (7+h) &= 37 \\ \Rightarrow h &= 37 - 7 = 30\text{m} \\ \text{Volume} &= \pi r^2 h \\ &= \left(\frac{22}{7} \times 7 \times 7 \times 30\right)\text{m}^3 = 4620\text{m}^3. \end{aligned}$$

**Question 10:**

Curved surface area =  $2\pi rh$

Total surface area =  $2\pi r(h+r)$

Since they are in the ratio of 1: 2

$$\begin{aligned} \therefore \frac{2\pi rh}{2\pi r(h+r)} &= \frac{1}{2} \\ \Rightarrow \frac{h}{h+r} &= \frac{1}{2} \\ \Rightarrow 2h &= h+r \\ \Rightarrow 2h - h &= r \\ \Rightarrow h &= r \\ \Rightarrow 2\pi r(h+r) &= 616\text{ cm}^2 \\ \Rightarrow 4\pi r^2 &= 616\text{ cm}^2 \quad [\text{Putting } h = r] \\ \Rightarrow 4 \times \frac{22}{7} \times r^2 &= 616 \\ \Rightarrow r^2 &= \frac{616 \times 7}{88} = 49 \\ \Rightarrow r &= \sqrt{49} = 7\text{ cm} \\ \text{Then, } r &= 7\text{ cm and } h = 7\text{ cm} \\ \therefore \text{Volume} &= (\pi r^2 h) \\ &= \left(\frac{22}{7} \times 7 \times 7 \times 7\right)\text{cm}^3 = 1078\text{cm}^3 \\ \therefore \text{the volume of the cylinder} &= 1078\text{cm}^3. \end{aligned}$$

**Question 11:**

$1\text{cm}^3 = 1\text{ cm} \times 1\text{cm} \times 1\text{cm}$  and  $1\text{cm} = 0.01\text{m}$

Therefore,

Volume of the

gold =  $0.01\text{m} \times 0.01\text{m} \times 0.01\text{m} = 0.000001\text{m}^3$ .....(1)

Diameter of the wire drawn = 0.1 mm

Radius of the wire drawn =  $\frac{0.1}{2}\text{mm} = 0.05\text{mm}$

$r = 0.00005\text{ m}$  .....(2)

Length of the wire =  $h\text{ m}$  .....(3)

Volume of the wire drawn = Volume of the gold

$\Rightarrow \pi r^2 h = 0.000001$

$\Rightarrow \pi \times 0.00005 \times 0.00005 \times h = 0.000001$  [from equations (1), (2) and (3)]

$$h = \frac{0.000001 \times 7}{0.00005 \times 0.00005 \times 22}$$

$\therefore h = 127.27\text{m}$

$\therefore$  the length of the wire is 127.27m

**Question 12:**

Let the radii of the two cylinders be  $2R$  and  $3R$ .

And their heights be  $5H$  and  $3H$ .

$$\text{Then, } \frac{V_1}{V_2} = \frac{\pi \times (2R)^2 \times 5H}{\pi \times (3R)^2 \times 3H} = \frac{\pi \times 4R^2 \times 5H}{\pi \times 9R^2 \times 3H} = \frac{20}{27}$$

$\therefore$  the ratio of their volumes = 20:27

$$\text{Now, } \frac{S_1}{S_2} = \frac{2\pi(2R)(5H)}{2\pi(3R)(3H)} = \frac{10}{9}$$

$\therefore$  the ratio of their curved surface = 10:9

### Question 13:

For the tin having square base,

side = 12 cm and height = 17.5 cm.

$$\therefore \text{Volume} = (12 \times 12 \times 17.5) \text{ cm}^3 = 2520 \text{ cm}^3$$

Now, diameter of tin with cylindrical base = 12 cm

$$\therefore \text{radius} = \left(\frac{12}{2}\right) \text{ cm} = 6 \text{ cm and height} = 17.5 \text{ cm}$$

$$\therefore \text{Volume} = \left(\frac{22}{7} \times 6 \times 6 \times 17.5\right) \text{ cm}^3 = 1980 \text{ cm}^3$$

Tin with square base has more capacity by  $(2520 - 1980) \text{ cm}^3$   
= 540  $\text{cm}^3$ .

### Question 14:

Here, cylindrical bucket has diameter = 28 cm.

$$\therefore \text{radius} = \left(\frac{28}{2}\right) \text{ cm} = 14 \text{ cm and height} = 72 \text{ cm.}$$

Length of the tank = 66 cm

Breadth of the tank = 28 cm

$\therefore$  Volume of tank = Volume of cylindrical bucket

$$\Rightarrow l \times b \times h = \pi r^2 h$$

$$\Rightarrow 66 \times 28 \times h = \frac{22}{7} \times 14 \times 14 \times 72$$

$$\Rightarrow h = \left(\frac{22 \times 2 \times 14 \times 72}{66 \times 28}\right) \text{ cm}$$

$$\Rightarrow h = 24 \text{ cm.}$$

$\therefore$  The height of the water level in the tank = 24 cm.

### Question 15:

$$\text{Internal radius} = \left(\frac{3}{2}\right) \text{ cm} = 1.5 \text{ cm}$$

And, external radius =  $(1.5 + 1) \text{ cm} = 2.5 \text{ cm}$

$$\text{Volume of cast iron} = \left[\pi \times (2.5)^2 \times 100 - \pi \times (1.5)^2 \times 100\right] \text{ cm}^3$$

$$= \pi \times 100 \times [(2.5)^2 - (1.5)^2] \text{ cm}^3$$

$$= \frac{22}{7} \times 100 \times [6.25 - 2.25] \text{ cm}^3$$

$$= \left(\frac{22}{7} \times 100 \times 4\right) \text{ cm}^3$$

$$\therefore \text{Weight} = \left(\frac{22}{7} \times 100 \times 4 \times \frac{21}{1000}\right) \text{ kg}$$

[ $\because$  1 kg = 1000 g]

$$= 26.4 \text{ kg.}$$

$\therefore$  the weight of the iron pipe = 26.4 kg.

