

**Exercise – 21.1**

1. Find the surface area of a sphere of radius:

- (i) 10.5 cm (ii) 5.6 cm (iii) 14 cm

**Sol:**

- (i) Given radius = 10.5 cm

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

$$= 4 \times \frac{22}{7} \times (10.5)^2$$

$$= 1386 \text{ cm}^2$$

- (ii) Given radius = 5.6 cm

$$\text{Surface area} = 4\pi r^2 = 4 \times \frac{22}{7} \times (5.6)^2 = 394.24 \text{ cm}^2$$

- (iii) Given radius = 14 cm

$$\text{Surface area} = 4\pi r^2 = 4 \times \frac{22}{7} \times (14)^2 = 2464 \text{ cm}^2$$

2. Find the surface area of a sphere of diameter:

- (i) 14 cm (ii) 21 cm (iii) 3.5 cm

**Sol:**

- (i) Diameter = 14 cm

$$\text{Radius} = \frac{\text{Diameter}}{2} = \frac{14}{2} = 7 \text{ cm}$$

$$\therefore \text{Surface area} = 4\pi r^2 = 4 \times \frac{22}{7} \times (7)^2 = 616 \text{ cm}^2$$

- (ii) Diameter = 21 cm

$$\text{Radius} = \frac{\text{Diameter}}{2} = \frac{21}{2} = 10.5 \text{ cm}$$

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

- (iii) Diameter = 3.5 cm

$$\text{Radius} = 3.5 \text{ cm} / 2 = 1.75 \text{ cm}$$

$$\therefore \text{Surface area} = 4\pi r^2 = 4 \times \frac{22}{7} \times \frac{3.5}{2}^2 = 38.5 \text{ cm}^2$$

3. Find the total surface area of a hemisphere and a solid hemisphere each of radius 10 cm.  
(Use  $\pi = 3.14$ )

**Sol:**

$$\begin{aligned}\text{The surface area of the hemisphere} &= 2\pi r^2 \\ &= 2 \times 3.14 \times (10)^2 \\ &= 628\text{cm}^2\end{aligned}$$

$$\begin{aligned}\text{The surface area of solid hemisphere} &= 3\pi r^2 \\ &= 3 \times 3.14 \times (10)^2 \\ &= 942\text{cm}^2\end{aligned}$$

4. The surface area of a sphere is  $5544\text{ cm}^2$ , find its diameter.

**Sol:**

Surface area of a sphere is  $5544\text{cm}^2$

$$\Rightarrow 4\pi r^2 = 5544$$

$$\Rightarrow \frac{4 \times 22}{7} \times r^2 = 5544$$

$$\Rightarrow r^2 = \frac{5544 \times 7}{88}$$

$$\Rightarrow r = \sqrt{21\text{cm} \times 21\text{cm}} = \sqrt{(21)^2} \text{ cm}$$

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

Diameter = 2(radius)

$$= 2(21\text{cm})$$

$$= 42\text{cm}.$$

5. A hemispherical bowl made of brass has inner diameter 10.5 cm. Find the cost of tin-plating it on the inside at the rate of Rs. 4 per  $100\text{ cm}^2$ .

**Sol:**

Given

Inner diameter of hemisphere bowl =  $10.5\text{cm}$

$$\text{Radius} = \frac{10.5}{2} \text{ cm} = 5.25\text{cm}.$$

Surface area of hemispherical bowl =  $2\pi r$

$$= 2 \left[ \frac{22}{7} \right] \times (5.25)^2 \text{ cm}^2$$

$$= 173.25\text{cm}^2.$$

Cost of tin planning  $100\text{cm}^2$  area = Rs. 4

$$\text{Cost of tin plating } 173 \cdot 25 \text{ cm}^2 \text{ area} = \text{Rs.} \left( \frac{4 \times 173 \cdot 25}{100} \right)$$

$$= \text{Rs. } 6 \cdot 93$$

Thus, The cost of tin plating the inner side of hemisphere bowl is Rs. 6.93

6. The dome of a building is in the form of a hemisphere. Its radius is 63 dm. Find the cost of painting it at the rate of Rs. 2 per sq. m.

**Sol:**

$$\text{Dome Radius} = 63 \text{ dm} = 6 \cdot 3 \text{ m}$$

$$\text{Inner S.A of dome} = 2\pi r^2 = 2 \times \frac{22}{7} \times (6 \cdot 3)^2 = 249 \cdot 48 \text{ m}^2$$

$$\text{Now, cost of } 1 \text{ m}^2 = \text{Rs. } 2.$$

$$\therefore \text{Cost of } 249 \cdot 48 \text{ m}^2 = \text{Rs.} [2 \times 249 \cdot 48]$$

$$= \text{Rs. } 498 \cdot 96.$$

7. Assuming the earth to be a sphere of radius 6370 km, how many square kilo metres is area of the land, if three-fourth of the earth's surface is covered by water?

**Sol:**

$$\frac{3}{4}^{\text{th}} \text{ of earth surface is covered by water}$$

$$\therefore \frac{1}{4}^{\text{th}} \text{ earth surface is covered by land}$$

$$\therefore \text{Surface area covered by land} = \frac{1}{4} \times 4\pi r^2$$

$$= \frac{1}{4} \times 4 \times \frac{22}{7} \times 6370^2$$

$$= 127527 \cdot 4 \text{ km}^2$$

8. A cylinder of same height and radius is placed on the top of a hemisphere. Find the curved surface area of the shape if the length of the shape be 7 cm.

**Sol:**

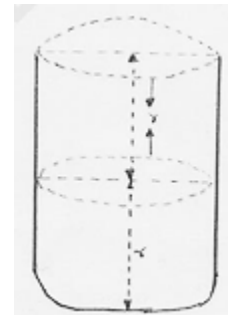
$$\text{Given length of the shape} = 7 \text{ cm}$$

$$\text{But length} = r + r$$

$$\Rightarrow 2r = 7 \text{ cm}$$

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

$$\Rightarrow r = 3 \cdot 5 \text{ cm}$$



Also;  $h = r$

$$\begin{aligned} \text{Total S.A of shape} &= 2\pi rh + 2\pi r^2 = 2\pi r \times r + 2\pi r^2 \\ &= 2\pi r^2 + 2\pi r^2 \\ &= 4\pi r^2 \\ &= 4 \times \frac{22}{7} \times (3.5)^2 \\ &= 154 \text{ cm}^2 \end{aligned}$$

9. A wooden toy is in the form of a cone surmounted on a hemisphere. The diameter of the base of the cone is 16 cm and its height is 15 cm. Find the cost of painting the toy at Rs. 7 per 100  $\text{cm}^2$ .

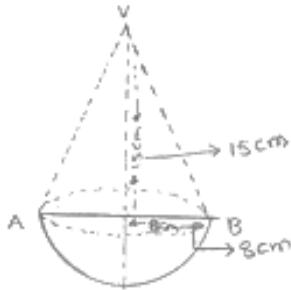
**Sol:**

Diameter of cone = 16 cm.

$\therefore$  Radius of cone = 8 cm.

Height of cone = 15 cm

Slant height of cone =  $\sqrt{8^2 + 15^2}$



$$= \sqrt{64 + 225}$$

$$= \sqrt{289}$$

$$= 17 \text{ cm}$$

$\therefore$  Total curved surface area of toy

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

$$= \frac{22}{7} \times 8 \times 17 + 2 \times \frac{22}{7} \times 8^2$$

$$= \frac{5808}{7} \text{ cm}^2$$

Now, cost of  $100 \text{ cm}^2 = \text{Rs. } 7$

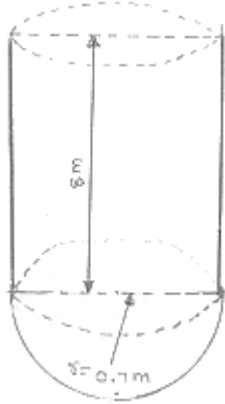
$$1 \text{ cm}^2 = \text{Rs. } \frac{7}{100}$$

$$\text{Hence, cost of } \frac{5808}{7} \text{ cm}^2 = \text{Rs. } \left( \frac{5808}{7} \times \frac{7}{100} \right)$$

$$= \text{Rs. } 58.08$$

10. A storage tank consists of a circular cylinder with a hemisphere adjoined on either end. If the external diameter of the cylinder be 1.4 m and its length be 8 m, find the cost of painting it on the outside at the rate of Rs. 10 per  $m^2$ .

**Sol:**



Diameter of cylinder = 1.4 m

$$\therefore \text{Radius of cylinder} = \frac{1.4}{2} = 0.7 \text{ m}$$

Height of cylinder = 8 m.

$$\begin{aligned} \therefore S.A \text{ of tank} &= 2\pi rh + 2\pi r^2 \\ &= 2 \times \frac{22}{7} \times 0.7 \times 8 + 2 \times \frac{22}{7} \times (0.7)^2 \\ &= \frac{176}{5} + \frac{77}{25} \\ &= \frac{957}{25} = 38.28 \text{ m}^2 \end{aligned}$$

Now, cost of  $1 \text{ m}^2 = \text{Rs. } 10$ .

$$\begin{aligned} \therefore \text{Cost of } 38.28 \text{ m}^2 &= \text{Rs. } [10 \times 38.28] \\ &= \text{Rs. } 382.80 \end{aligned}$$

11. The diameter of the moon is approximately one fourth of the diameter of the earth. Find the ratio of their surface areas.