### Question 16:

Internal diameter of the tube = 10.4 cm

$$\text{internal radius} = \left(\frac{10.4}{2}\right) \text{ cm} = 5.2 \text{ cm}$$

$$\text{and length} = 25 \text{ cm}$$

$$\text{and external radius} = (5.2 + 0.8) \text{ cm} = 6 \text{ cm}$$

$$\begin{aligned} \text{Required volume} &= [\pi \times (6)^2 \times 25 - \pi \times (5.2)^2 \times 25] \text{ cm}^3 \\ &= \pi \times 25 [(6)^2 - (5.2)^2] \text{ cm}^3 \\ &= \frac{22}{7} \times 25 [36 - 27.04] \text{ cm}^3 \\ &= \left(\frac{22}{7} \times 25 \times 8.96\right) \text{ cm}^3 \\ &= 704 \text{ cm}^3 \end{aligned}$$

∴ the volume of the metal = 704 cm<sup>3</sup>

**Question 17:**

Length = 7 cm = (height)

$$\begin{aligned} \text{Diameter} = 5 \text{ mm} \Rightarrow \text{radius} &= \left(\frac{5}{2}\right) \text{ mm} = 2.5 \text{ mm} \\ &= 0.25 \text{ cm} \end{aligned}$$

$$\therefore \text{Volume of the barrel} = \pi r^2 h$$

$$= \left(\frac{22}{7} \times 0.25 \times 0.25 \times 7\right) \text{ cm}^3$$

$$= \frac{11}{8} \text{ cm}^3$$

$\frac{11}{8} \text{ cm}^3$  is used for writing 330 words.

So,  $\left(\frac{1}{5} \times 1000\right) \text{ cm}^3$  will be used for writing

$$\begin{aligned} \left(330 \times \frac{8}{11} \times \frac{1}{5} \times 1000\right) \text{ words} \\ = 48000 \text{ words} \end{aligned}$$

**Question 18:**

$$\begin{aligned} \text{Weight of the graphite} &= \left[\frac{22}{7} \times (0.05)^2 \times 10 \times 2.1\right] \text{ g} \\ &= \frac{33}{200} \text{ g} \end{aligned}$$

$$\begin{aligned} \text{Weight of wood} &= \left[\frac{22}{7} \times 10 \left\{(0.35)^2 - (0.05)^2\right\} \times 0.7\right] \\ &= \left[\frac{22}{7} \times 10 (0.1225 - 0.0025) \times 0.7\right] \\ &= \frac{66}{25} \text{ g} \end{aligned}$$

$$\therefore \text{Total weight of the pencil} = \left(\frac{33}{200} + \frac{66}{25}\right) \text{ g}$$

$$= \left(\frac{33 + 528}{200}\right) \text{ g} = \frac{561}{200} = 2.805 \text{ g}$$

∴ Weight of the whole pencil = 2.805 g

### Exercise 13C

**Question 1:**

Here,  $r = 35$  cm and  $h = 84$  cm

$$\begin{aligned} \therefore \text{Volume of the cone} &= \frac{1}{3} \pi r^2 h \\ &= \left( \frac{1}{3} \times \frac{22}{7} \times 35 \times 35 \times 84 \right) \text{cm}^3 \\ &= 107800 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \therefore \text{Curved surface area} &= \left( \pi r \sqrt{h^2 + r^2} \right) \quad [\because l = \sqrt{h^2 + r^2}] \\ &= \pi r \sqrt{84^2 + 35^2} \\ &= \pi r \sqrt{8281} \\ &= \frac{22}{7} \times 35 \times 91 \\ &= 10010 \text{ cm}^2 \end{aligned}$$

$$\therefore \text{Total surface area} = \pi r(l + r)$$

$$\begin{aligned} \text{Now,} \quad l &= \sqrt{h^2 + r^2} \\ &= \sqrt{84^2 + 35^2} \\ &= \sqrt{7056 + 1225} = \sqrt{8281} = 91 \text{ cm} \end{aligned}$$

$$\begin{aligned} \therefore \text{Total surface area} &= \frac{22}{7} \times 35(91 + 35) \\ &= (22 \times 5 \times 126) \text{cm}^2 = 13860 \text{ cm}^2 \end{aligned}$$

### Question 2:

Here, height ( $h$ ) = 6 cm and slant height ( $l$ ) = 10 cm

$$\begin{aligned} \therefore \text{radius}(r) &= \sqrt{l^2 - h^2} \\ &= \sqrt{10^2 - 6^2} = \sqrt{100 - 36} \\ &= \sqrt{64} = 8 \text{ cm} \end{aligned}$$

$$\begin{aligned} \therefore \text{Volume of cone} &= \frac{1}{3} \pi r^2 h \\ &= \left( \frac{1}{3} \times 3.14 \times 8 \times 8 \times 6 \right) \text{cm}^3 \\ &= 401.92 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \therefore \text{Curved surface area} &= \pi r l \\ &= (3.14 \times 8 \times 10) \text{ cm}^2 \\ &= 251.2 \text{ cm}^2 \end{aligned}$$

$$\begin{aligned} \therefore \text{Total surface area} &= \pi r(l + r) \\ &= \pi r(10 + 8) \\ &= (3.14 \times 8 \times 18) \text{ cm}^2 \\ &= 452.16 \text{ cm}^2 \end{aligned}$$

### Question 3:

Here, Volume =  $(100\pi)$  cm<sup>3</sup>, height ( $h$ ) = 12 cm

$$\begin{aligned} \text{Volume of the cone} &= \frac{1}{3} \pi r^2 h \\ \Rightarrow 100 \pi &= \frac{1}{3} \pi \times r^2 \times 12 \end{aligned}$$

$$\Rightarrow r^2 = \frac{100\pi \times 3}{\pi \times 12}$$

$$\Rightarrow r^2 = 25$$

$$\Rightarrow r = \sqrt{25} = 5 \text{ cm.}$$

$$\begin{aligned} \text{Slant height}(l) &= \sqrt{h^2 + r^2} \\ &= \sqrt{12^2 + 5^2} \\ l &= \sqrt{144 + 25} = \sqrt{169} = 13 \text{ cm} \end{aligned}$$

$$\therefore \text{Slant height, } l = 13 \text{ cm}$$

$$\begin{aligned} \therefore \text{Curved surface area} &= \pi r l \\ &= \pi \times 5 \times 13 \text{ cm}^2 \\ &= 65\pi \text{ cm}^2 \end{aligned}$$

### Question 5:

Here, curved surface area = 550 cm<sup>2</sup> and

slant height ( $\ell$ ) = 25 cm

$\therefore$  Curved surface area =  $\pi r \ell$

$$\Rightarrow 550 = \frac{22}{7} \times r \times 25$$

$$\Rightarrow r = \left( \frac{550 \times 7}{22 \times 25} \right) \text{ cm} = 7 \text{ cm}$$

$$\begin{aligned} \text{Now, height (h)} &= \sqrt{\ell^2 - r^2} \\ &= \sqrt{(25)^2 - (7)^2} \\ &= \sqrt{625 - 49} \\ &= \sqrt{576} = 24 \text{ cm} \end{aligned}$$

$\therefore$  height of the cone = 24 cm

Volume of the cone =  $\frac{1}{3} \pi r^2 h$

$$\begin{aligned} &= \left( \frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 24 \right) \text{ cm}^3 \\ &= 1232 \text{ cm}^3 \end{aligned}$$

$\therefore$  Volume of the cone = 1232 cm<sup>3</sup>

**Question 6:**

Here, radius,  $r = 35$  cm and slant height,  $\ell = 37$  cm

$$\begin{aligned} \therefore h &= \sqrt{\ell^2 - r^2} \\ &= \sqrt{(37)^2 - (35)^2} \\ &= \sqrt{1369 - 1225} = \sqrt{144} = 12 \text{ cm} \end{aligned}$$

$\therefore$  height(h) = 12 cm

$$\begin{aligned} \therefore \text{Volume of the cone} &= \frac{1}{3} \pi r^2 h \\ &= \left( \frac{1}{3} \times \frac{22}{7} \times 35 \times 35 \times 12 \right) \text{ cm}^3 \\ &= 15400 \text{ cm}^3 \end{aligned}$$

$\therefore$  Volume of the cone = 15400 cm<sup>3</sup>

**Question 7:**

Here, curved surface area = 4070 cm<sup>2</sup>

Diameter = 70 cm  $\Rightarrow$  radius =  $\left( \frac{70}{2} \right)$  cm = 35 cm

$\therefore$  Curved surface area =  $\pi r \ell$

$$\Rightarrow 4070 = \frac{22}{7} \times 35 \times \ell$$

$$\Rightarrow \ell = \left( \frac{4070}{110} \right) \text{ cm} = 37 \text{ cm}$$

$\therefore$  slant height = 37 cm.

**Question 8:**

Here, radius = 7 m and height(h) = 24 m

$$\begin{aligned} \therefore \text{slant height}(\ell) &= \sqrt{h^2 + r^2} \\ &= \sqrt{(24)^2 + (7)^2} \\ \ell &= \sqrt{576 + 49} = \sqrt{625} = 25 \text{ m} \end{aligned}$$

Now, area of cloth =  $\pi r \ell$

$$= \left( \frac{22}{7} \times 7 \times 25 \right) \text{ m}^2 = 550 \text{ m}^2$$

$$\begin{aligned} \therefore \text{length of cloth} &= \frac{\text{area of cloth}}{\text{width of cloth}} = \left( \frac{550}{2.5} \right) \text{ m} \\ &= 220 \text{ m} \end{aligned}$$

$\therefore$  Length of cloth required to make a conical tent = 220 m

**Question 9:**



Here, height of cone = 3.6 cm and radius = 1.6 cm

After melting, its radius = 1.2 cm

Volume of original cone = Volume of cone after melting

$$\therefore \frac{1}{3}\pi \times 1.6 \times 1.6 \times 3.6 = \frac{1}{3}\pi \times 1.2 \times 1.2 \times h$$

$$\Rightarrow h = \frac{\frac{1}{3}\pi \times 1.6 \times 1.6 \times 3.6}{\frac{1}{3}\pi \times 1.2 \times 1.2} = 6.4 \text{ cm}$$

$\therefore$  height of new cone = 6.4 cm

**Question 10:**

Let their heights be  $h$  and  $3h$

And, their radii be  $3r$  and  $r$ .

$$\text{Then, } V_1 = \frac{1}{3}\pi(3r)^2 \times h$$

$$\text{and, } V_2 = \frac{1}{3}\pi r^2 \times 3h$$

$$\Rightarrow \frac{V_1}{V_2} = \frac{\frac{1}{3}\pi(3r)^2 \times h}{\frac{1}{3}\pi r^2 \times 3h} = \frac{3}{1}$$

$$\therefore V_1 : V_2 = 3 : 1$$

**Question 11:**

Radius of the cylinder,  $R = \left(\frac{105}{2}\right)$  m and its height,  $H = 3$  m

Slant height ( $\ell$ ) = 53 m

$\therefore$  area of canvas =  $(2\pi RH + \pi R\ell)$

$$= \left[ \left( 2 \times \frac{22}{7} \times \frac{105}{2} \times 3 \right) + \left( \frac{22}{7} \times \frac{105}{2} \times 53 \right) \right] \text{ m}^2$$

$$= (990 + 8745) \text{ m}^2$$

$$= 9735 \text{ m}^2$$

$$\therefore \text{ length of canvas} = \left( \frac{\text{area of canvas}}{\text{width of canvas}} \right) \text{ m}$$

$$= \left( \frac{9735}{5} \right) = 1947 \text{ m.}$$

**Question 12:**

Let the radius be  $r$  metres and height be  $h$  metres.

$$\text{Area of the base} = (11 \times 4) \text{ m}^2 = 44 \text{ m}^2$$

$$\therefore \pi r^2 = 44$$

$$\Rightarrow r^2 = \left( 44 \times \frac{7}{22} \right) = 14 \text{ m}$$

$$\Rightarrow r^2 = 14 \text{ m}$$

$$\text{Volume of the cone} = \frac{1}{3}\pi r^2 h$$

$$\therefore \text{Volume of the cone} = (11 \times 20) \text{ m}^3 = 220 \text{ m}^3$$

$$\Rightarrow 220 = \frac{1}{3} \times \frac{22}{7} \times 14 \times h$$

$$\Rightarrow h = \frac{220 \times 3}{22 \times 2} = 15 \text{ m}$$

$\therefore$  the height of the cone = 15 m.