**Sol:**

Let the diameter of the earth is  $d$  then, diameter of moon will be  $\frac{d}{4}$

$$\text{Radius of earth} = \frac{d}{2}$$

$$\text{Radius of moon} = \frac{\frac{d}{4}}{2} = \frac{d}{8}$$

$$S \cdot A \text{ of moon} = 4\pi \left(\frac{d}{8}\right)^2$$

$$\text{Surface area of earth} = 4\pi \left(\frac{d}{2}\right)^2$$

$$\text{Required ratio} = \frac{4\pi \left(\frac{d}{8}\right)^2}{4\pi \left(\frac{d}{2}\right)^2} = \frac{4}{64} = \frac{1}{16}$$

Thus, the required ratio of the surface areas is  $\frac{1}{16}$ .

12. A hemi-spherical dome of a building needs to be painted. If the circumference of the base of the dome is 17.6 cm, find the cost of painting it, given the cost of painting is Rs. 5 per 100  $\text{cm}^2$

**Sol:**

Given that only the rounded surface of the dome to be painted, we would need to find the curved surface area of the hemisphere to know the extent of painting that needs to be done.

Now, circumference of the dome =  $17.6\text{m}$ .

Therefore,  $17.6 = 2\pi r$ .

$$2 \times \frac{22}{7} r = 17.6\text{m}.$$

$$\text{So, the radius of the dome} = 17.6 \times \frac{7}{2 \times 22} \text{m} = 2.8\text{m}$$

The curved surface area of the dome =  $2\pi r^2$

$$= 2 \times \frac{22}{7} \times 2.8 \times 2.8 \text{cm}^2$$

$$= 49.28\text{m}^2$$

Now, cost of painting  $100\text{cm}^2$  is Rs. 5.

So, cost of painting  $1\text{m}^2 = \text{Rs. } 500$

Therefore, cost of painting the whole dome

$$= \text{Rs. } 500 \times 49.28$$

$$= \text{Rs. } 24640$$

13. The front compound wall of a house is decorated by wooden spheres of diameter 21 cm, placed in small supports as shown in Fig. below. Eight such spheres are used for this purpose, and are to be painted silver. Each support is a cylinder of radius 1.5 cm and height 7 cm and is to be painted black. Find the cost of paint required if silver paint costs 25 paise per  $\text{cm}^2$  and black paint costs 5 paise per  $\text{cm}^2$ .



**Sol:**

$$\text{Wooden sphere radius} = \left(\frac{21}{2}\right) \text{cm} = 10.5 \text{cm}.$$

Surface area of a wooden sphere

$$= 4\pi r^2 = 4 \left[\frac{22}{7}\right] [10.5]^2 \text{cm}^2 = 1386 \text{cm}^2$$

$$\text{Radius } (r^1) \text{ of cylindrical support} = 1.5 \text{cm}$$

$$\text{Height } (h^1) \text{ of cylindrical support} = 7 \text{cm}$$

$$\text{CSA of cylindrical support} = 2\pi r^1 h \left[2 \times \frac{22}{7} \times 1.5 \times 7\right]$$

$$= 66 \text{cm}^2$$

$$\text{Area of circular end of cylindrical support} = \pi r^2 = \left[\frac{22}{7} (1.5)^2\right] = 7.07 \text{cm}^2$$

$$\text{Area to be painted silver} = [8 \times (1386 - 7.07)] \text{cm}^2$$

$$= 8(1378.93) \text{cm}^2$$

$$= 11031.44 \text{cm}^2$$

Cost occurred in painting silver color

$$= \text{Rs. } (11031.44 \times 0.25) = \text{Rs. } 2757.86$$

$$\text{Area to painted black} = (8 \times 66) \text{cm}^2 = 528 \text{cm}^2$$

$$\text{Cost occurred in painting black color} = \text{Rs. } (528 \times 0.05) = \text{Rs. } 26.40$$

$$\therefore \text{Total cost occurred in painting} = \text{Rs. } (2757.86 + 26.40) = \text{Rs. } 2784.26$$

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**Exercise – 21.2**

1. Find the volume of a sphere whose radius is:

(i) 2 cm (ii) 3.5 cm (iii) 10.5 cm

**Sol:**

(i) Radius ( $r$ ) = 2 cm

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

$$= \frac{4}{3} \times \frac{22}{7} \times (2)^3 = 33.52 \text{ cm}^3$$

(ii) Radius ( $r$ ) = 3.5 cm

$$\therefore \text{Volume} = (3.5)^3 \times \pi \times \frac{4}{3} = \frac{4}{3} \times \frac{22}{7} \times (3.5)^3 = 179.666 \text{ cm}^3$$

(iii) Radius ( $r$ ) = 10.5 cm

$$\text{Volume} = \frac{4}{3} \pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (10.5)^3 = 4851 \text{ cm}^3$$

2. Find the volume of a sphere whose diameter is:

(i) 14 cm (ii) 3.5 dm (iii) 2.1 m

**Sol:**

(i) Diameter = 14 cm, radius =  $\frac{14}{2} = 7 \text{ cm}$

$$\Rightarrow \text{Volume} = \frac{4}{3} \pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (7)^3 = 1437.33 \text{ cm}^3$$

(ii) Diameter = 3.5 dm, radius =  $\frac{3.5}{2} \text{ dm} = 1.75 \text{ dm}$

$$\therefore \text{Volume} = \frac{4}{3} \times \frac{22}{7} \times \left(\frac{3.5}{2}\right)^3 = 22.46 \text{ dm}^3$$

(iii) Diameter = 2.1 m  $\Rightarrow r = \frac{2.1}{2} \text{ m}$

$$\begin{aligned} \therefore \text{Volume} &= \frac{4}{3} \times \left(\frac{22}{7}\right) \times \left(\frac{2.1}{2}\right)^3 \\ &= 4.851 \text{ m}^3. \end{aligned}$$

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3. A hemispherical tank has inner radius of 2.8 m. Find its capacity in litres.

**Sol:**

$$\text{Radius of tank} = 2.8\text{m}$$

$$\therefore \text{Capacity} = \frac{2}{3} \times \frac{22}{7} \times (2.8)^3$$

$$= 45.994\text{m}^3$$

$$\therefore \text{Capacity in liters} = 45994 \text{ liters} [1\text{m}^3 = 1000]$$

4. A hemispherical bowl is made of steel 0.25 cm thick. The inside radius of the bowl is 5 cm. Find the volume of steel used in making the bowl.

**Sol:**

$$\text{Inner radius} = 5\text{cm}$$

$$\text{Outer radius} = 5 + 0.25$$

$$= 5.25$$

$$\text{Volume of steel used} = \text{outer volume} - \text{inner volume}$$

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

$$= \frac{2}{3} \times \frac{22}{7} [5.25^3 - 5^3]$$

$$= 41.282\text{cm}^3$$

5. How many bullets can be made out of a cube of lead, whose edge measures 22 cm, each bullet being 2 cm in diameter?

**Sol:**

$$\text{Cube edge} = 22\text{cm}$$

$$\therefore \text{Volume of cube} = (22)^3$$

$$= 10648\text{cm}^3$$

And,

$$\text{Volume of each bullet} = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \times \frac{22}{7} \times \left(\frac{2}{2}\right)^3$$

$$= \frac{4}{3} \times \frac{22}{7}$$

$$= \frac{88}{21} \text{cm}^3$$

$$\begin{aligned} \therefore \text{No. of bullets} &= \frac{\text{Volume of cube}}{\text{Volume of bullet}} \\ &= \frac{10648}{\frac{88}{21}} = 2541 \end{aligned}$$

6. A shopkeeper has one laddoo of radius 5 cm. With the same material, how many laddoos of radius 2.5 cm can be made.

**Sol:**

Volume of laddoo having radius = 5 cm

$$\text{i.e volume } (V_1) = \frac{4}{3} \pi r^3$$

$$V_1 = \frac{4}{3} \times \frac{22}{7} \times (5)^3$$

$$V_1 = \frac{11000}{21} \text{ cm}^3$$

Also volume of laddoo having radius = 2.5 cm

$$\text{i.e., } V_2 = \frac{4}{3} \pi r^3$$

$$V_2 = \frac{4}{3} \times \frac{22}{7} \times (2.5)^3$$

$$V_2 = \frac{1375}{21} \text{ cm}^3$$

$$\therefore \text{No. of laddoos} = \frac{V_1}{V_2} = \frac{11000}{1375} = 8.$$

7. A spherical ball of lead 3 cm in diameter is melted and recast into three spherical balls. If the diameters of two balls be  $\frac{3}{2}$  cm and 2 cm, find the diameter of the third ball.

**Sol:**

$$\text{Volume of lead ball} = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \times \frac{22}{7} \times \left(\frac{3}{2}\right)^3$$

$\therefore$  According to question,

$$\text{Volume of lead ball} = \frac{4}{3} \times \pi \left(\frac{3}{4}\right)^3 + \frac{4}{3} \pi \left(\frac{2}{2}\right)^3 + \frac{4}{3} \pi \left(\frac{d}{2}\right)^3$$

$$\Rightarrow \frac{4}{3}\pi\left(\frac{3}{2}\right)^3 = \frac{4}{3}\pi\left(\frac{3}{4}\right)^3 + \frac{4}{3}\left[\pi\left(\frac{2}{2}\right)^3 + \left(\frac{d}{2}\right)^3\right]$$

$$\Rightarrow \frac{4}{3}\pi\left[\left(\frac{3}{2}\right)^3\right] = \frac{4}{3}\pi\left[\left(\frac{3}{4}\right)^3 + \left(\frac{2}{2}\right)^3 + \left(\frac{d}{2}\right)^3\right]$$

$$\Rightarrow \frac{27}{8} = \frac{27}{64} + \frac{8}{8} + \frac{d^3}{8}$$

$$\Rightarrow \left[\frac{27}{8} - \frac{27}{64} - 1\right]8 = d^3$$

$$\Rightarrow \frac{d^3}{8} = \frac{125}{64}$$

$$\Rightarrow \frac{d}{2} = \frac{5}{4}$$

$$\Rightarrow d = \frac{10}{4}$$

$$\Rightarrow d = 2.5\text{cm}$$

8. A sphere of radius 5 cm is immersed in water filled in a cylinder, the level of water rises  $\frac{5}{3}$  cm. Find the radius of the cylinder.