**Question 13:**

Here, height of the cylindrical bucket = 32 m and radius = 18 cm.

Now, let the radius of the heap be  $R$  cm and its slant height be  $\ell$  cm

$$\text{Then, } \pi \times (18)^2 \times 32 = \frac{1}{3} \pi \times R^2 \times 24$$

$$\Rightarrow R^2 = \frac{\pi \times 18 \times 18 \times 32 \times 3}{\pi \times 24} = 1296$$

$$\Rightarrow R = \sqrt{1296} = 36 \text{ cm.}$$

$\therefore$  Radius of the heap = 36 cm

$$\begin{aligned} \text{Slant height}(\ell) &= \sqrt{h^2 + R^2} \\ &= \sqrt{(24)^2 + (36)^2} \\ &= \sqrt{576 + 1296} \\ &= \sqrt{1872} = 43.27 \text{ cm} \end{aligned}$$

$\therefore$  Slant height of the heap = 43.27 cm.

**Question 14:**

Let the curved surface areas of cylinder and cone be  $8x$  and  $5x$ .

$$\text{Then, } 2\pi rh = 8x \dots (i)$$

$$\text{and, } \pi r \sqrt{h^2 + r^2} = 5x \dots (ii)$$

Squaring both sides of equation (i), we have

$$\begin{aligned} (2\pi rh)^2 &= (8x)^2 \\ 4\pi^2 r^2 h^2 &= 64x^2 \dots (iii) \end{aligned}$$

From (ii) we have,

$$\pi r \sqrt{h^2 + r^2} = 5x$$

Squaring both sides,

$$\begin{aligned} \Rightarrow \pi^2 r^2 (h^2 + r^2) &= 25x^2 \dots (iv) \\ \Rightarrow \frac{4\pi^2 r^2 h^2}{\pi^2 r^2 (h^2 + r^2)} &= \frac{64}{25} \quad [\text{Divide (iii) by (iv)}] \\ \Rightarrow \frac{h^2}{(h^2 + r^2)} &= \frac{16}{25} \\ \Rightarrow 9h^2 &= 16r^2 \\ \Rightarrow \frac{r^2}{h^2} &= \frac{9}{16} \\ \Rightarrow \frac{r}{h} &= \frac{3}{4} \end{aligned}$$

$\therefore$  The ratio of radius and height = 3 : 4

**Question 15:**

Here, height ( $h$ ) of cylinder = 2.8 m = 280 cm and diameter = 20 cm

$$\Rightarrow \text{radius} = \left(\frac{20}{2}\right) = 10 \text{ cm}$$

height ( $H$ ) of the cone = 42 cm

$$\begin{aligned} \therefore \text{Volume of the pillar} &= \left(\pi r^2 h + \frac{1}{3} \pi r^2 H\right) \text{ cm}^3 \\ &= \pi r^2 \left(h + \frac{1}{3} H\right) \text{ cm}^3 \\ &= \frac{22}{7} \times 10 \times 10 \left(280 + \frac{1}{3} \times 42\right) \text{ cm}^3 \\ &= \frac{2200}{7} \times [280 + 14] \\ &= 92400 \text{ cm}^3 \end{aligned}$$

$$\therefore \text{Weight of pillar} = \left(\frac{92400 \times 7.5}{1000}\right) \text{ kg} = 693 \text{ kg}$$

**Question 16:**

Let the smaller cone have radius =  $r$  cm and height =  $h$  cm

And, let the radius of the given original cone be  $R$  cm

Since the two triangles,  $\triangle OCD$  and  $\triangle OAB$  are similar to each other, we have

$$\text{Then, } \frac{r}{R} = \frac{h}{30} \quad [\because \triangle OCD \sim \triangle OAB]$$

$$\Rightarrow r = \frac{Rh}{30} \quad \dots\dots(1)$$

Given that the volume of the small cone is

$\frac{1}{27}$  of the volume of the given cone.

$$\therefore \frac{1}{3} \pi r^2 h = \frac{1}{27} \times \frac{1}{3} \pi R^2 \times 30 \quad [\text{given}]$$

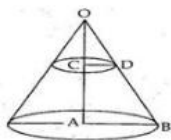
$$\Rightarrow \frac{1}{3} \pi \left(\frac{hR}{30}\right)^2 h = \frac{1}{81} \pi R^2 \times 30 \quad [\text{from (1)}]$$

$$\Rightarrow \frac{1}{3} \pi \frac{h^3 R^2}{900} = \frac{1}{81} \pi R^2 \times 30$$

$$\Rightarrow h^3 = \frac{1 \times 30 \times 900 \times 3}{81}$$

$$\Rightarrow h^3 = 1000 \text{ cm}^3$$

$$\Rightarrow h = 10 \text{ cm}$$



From the figure,

$$AC = (OA - OC)$$

$$= (30 - 10) \text{ cm} = 20 \text{ cm}$$

$\therefore$  the required height = 20 cm

#### Question 17:

Here, height( $h$ ) = 10 cm and radius = 6 cm

$$\begin{aligned} \therefore \text{Volume of the remaining solid} &= (\pi r^2 h) - \left(\frac{1}{3} \pi r^2 h\right) \\ &= (\pi \times 6 \times 6 \times 10) \text{ cm}^3 - \left(\frac{1}{3} \pi \times 6 \times 6 \times 10\right) \text{ cm}^3 \\ &= \frac{2}{3} \pi \times 6 \times 6 \times 10 \text{ cm}^3 \\ &= \left(\frac{2}{3} \times 3.14 \times 360\right) \text{ cm}^3 = 753.6 \text{ cm}^3 \\ \therefore \text{Volume of the remaining solid} &= 753.6 \text{ cm}^3 \end{aligned}$$

#### Question 18:

Diameter of the pipe = 5 mm = 0.5 cm

Radius of the pipe =  $\frac{0.5}{2} = 0.25$  cm

Length of the pipe = 10 metres = 1000 cm

Volume that flows in 1 min =  $\left[\pi \times (0.25)^2 \times 1000\right] \text{ cm}^3$

$\therefore$  Volume of the conical vessel =  $\left[\frac{1}{3} \pi \times (20)^2 \times 24\right] \text{ cm}^3$

$$\therefore \text{Required time} = \left[\frac{\frac{1}{3} \pi \times (20)^2 \times 24}{\pi \times (0.25)^2 \times 1000}\right] \text{ min}$$

$$= \left[\frac{\frac{1}{3} \pi \times 400 \times 24}{\pi \times 0.0625 \times 1000}\right] \text{ min}$$

$$= 51.2 \text{ min}$$

$$= 51 \text{ min } 12 \text{ sec}$$

Exercise 13D

Question 1:

(i) Radius of sphere = 3.5 cm

$$\begin{aligned}\therefore \text{Volume of the sphere} &= \left(\frac{4}{3} \pi r^3\right) \\ &= \left(\frac{4}{3} \times \frac{22}{7} \times 3.5 \times 3.5 \times 3.5\right) \text{ cm}^3 \\ &= 179.67 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\therefore \text{Surface area of the sphere} &= (4\pi r^2) \\ &= \left(4 \times \frac{22}{7} \times 3.5 \times 3.5\right) \text{ cm}^2 \\ &= 154 \text{ cm}^2\end{aligned}$$

(ii) Radius of the sphere = 4.2 cm

$$\begin{aligned}\therefore \text{Volume of the sphere} &= \left(\frac{4}{3} \pi r^3\right) \\ &= \left(\frac{4}{3} \times \frac{22}{7} \times 4.2 \times 4.2 \times 4.2\right) \text{ cm}^3 \\ &= 310.464 \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\therefore \text{Surface area of the sphere} &= (4\pi r^2) \\ &= \left(4 \times \frac{22}{7} \times 4.2 \times 4.2\right) \text{ cm}^2 \\ &= 221.76 \text{ cm}^2\end{aligned}$$

(iii) Radius of sphere = 5 m

$$\begin{aligned}\therefore \text{Volume of the sphere} &= \left(\frac{4}{3} \pi r^3\right) \\ &= \left(\frac{4}{3} \times \frac{22}{7} \times 5 \times 5 \times 5\right) \text{ m}^3 \\ &= 523.81 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\therefore \text{Surface area of the sphere} &= (4\pi r^2) \\ &= \left(4 \times \frac{22}{7} \times 5 \times 5\right) \text{ m}^2 \\ &= 314.28 \text{ m}^2\end{aligned}$$

$$\text{Volume of the sphere} = \left(\frac{4}{3}\pi r^3\right)$$

$$\Rightarrow 38808 = \frac{4}{3} \times \frac{22}{7} \times r^3 \quad [\because \text{Volume} = 38808 \text{ cm}^3]$$

$$\Rightarrow r^3 = \frac{38808 \times 3 \times 7}{88} = 9261$$

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

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

$$= \left(4 \times \frac{22}{7} \times 21 \times 21\right) \text{ cm}^2$$

$$= 5544 \text{ cm}^2$$

**Question 3:**

$$\text{Volume of the sphere} = 606.375 \text{ m}^3 \quad \dots(1)$$

$$\text{Volume of the sphere} = \frac{4}{3}\pi r^3$$

$$\Rightarrow 606.375 = \frac{4}{3} \times \frac{22}{7} \times r^3 \quad [\text{from (1)}]$$

$$\Rightarrow r^3 = \frac{606.375 \times 3 \times 7}{4 \times 22}$$

$$= 144.703125$$

$$\Rightarrow r = 5.25 \text{ m}$$

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

$$= 4 \times \frac{22}{7} \times 5.25 \times 5.25 \text{ m}^2$$

$$= 346.5 \text{ m}^2$$

**Question 4:**

Let the radius of the sphere be  $r$  m.

$$\text{Then, its surface area} = (4\pi r^2)$$

$$\therefore (4\pi r^2) = 394.24$$

$$[\text{Surface area} = 394.24 \text{ m}^2]$$

$$4 \times \frac{22}{7} \times r^2 = 394.24$$

$$r^2 = \left(\frac{394.24 \times 7}{4 \times 22}\right) = 31.36$$

$$r = \sqrt{31.36} = 5.6 \text{ m}$$

$$\therefore \text{radius of the sphere} = 5.6 \text{ m}$$

$$\therefore \text{Volume of the sphere} = \left(\frac{4}{3}\pi r^3\right)$$

$$= \left(\frac{4}{3} \times \frac{22}{7} \times 5.6 \times 5.6 \times 5.6\right) \text{ m}^3$$

$$= 735.91 \text{ m}^3$$

$$\therefore \text{Volume of the sphere} = 735.91 \text{ m}^3$$

**Question 5:**

Surface area of sphere =  $(4\pi r^2)$

$$\therefore (4\pi r^2) = (576\pi) \quad [\text{Surface area} = 576\pi \text{ cm}^2]$$