**Sol:**

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

$$= \frac{4}{3}\pi(5)^3$$

$\therefore$  Volume of water rise in cylinder = Volume of sphere

Let  $r$  be the radius of the cylinder

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

$$\Rightarrow r^2 \times \frac{5}{3} = \frac{4}{3}(5)^3$$

$$\Rightarrow r^2 = 20 \times 5$$

$$\Rightarrow r^2 = 100$$

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

9. If the radius of a sphere is doubled, what is the ratio of the volume of the first sphere to that of the second sphere?

**Sol:**

Let  $V_1$  and  $V_2$  be the volumes of first sphere and second sphere respectively

Radius of 1<sup>st</sup> sphere =  $r$

2<sup>nd</sup> sphere radius =  $2r$

$$\therefore \frac{\text{Volume } 1^{\text{st}}}{\text{Volume } 2^{\text{nd}}} = \frac{\frac{4}{3}\pi r^3}{\frac{4}{3}\pi(2r)^3} = \frac{1}{8}$$

10. A cone and a hemisphere have equal bases and equal volumes. Find the ratio of their heights.

**Sol:**

Given that

Volume of the cone = Volume of the hemisphere

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

$$\Rightarrow r^2 h = 2r^3$$

$$\Rightarrow h = 2r$$

$$\Rightarrow \frac{h}{r} = \frac{1}{1} \times 2 = \frac{2}{1}$$

$\therefore$  Ratio of their heights is 2:1

11. A vessel in the form of a hemispherical bowl is full of water. Its contents are emptied in a right circular cylinder. The internal radii of the bowl and the cylinder are 3.5 cm and 7 cm respectively. Find the height to which the water will rise in the cylinder.

**Sol:**

Given that

Volume of water in the hemisphere bowl = Volume of water in the cylinder

Let  $h$  be the height to which water rises in the cylinder.

Inner radii of bowl =  $3.5\text{ cm} = r_1$

Inner radii of bowl =  $7\text{ cm} = r_2$

$$\Rightarrow \frac{2}{3}\pi r_1^3 = \pi r_2^2 h$$

$$\Rightarrow h = \frac{2r_1^3}{3r_2^2} = \frac{2(3.5)^3}{3(7)^2}$$

$$\Rightarrow h = \frac{7}{12}\text{ cm.}$$

12. A cylinder whose height is two thirds of its diameter, has the same volume as a sphere of radius 4 cm. Calculate the radius of the base of the cylinder.

**Sol:**

Given that,

$$\text{Height of cylinder} = \frac{2}{3}(\text{diameter})$$

We know that,

$$\text{Diameter} = 2(\text{radius})$$

$$h = \frac{2}{3} \times 2r = \frac{4}{3}r$$

Volume of the cylinder = volume of the sphere

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

$$\Rightarrow r^3 = 4^3$$

$$\Rightarrow r = 4\text{cm}$$

13. A vessel in the form of a hemispherical bowl is full of water. The contents are emptied into a cylinder. The internal radii of the bowl and cylinder are respectively 6 cm and 4 cm. Find the height of water in the cylinder.

**Sol:**

It is given that,

Volume of water in hemisphere bowl = volume of cylinder

$$\Rightarrow \frac{2}{3} \pi (6)^3 = \pi (4)^2 h$$

$$\Rightarrow h = \frac{2}{3} \times \frac{6 \times 6 \times 6}{4 \times 4}$$

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

$\therefore$  Height of cylinder = 9cm.

14. A cylindrical tub of radius 16 cm contains water to a depth of 30 cm. A spherical iron ball is dropped into the tub and thus level of water is raised by 9 cm. What is the radius of the ball?

**Sol:**

Let  $r$  be the radius of the iron ball

Then, Volume of iron ball = Volume of water raised in the tub

$$\Rightarrow \frac{4}{3} \pi r^3 = \pi r^2 h$$

$$\Rightarrow \frac{4}{3} r^3 = (16)^2 \times 9$$

$$\Rightarrow r^3 = \frac{27 \times 16 \times 16}{4}$$

$$\Rightarrow r^3 = 1728$$

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

Therefore, radius of the ball = 12cm.

15. A cylinder of radius 12 cm contains water to a depth of 20 cm. A spherical iron ball is dropped into the cylinder and thus the level of water is raised by 6.75 cm. Find the radius of the ball. (Use  $\pi = 22/7$ ).

**Sol:**

Given that,

Radius of cylinder = 12cm =  $r_1$

Raised in height = 6.75cm =  $h$

$\Rightarrow$  Volume of water raised = Volume of the sphere

$$\Rightarrow \pi r_1^2 h = \frac{4}{3} \pi r_2^3$$

$$\Rightarrow 12 \times 12 \times 6.75 = \frac{4}{3} r_2^3$$

$$\Rightarrow \frac{12 \times 12 \times 6.75 \times 3}{4} = r_2^3$$

$$\Rightarrow r_2^3 = 729$$

$$\Rightarrow \boxed{r_2 = 9cm}$$

Radius of sphere is 9cm.

16. The diameter of a copper sphere is 18 cm. The sphere is melted and is drawn into a long wire of uniform circular cross-section. If the length of the wire is 108 m, find its diameter.

**Sol:**

Given that diameter of a copper sphere = 18cm.

Radius of the sphere = 9cm

Length of the wire = 108m

= 10,800cm

Volume of cylinder = volume of sphere

$$\Rightarrow \pi r_1^2 h = \frac{4}{3} \pi r_2^3$$

$$\Rightarrow r_1^2 \times 10800 = \frac{4}{3} \times 9 \times 9 \times 9 \Rightarrow r_1^2 = 0.09$$

$$\therefore \text{Diameter} = 2 \times 0.3 = 0.6cm$$

17. A cylindrical jar of radius 6 cm contains oil. Iron spheres each of radius 1.5 cm are immersed in the oil. How many spheres are necessary to raise the level of the oil by two centimetres?

**Sol:**

Given that,

Radius of cylinder jar = 6cm =  $r_1$

Level to be raised = 2cm =  $h$

Radius of each iron sphere =  $1.5\text{ cm} = r_2$

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

$$= \frac{\pi r_1^2 h}{4\pi r_2^3}$$

$$= \frac{r_1^2 h}{r_2^3 \times \frac{4}{3}} = \frac{6 \times 6 \times 2}{\frac{4}{3} \times 1.5 \times 1.5 \times 1.5}$$

Number of sphere = 16.

18. A measuring jar of internal diameter 10 cm is partially filled with water. Four equal spherical balls of diameter 2 cm each are dropped in it and they sink down in water completely. What will be the change in the level of water in the jar?

**Sol:**

Given that,

Diameter of jar = 10cm

Radius of jar = 5cm

Let the level of water raised by 'h'

Diameter of spherical ball = 2cm

Radius of the ball = 1cm

Volume of jar = 4(Volume of spherical)

$$\Rightarrow \pi r_1^2 h = 4 \left( \frac{4}{3} \pi r_2^3 \right)$$

$$\Rightarrow r_1^2 h = 4 \times \frac{4}{3} r_2^3$$

$$\Rightarrow r_1^2 h = 4 \times \frac{4}{3} \times 1 \times 1 \times 1$$

$$\Rightarrow h = \frac{4 \times 4 \times 1}{3 \times 5 \times 5}$$

$$\Rightarrow h = \frac{16}{75} \text{ cm.}$$

$$\therefore \text{Height of water in jar} = \frac{16}{75} \text{ cm.}$$

19. The diameter of a sphere is 6 cm. It is melted and drawn into a wire of diameter 0.2 cm. Find the length of the wire.

**Sol:**

Given that,

Diameter of sphere = 6cm

$$\text{Radius of sphere} = \frac{d}{2} = \frac{6}{2} \text{ cm} = 3 \text{ cm} = r_1$$

$$\text{Diameter of the wire} = 0.2 \text{ cm}$$

$$\text{Radius of the wire} = 0.1 \text{ cm} = r_2$$

$$\text{Volume of sphere} = \text{Volume of wire}$$

$$\Rightarrow \frac{4}{3} \pi r_1^3 = \pi r_2^2 h$$

$$\Rightarrow \frac{4}{3} \times 3 \times 3 \times 3 = 0.1 \times 0.1 \times h$$

$$\Rightarrow \frac{4 \times 3 \times 3}{0.1 \times 0.1} = h$$

$$\Rightarrow h = 3600$$

$$\Rightarrow h = 36 \text{ m.}$$

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

20. The radius of the internal and external surfaces of a hollow spherical shell are 3 cm and 5 cm respectively. If it is melted and recast into a solid cylinder of height  $2\frac{2}{3}$  cm. Find the diameter of the cylinder.