$$\Rightarrow r^2 = \frac{(576\pi)}{(4\pi)}$$

$$\Rightarrow r = \sqrt{144} = 12 \text{ cm}$$

$$\begin{aligned} \therefore \text{Volume of the sphere} &= \left(\frac{4}{3}\pi r^3\right) \\ &= \left(\frac{4}{3} \times \pi \times 12 \times 12 \times 12\right) \text{ cm}^3 \\ &= (2304\pi) \text{ cm}^3 \end{aligned}$$

$$\therefore \text{Volume of the sphere} = (2304\pi) \text{ cm}^3$$

**Question 6:**

Outer diameter of spherical shell = 12 cm

$$\text{radius} = 6 \text{ cm} \quad \left[\text{radius} = \frac{D}{2}\right]$$

Outer diameter of spherical shell = 8 cm

$$\text{radius} = 4 \text{ cm}$$

$$\begin{aligned} \text{Now, Volume of the outer shell} &= \left(\frac{4}{3}\pi r^3\right) \\ &= \left(\frac{4}{3} \times \frac{22}{7} \times 6 \times 6 \times 6\right) \text{ cm}^3 \\ &= 905.15 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \therefore \text{Volume of the inner shell} &= \left(\frac{4}{3}\pi r^3\right) \\ &= \left(\frac{4}{3} \times \frac{22}{7} \times 4 \times 4 \times 4\right) \text{ cm}^3 \\ &= 268.20 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \therefore \text{Volume of metal contained in the shell} &= (\text{Volume of outer}) \\ &\quad - (\text{Volume of inner}) \\ &= (905.15 - 268.20) \text{ cm}^3 \\ &= 636.95 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} \therefore \text{Outer surface area} &= 4\pi r^2 \\ &= \left(4 \times \frac{22}{7} \times 6 \times 6\right) \text{ cm}^2 \\ &= 452.57 \text{ cm}^2 \end{aligned}$$

**Question 7:**

Here, diameter of the lead shot = 3 mm

$$\therefore \text{radius} = \left(\frac{3}{2}\right) \text{ mm} = \left(\frac{0.3}{2}\right) \text{ cm} \quad [1 \text{ mm} = 0.1 \text{ cm}]$$

Now, number of lead shots =  $\frac{\text{Volume of the cuboid}}{\text{Volume of 1 lead shot}}$

$$\begin{aligned} &= \left\{ \frac{(12 \times 11 \times 9)}{\frac{4}{3} \times \frac{22}{7} \times \left(\frac{0.3}{2}\right)^3} \right\} \\ &= \left\{ \frac{(12 \times 11 \times 9)}{\frac{4}{3} \times \frac{22}{7} \times \frac{0.027}{8}} \right\} \\ &= \left\{ \frac{12 \times 11 \times 9 \times 3 \times 7 \times 8}{4 \times 22 \times 0.027} \right\} = 84000 \end{aligned}$$

$$\therefore \text{number of lead shots} = 84000.$$

**Question 8:**

Here, radius of 1 lead ball = 1 cm

and radius of sphere = 8 cm

$$\begin{aligned} \therefore \text{Number of lead balls} &= \frac{\text{Volume of the sphere}}{\text{Volume of 1 lead ball}} \\ &= \frac{\left(\frac{4}{3} \pi R^3\right) \text{ cm}^3}{\left(\frac{4}{3} \pi r^3\right) \text{ cm}^3} \\ &= \left\{ \frac{\frac{4}{3} \times \frac{22}{7} \times 8^3}{\frac{4}{3} \times \frac{22}{7} \times 1^3} \right\} \\ &= \left\{ \frac{\frac{4}{3} \times \frac{22}{7} \times 512}{\frac{4}{3} \times \frac{22}{7} \times 1} \right\} = 512 \end{aligned}$$

$\therefore$  number of lead balls = 512.

**Question 9:**

Here, radius of sphere = 3 cm

Diameter of spherical ball = 0.6 cm  $\left[ \because \text{radius} = \frac{D}{2} \right]$

Radius of spherical ball = 0.3 cm

$$\begin{aligned} \therefore \text{Number of balls} &= \frac{\text{Volume of the sphere}}{\text{Volume of 1 small ball}} \\ &= \frac{\left\{ \frac{4}{3} \times \frac{22}{7} \times 3^3 \text{ cm}^3 \right\}}{\left\{ \frac{4}{3} \times \frac{22}{7} \times (0.3)^3 \text{ cm}^3 \right\}} \\ &= \frac{\left\{ \frac{4}{3} \times \frac{22}{7} \times 27 \right\}}{\left\{ \frac{4}{3} \times \frac{22}{7} \times 0.027 \right\}} = 1000 \end{aligned}$$

$\therefore$  number of small balls obtained = 1000.

**Question 10:**

Here, radius of sphere = 10.5 cm =  $\left(\frac{21}{2}\right)$  cm

Radius of smaller cone = 3.5 cm =  $\left(\frac{7}{2}\right)$  cm and height = 3 cm

$$\begin{aligned} \text{Now number of cones} &= \frac{\text{Volume of the sphere}}{\text{Volume of 1 small cone}} \\ &= \frac{\left\{ \frac{4}{3} \pi \times \left(\frac{21}{2}\right)^3 \text{ cm}^3 \right\}}{\left\{ \frac{1}{3} \pi \times \left(\frac{7}{2}\right)^2 \times 3 \text{ cm}^3 \right\}} \\ &= \frac{\left\{ \frac{4}{3} \times \frac{9261}{8} \right\}}{\left\{ \frac{1}{3} \times \frac{49}{4} \times 3 \right\}} = \frac{9261}{49} \\ &= \frac{9261}{6} \times \frac{4}{49} = 126 \end{aligned}$$

$\therefore$  Number of cones obtained = 126.

**Question 11:**

Diameter of a sphere = 12 cm

$$\text{radius} = \frac{\text{Diameter}}{2}$$

$$= \frac{12}{2}$$

$$= 6 \text{ cm}$$

$$\therefore \text{Volume of the sphere} = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \times \frac{22}{7} \times 6 \times 6 \times 6 \quad \text{(i)}$$

Diameter of cylinder = 8 cm

$$\text{Radius of cylinder} = \frac{\text{Diameter}}{2}$$

$$\text{Radius of cylinder} = \frac{8}{2}$$

$$\text{Radius of cylinder} = 4 \text{ cm}$$

Height of the cylinder = 90 cm

$$\therefore \text{Volume of the cylinder} = \pi r^2 h$$

$$= \frac{22}{7} \times 4 \times 4 \times 90 \quad \text{(ii)}$$

$$\text{Number of spheres} = \frac{\text{Volume of cylinder}}{\text{Volume of sphere}}$$

$$\text{Number of spheres} = \frac{\frac{22}{7} \times 4 \times 4 \times 90 \text{ cm}^3}{\frac{4}{3} \times \frac{22}{7} \times 6 \times 6 \times 6 \text{ cm}^3} \quad \text{[(ii) } \div \text{ (i)]}$$

$$\text{Number of spheres} = 5.$$

**Question 12:**

Here, Diameter of a sphere = 6 cm

$$\therefore \text{radius (R)} = \left(\frac{6}{2}\right) \text{ cm} = 3 \text{ cm}$$

Diameter of wire = 2 mm

$$\therefore \text{radius (r)} = 1 \text{ mm} = 0.1 \text{ cm}$$

Let the required length of wire be h cm.

Then,

$$\pi \times (r)^2 \times h = \frac{4}{3} \times \pi \times (R)^3$$

$$\Rightarrow \pi \times (0.1)^2 \times h = \frac{4}{3} \times \pi \times (3)^3$$

$$\Rightarrow h = \frac{\frac{4}{3} \times \pi \times 27}{\pi \times (0.1)^2}$$

$$= \left(\frac{4 \times 9}{0.01}\right) \text{ cm} = \frac{36}{0.01}$$

$$= 3600 \text{ cm} = 36 \text{ m}$$

$$\therefore \text{the length of the wire} = 36 \text{ m.}$$

**Question 13:**



Here, diameter of sphere = 18 cm

$$\therefore \text{radius of sphere} = \left(\frac{18}{2}\right) \text{ cm} = 9 \text{ cm}$$

Length of the wire = 108 m = 10800 cm

Then,

$$\frac{4}{3} \pi \times (r)^3 = \pi \times r^2 \times 10800$$

$$\Rightarrow \frac{4}{3} \pi \times (9)^3 = \pi \times r^2 \times 10800$$

$$\Rightarrow r^2 = \frac{\frac{4}{3} \times \pi \times 729}{\pi \times 10800}$$

$$= \frac{4 \times 243}{10800} = \frac{972}{10800} = \frac{9}{100}$$

$$\Rightarrow r = \sqrt{\frac{9}{100}} = \frac{3}{10} = 0.3$$

$$\therefore r = 0.3 \text{ cm}$$

So, Diameter =  $(2 \times 0.3) \text{ cm} = 0.6 \text{ cm}$ .

**Question 14:**

Here, diameter of sphere = 15.6 cm

$$\therefore \text{Radius of sphere} = \left(\frac{15.6}{2}\right) \text{ cm} = 7.8 \text{ cm}$$

and, height of cone = 31.2 cm

Then,

$$\frac{4}{3} \pi \times R^3 = \frac{1}{3} \pi \times r^2 \times h$$

$$\Rightarrow \frac{4}{3} \pi \times (7.8)^3 = \frac{1}{3} \pi \times r^2 \times 31.2$$

$$\Rightarrow r^2 = \frac{\frac{4}{3} \times \pi \times (7.8)^3}{\frac{1}{3} \times \pi \times 31.2}$$

$$r^2 = \left(\frac{4 \times 474.552}{31.2}\right) = (60.84) = (7.8)^2$$

$$\Rightarrow r = 7.8 \text{ cm}$$

$\therefore$  Diameter of cone =  $(2 \times 7.8) \text{ cm} = 15.6 \text{ cm}$ .

**Question 15:**

Here, diameter of sphere = 28 cm

$$\therefore \text{radius of sphere} = \left(\frac{28}{2}\right) \text{ cm} = 14 \text{ cm}$$

Diameter of cone = 35

$$\therefore \text{radius of cone} = \left(\frac{35}{2}\right) \text{ cm} = 17.5 \text{ cm}$$

$$\therefore \frac{4}{3} \pi \times R^3 = \frac{1}{3} \pi \times (r)^2 \times h$$

$$\Rightarrow h = \frac{\frac{4}{3} \times \pi \times (14)^3}{\frac{1}{3} \times \pi \times (17.5)^2}$$

$$= \left(\frac{4 \times 2744}{306.25}\right) \text{ cm}$$

$$= \left(\frac{10976}{306.25}\right) \text{ cm} = 35.84 \text{ cm}$$

$\therefore$  Height of the cone = 35.84 cm

**Question 16:**

Let the radius of the third ball be  $r$  cm

Then,

$$\begin{aligned} \frac{4}{3} \times \pi \times (3)^3 &= \frac{4}{3} \pi \left(\frac{3}{2}\right)^3 + \frac{4}{3} \times \pi (2)^3 + \frac{4}{3} \pi \times (r)^3 \\ \Rightarrow \frac{4}{3} \times \pi \times 27 &= \frac{4}{3} \pi \times \frac{27}{8} + \frac{4}{3} \times \pi \times 8 + \frac{4}{3} \pi \times (r)^3 \\ \Rightarrow 27 &= \frac{27}{8} + 8 + (r)^3 \\ \Rightarrow r^3 &= \left\{ 27 - \left( \frac{27}{8} + 8 \right) \right\} \\ \Rightarrow r^3 &= \left\{ 27 - \left( \frac{27 + 64}{8} \right) \right\} \\ \Rightarrow r^3 &= \left\{ 27 - \frac{91}{8} \right\} \\ \Rightarrow r^3 &= \left\{ \frac{216 - 91}{8} \right\} \\ \Rightarrow r^3 &= \frac{125}{8} \Rightarrow r^3 = \left( \frac{5}{2} \right)^3 \\ \Rightarrow r &= \frac{5}{2} = 2.5 \text{ cm} \end{aligned}$$

$\therefore$  radius of the third ball = 2.5 cm

**Question 17:**

Let the radii of two spheres be  $x$  and  $2x$  and their respective surface areas be  $S_1$  and  $S_2$ .

$$\begin{aligned} \text{Then, } \frac{S_1}{S_2} &= \frac{4\pi x^2}{4\pi (2x)^2} \\ &= \frac{x^2}{4x^2} = \frac{1}{4} \end{aligned}$$

$\therefore$  the ratio of their surface areas = 1 : 4.