**Sol:**

Given that,

$$\text{Internal radius of the sphere} = 3 \text{ cm} = r_1$$

$$\text{External radius of the sphere} = 5 \text{ cm} = r_2$$

$$\text{Height of cylinder} = 2\frac{2}{3} \text{ cm} = \frac{8}{3} \text{ cm} = h$$

$$\text{Volume of spherical shell} = \text{Volume of the cylinder}$$

$$\Rightarrow \frac{4}{3} \pi (r_2^3 - r_1^3) = \pi r_3^2 h$$

$$\Rightarrow \frac{4}{3} (5^3 - 3^3) = \frac{8}{3} r_3^2$$

$$\Rightarrow \frac{4 \times 98 \times 3}{3 \times 8} = r_3^2$$

$$\Rightarrow r_3^2 = \sqrt{49}$$

$$\Rightarrow r_3 = 7 \text{ cm}$$

$$\therefore \text{Diameter of the cylinder} = 2 (\text{radius}) = 14 \text{ cm}$$



21. A hemisphere of lead of radius 7 cm is cast into a right circular cone of height 49 cm. Find the radius of the base.

**Sol:**

Given radius of hemisphere = 7cm =  $r_1$

Height of cone  $h = 49\text{cm}$

Volume of hemisphere = Volume of cone

$$\Rightarrow \frac{2}{3} \pi r_1^3 = \frac{1}{3} \pi r_2^2 h$$

$$\Rightarrow \frac{2}{3} \times 7^3 = \frac{1}{3} r_2^2 \times 49$$

$$\Rightarrow \frac{2 \times 7 \times 7 \times 7 \times 3}{3 \times 49} = r_2^2$$

$$\Rightarrow r_2^2 = 3.74\text{cm}$$

$\therefore$  Radius of the base = 3.74cm.

22. A hollow sphere of internal and external radii 2 cm and 4 cm respectively is melted into a cone of base radius 4 cm. Find the height and slant height of the cone.

**Sol:**

Given that

Hollow sphere external radii = 4cm =  $r_2$

Internal radii ( $r_1$ ) = 2cm

Cone base radius ( $R$ ) = 4cm

Height = ?

Volume of cone = Volume of sphere

$$\Rightarrow \frac{1}{3} \pi r^2 H = \frac{4}{3} \pi (R_2^3 - R_1^3)$$

$$\Rightarrow 4^2 H = 4(4^3 - 2^3)$$

$$\Rightarrow H = H = \frac{4 \times 56}{16} = 14\text{cm}$$

$$\text{Slant height} = \sqrt{R^2 + H^2} = \sqrt{4^2 + 14^2}$$

$$\Rightarrow l = \sqrt{16 + 196} = \sqrt{212}$$

$$= 14.56\text{cm}.$$

23. A metallic sphere of radius 10.5 cm is melted and thus recast into small cones, each of radius 3.5 cm and height 3 cm. Find how many cones are obtained.

**Sol:**

Given that

Metallic sphere of radius =  $10.5\text{ cm}$

Cone radius =  $3.5\text{ cm}$

Height of radius =  $3\text{ cm}$

Let the number of cones obtained be  $x$

$$V_s = x \times V_{\text{cone}}$$

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

$$\Rightarrow \frac{4 \times 10.5 \times 10.5 \times 10.5}{3.5 \times 3.5 \times 3} = x$$

$$\Rightarrow x = 126$$

$\therefore$  Number of cones = 126

24. A cone and a hemisphere have equal bases and equal volumes. Find the ratio of their heights.

**Sol:**

Given that

A cone and a hemisphere have equal bases and volumes

$$V_{\text{cone}} = V_{\text{hemisphere}}$$

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

$$\Rightarrow r^2 h = 2r^3$$

$$\Rightarrow h = 2r$$

$$\Rightarrow h : r = 2r : r = 2 : 1$$

25. A cone, a hemisphere and a cylinder stand on equal bases and have the same height. Show that their volumes are in the ratio 1 : 2 : 3.

**Sol:**

Given that,

A cone, hemisphere and a cylinder stand on equal bases and have the same height

We know that

$$V_{\text{cone}} : V_{\text{hemisphere}} : V_{\text{cylinder}}$$

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

Multiplying by 3

$$\Rightarrow \pi r^2 h : 2\pi r^3 : 3\pi r^2 h \text{ or}$$

$$\pi r^3 : 2\pi r^3 : 3\pi r^3 \left[ \because r = h \therefore r^2 h = r^3 \right]$$

Or 1 : 2 : 3

26. A cylindrical tub of radius 12 cm contains water to a depth of 20 cm. A spherical form ball is dropped into the tub and thus the level of water is raised by 6.75 cm. What is the radius of the ball?

**Sol:**

A cylindrical tub of radius = 12 cm

Depth = 20 cm.

Let  $r$  cm be the radius of the ball

Then, volume of ball = volume of water raised

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

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

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

$$\Rightarrow r^3 = 729$$

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

Thus, radius of the ball = 9 cm.

27. The largest sphere is carved out of a cube of side 10.5 cm. Find the volume of the sphere.

**Sol:**

Given that,

The largest sphere is carved out of a cube of side = 10.5 cm

Volume of the sphere = ?