**Question 18:**

Let the radii of two spheres be  $r$  and  $R$

Then,

$$\begin{aligned} \frac{4\pi r^2}{4\pi R^2} &= \frac{1}{4} \\ \Rightarrow \left( \frac{r}{R} \right)^2 &= \left( \frac{1}{2} \right)^2 \Rightarrow \frac{r}{R} = \frac{1}{2} \end{aligned}$$

Let  $V_1$  and  $V_2$  be the volumes of the respective spheres whose radii are  $r$  and  $R$

$$\therefore \frac{V_1}{V_2} = \frac{\frac{4}{3} \pi r^3}{\frac{4}{3} \pi R^3} = \left( \frac{r}{R} \right)^3 = \left( \frac{1}{2} \right)^3 = \frac{1}{8}$$

$\therefore$  the ratio of their volume = 1 : 8.

**Question 19:**

Let the radius of ball be  $r$  cm and  $R$  be the radius of the cylindrical tub.

Then,

$$\frac{4}{3} \times \pi \times (r)^3 = \pi \times R^2 \times h$$

$$\Rightarrow \frac{4}{3} \times \pi \times (r)^3 = \pi \times (12)^2 \times 6.75$$

$$\Rightarrow (r)^3 = \frac{\pi \times 144 \times 6.75}{\frac{4}{3} \times \pi} = \frac{144 \times 6.75}{\frac{4}{3}}$$

$$r^3 = \frac{972 \times 3}{4} = \frac{2916}{4} = 729$$

$$\Rightarrow r = 9 \text{ cm}$$

$\therefore$  the radius of the ball = 9 cm.

**Question 20:**

Radius of the cylindrical bucket = 15 cm

Height of the cylindrical bucket = 20 cm

Volume of the water in the bucket =  $\pi \times 15 \times 15 \times 20 \text{ cm}^3$

Radius of spherical ball = 9 cm

Volume of the spherical ball =  $\frac{4}{3} \times \pi \times 9 \times 9 \times 9 \text{ cm}^3 \dots (1)$

Increase in the water level =  $h$  cm

Volume of the increased water level =  $\pi \times 15 \times 15 \times h \text{ cm}^3 \dots (2)$

Equating (1) and (2),

we have

$$\pi \times 15 \times 15 \times h = \frac{4}{3} \times \pi \times 9 \times 9 \times 9$$

$$h = \frac{\frac{4}{3} \times \pi \times 9 \times 9 \times 9}{\pi \times 15 \times 15}$$

$$h = 4.32 \text{ cm}$$

**Question 21:**

Radius of hemisphere = 9 cm

Height of cone = 72 cm

Let the radius of the base of cone be  $r$  cm.

Then,

$$\frac{1}{3} \times \pi \times r^2 \times h = \frac{2}{3} \times \pi \times R^3$$

$$\Rightarrow \frac{1}{3} \times \pi \times r^2 \times 72 = \frac{2}{3} \times \pi \times (9)^3$$

$$\Rightarrow r^2 = \frac{\frac{2}{3} \times \pi \times 729}{\frac{1}{3} \times \pi \times 72} = \frac{2 \times 729}{72}$$

$$r^2 = \frac{1458}{72} = 20.25$$

$$\Rightarrow r = 4.5 \text{ cm}$$

$\therefore$  the radius of the base of the cone = 4.5 cm.

**Question 22:**

Here, internal radius of hemisphere bowl (R) = 9 cm

Diameter of bottle = 3 cm

$$\Rightarrow \text{radius } (r) = \left(\frac{3}{2}\right) \text{ cm}$$

and, height of bottle = 4 cm

$$\therefore \text{Number of bottles} = \frac{\text{Volume of the bowl}}{\text{Volume of each bottle}}$$

$$= \left\{ \frac{\frac{2}{3} \pi \times R^3}{\pi \times (r)^2 \times h} \right\}$$

$$= \left\{ \frac{\frac{2}{3} \pi \times (9)^3}{\pi \times \left(\frac{3}{2}\right)^2 \times 4} \right\}$$

$$= \left\{ \frac{\frac{2}{3} \times 9 \times 9 \times 9}{\frac{9}{4} \times 4} \right\}$$

$$= \frac{2 \times 3 \times 81}{9} = 54$$

$\therefore$  the number of bottle required = 54.

**Question 23:**

Internal radius (r) = 8 cm

External radius (R) = 9 cm

Density of metal = 4.5 g per  $\text{cm}^3$

$$\begin{aligned} \therefore \text{weight of the shell} &= \left[ \frac{4}{3} \pi \times \{(R)^3 - (r)^3\} \times \text{density} \right] \\ &= \left[ \frac{4}{3} \times \frac{22}{7} \times \{(9)^3 - (8)^3\} \times \frac{4.5}{1000} \right] \text{kg} \\ &= \left[ \frac{4}{3} \times \frac{22}{7} \times \{729 - 512\} \times \frac{4.5}{1000} \right] \text{kg} \\ &= \left[ \frac{4}{3} \times \frac{22}{7} \times 217 \times \frac{4.5}{1000} \right] \text{kg} \\ &= \left( \frac{85932}{21000} \right) \text{kg} = 4.092 \text{kg} \end{aligned}$$

$\therefore$  weight of the shell = 4.092 kg.