We have,

Diameter of the largest sphere = 10.5 cm

$$2r = 10.5$$

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

$$\text{Volume of sphere} = \frac{4}{3} \times \frac{22}{7} \times (5.25)^3 = \frac{4}{3} \times \frac{22}{7} \times 5.25 \times 5.25 \times 5.25$$

$$\Rightarrow \text{Volume} = \frac{11 \times 441}{8} \text{ cm}^3 = 606.37 \text{ cm}^3.$$

28. A sphere, a cylinder and a cone have the same diameter. The height of the cylinder and also the cone are equal to the diameter of the sphere. Find the ratio of their volumes.

**Sol:**

Let  $r$  be the common radius thus,

$h$  = height of the cone = height of the cylinder =  $2r$

Let

$$V_1 = \text{Volume of sphere} = \frac{4}{3}\pi r^3$$

$$V_2 = \text{Volume of cylinder} = \pi r^2 \times 2r = 2\pi r^3$$

$$V_3 = \text{Volume of the cone} = \frac{1}{3}\pi r^2 \times 2r = \frac{2}{3}\pi r^3$$

Now,

$$V_1 : V_2 : V_3 = \frac{4}{3}\pi r^3 : 2\pi r^3 : \frac{2}{3}\pi r^3$$

$$= 4 : 6 : 2$$

$$= 2 : 3 : 1$$

- 29.** A cube of side 4 cm contains a sphere touching its side. Find the volume of the gap in between.

**Sol:**

It is given that

Cube side = 4cm

$$\text{Volume of cube} = (4\text{cm})^3 = 64\text{cm}^3$$

Diameter of the sphere = Length of the side of the cube = 4cm

∴ Radius of sphere = 2cm

$$\text{Volume of the sphere} = \frac{4}{3}\pi r^3 = \frac{4}{3} \times \frac{22}{7} \times (2)^3 = 33.52\text{cm}^3$$

$$\begin{aligned} \therefore \text{Volume of gap} &= \text{Volume of cube} - \text{Volume of sphere} \\ &= 64\text{cm}^3 - 33.52\text{cm}^3 = 30.48\text{cm}^3. \end{aligned}$$

- 30.** A hemispherical tank is made up of an iron sheet 1 cm thick. If the inner radius is 1 m, then find the volume of the iron used to make the tank.

**Sol:**

Given that,

Inner radius ( $r_1$ ) of hemispherical tank = 1m =  $r_1$

Thickness of hemispherical tank = 1cm = 0.01m

Outer radius ( $r_2$ ) of the hemispherical = (1 + 0.01m) = 1.01m =  $r_2$

$$\text{Volume of iron used to make the tank} = \frac{2}{3}\pi(r_2^3 - r_1^3)$$

$$= \frac{2}{3} \times \frac{22}{7} [(1.01)^3 - 1^3]$$

$$= \frac{44}{21} [1.030301 - 1] \text{m}^3$$

$$= 0.06348\text{m}^3 \quad (\text{Approximately})$$

31. A capsule of medicine is in the shape of a sphere of diameter 3.5 mm. How much medicine (in  $\text{mm}^3$ ) is needed to fill this capsule?

**Sol:**

Given that,

Diameter of capsule = 3.5 mm

$$\text{Radius} = \frac{3.5}{2} = 1.75 \text{ mm}$$

$$\text{Volume of spherical capsule} = \frac{4}{3} \pi r^3$$

$$= \frac{4}{3} \times \frac{22}{7} \times (1.75)^3 \text{ mm}^3$$

$$= 22.458 \text{ mm}^3$$

$\therefore 22.46 \text{ mm}^3$  of medicine is required.

32. The diameter of the moon is approximately one fourth of the diameter of the earth. What fraction of the volume of the earth is the volume of the moon?

**Sol:**

Given that,

The diameter of the moon is approximately one fourth of the diameter of the earth.

Let diameter of earth be  $d$ . So radius =  $\frac{d}{2}$

Then, diameter of moon =  $\frac{d}{4}$ , radius =  $\frac{\frac{d}{4}}{2} = \frac{d}{8}$

$$\text{Volume of moon} = \frac{4}{3} \pi r^3 = \frac{4}{3} \pi \left(\frac{d}{8}\right)^3 = \frac{4}{3} \times \frac{1}{512} \pi d^3$$

$$\text{Volume of earth} = \frac{4}{3} \pi r^3 = \frac{4}{3} \pi \left(\frac{d}{2}\right)^3 = \frac{1}{8} \times \frac{4}{3} \pi d^3$$

$$\frac{\text{Volume of moon}}{\text{Volume of earth}} = \frac{\frac{1}{512} \times \frac{4}{3} \pi d^3}{\frac{1}{8} \times \frac{4}{3} \pi d^3} = \frac{1}{64}$$

Thus, the volume of moon is  $\frac{1}{64}$  of volume of earth.