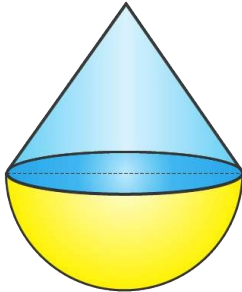


Exercise 20(E)

A cone of height 15 cm and diameter 7 cm is mounted on a hemisphere of same diameter. Determine the volume of the solid thus formed.

Solution:



Given,

Height of the cone = 15 cm

Diameter of the cone = 7 cm

So, its radius = 3.5 cm

Radius of the hemisphere = 3.5 cm

Now,

Volume of the solid = Volume of the cone + Volume of the hemisphere

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

$$= \frac{1}{3} \times \frac{22}{7} \times (3.5)^2 \times 15 + \frac{2}{3} \times \frac{22}{7} \times (3.5)^3$$

$$= \frac{1}{3} \times \frac{22}{7} \times (3.5)^2 (15 + 2 \times 3.5)$$

$$= \frac{847}{3}$$

$$= 282.33 \text{ cm}^3$$

1. A buoy is made in the form of a hemisphere surmounted by a right cone whose circular base coincides with the plane surface of the hemisphere. The radius of the base of the cone is 3.5 m and its volume is two-third of the hemisphere. Calculate the height of the cone and the surface area of the buoy, correct to two decimal places.

Solution:

Given,

Radius of the hemisphere part (r) = 3.5 m = $\frac{7}{2}$ m

Volume of hemisphere = $\frac{2}{3} \pi r^3$

$$= \frac{2}{3} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times \frac{7}{2}$$

$$= \frac{539}{6} \text{ m}^3$$

Volume of conical part = $\frac{2}{3} \times \frac{539}{6} \text{ m}^3$ [2/3rd of the hemisphere]

Let height of the cone = h

Then,

$$\frac{1}{3} \pi r^2 h = \frac{2 \times 539}{3 \times 6}$$

$$\frac{1}{3} \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} \times h = \frac{2 \times 539}{3 \times 6}$$

$$h = \frac{2 \times 539 \times 2 \times 2 \times 7 \times 3}{3 \times 6 \times 22 \times 7 \times 7}$$

$$h = \frac{14}{3} \text{ m} = 4.67 \text{ m}$$

Height of the cone = 4.67 m

Surface area of buoy = $2 \pi r^2 + \pi r l$

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But, we know that

$$l = (r^2 + h^2)^{1/2}$$

$$l = ((7/2)^2 + (14/3)^2)^{1/2}$$

$$l = (1225/36)^{1/2} = 35/6 \text{ m}$$

Hence,

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

$$= (2 \times 22/7 \times 7/2 \times 7/2) + (22/7 \times 7/2 \times 35/6)$$

$$= 77 + 385/6 = 847/6$$

$$= 141.17 \text{ m}^2 \quad [\text{Corrected to 2 decimal places}]$$

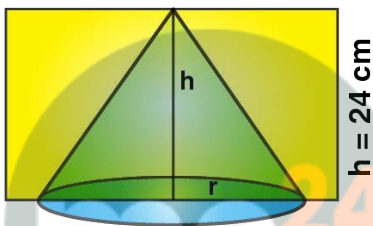
2. From a rectangular solid of metal 42 cm by 30 cm by 20 cm, a conical cavity of diameter 14 cm and depth 24 cm is drilled out. Find:

(i) the surface area of the remaining solid

(ii) the volume of remaining solid

(iii) the weight of the material drilled out if it weighs 7 gm per cm³.

Solution:



Given,

Dimensions of rectangular solid $l = 42 \text{ cm}$, $b = 30 \text{ cm}$ and $h = 20 \text{ cm}$

Conical cavity's diameter = 14 cm

So, its radius = 7 cm

Depth (height) = 24 cm

$$\begin{aligned} \text{(i) Total surface area of cuboid} &= 2(lb + bh + lh) \\ &= 2(42 \times 30 + 30 \times 20 + 20 \times 42) \\ &= 2(1260 + 600 + 840) \\ &= 2(2700) \\ &= 5400 \text{ cm}^2 \end{aligned}$$

Diameter of the cone = 14 cm

So, its radius = $14/2 = 7 \text{ cm}$

$$\text{Area of circular base} = \pi r^2 = 22/7 \times 7 \times 7 = 154 \text{ cm}^2$$

We know that,

$$l = (7^2 + 24^2)^{1/2} = (49 + 576)^{1/2} = (625)^{1/2} = 25$$

$$\text{Area of curved surface area of cone} = \pi r l = 22/7 \times 7 \times 25 = 22 \times 25 = 550 \text{ cm}^2$$

$$\text{Surface area of remaining part} = 5400 + 550 - 154 = 5796 \text{ cm}^2$$

$$\text{(ii) Volume of the rectangular solid} = (42 \times 30 \times 20) \text{ cm}^3 = 25200 \text{ cm}^3$$

Radius of conical cavity (r) = 7 cm

Height (h) = 24 cm

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$$\begin{aligned}\text{Volume of cone} &= \frac{1}{3} \pi r^2 h \\ &= \frac{1}{3} \times \frac{22}{7} \times 7 \times 7 \times 24 \\ &= 1232 \text{ cm}^3\end{aligned}$$

(iii) Weight of material drilled out = $1232 \times 7\text{g} = 8624\text{g} = 8.624 \text{ kg}$

3. The cubical block of side 7 cm is surmounted by a hemisphere of the largest size. Find the surface area of the resulting solid.

Solution:

It's known that, the diameter of the largest hemisphere that can be placed on a face of a cube of side 7 cm will be 7 cm.

So, it's radius = $r = 7/2 \text{ cm}$

It's curved surface area = $2 \pi r^2 = 2 \times \frac{22}{7} \times \frac{7}{2} \times \frac{7}{2} = 77 \text{ cm}^2 \dots\dots (i)$

Now,

Surface area of the top of the resulting solid = Surface area of the top face of the cube - Area of the base of the hemisphere

$$= (7 \times 7) - \left(\frac{22}{7} \times \frac{49}{4}\right)$$

$$= 49 - \frac{77}{2}$$

$$= \frac{98 - 77}{2}$$

$$= \frac{21}{2}$$

$$= 10.5 \text{ cm}^2 \dots\dots (ii)$$

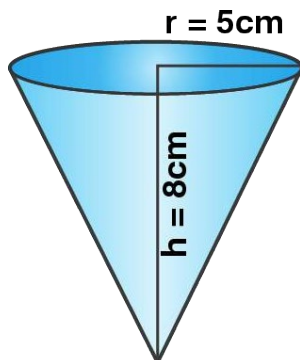
Surface area of the cube = $5 \times (\text{side})^2 = 5 \times 49 = 245 \text{ cm}^2 \dots\dots (iii)$

Hence,

Total area of resulting solid = $(i) + (ii) + (iii) = 245 + 10.5 + 77 = 332.5 \text{ cm}^2$

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

Solution:



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Given,

Height of cone = 8 cm

Radius = 5 cm

$$\begin{aligned}\text{Volume} &= \frac{1}{3} \pi r^2 h \\ &= \frac{1}{3} \times \frac{22}{7} \times 5 \times 5 \times 8 \text{ cm}^3 \\ &= \frac{4400}{21} \text{ cm}^3\end{aligned}$$

$$\begin{aligned}\text{Hence, the volume of water that flowed out} &= \frac{1}{4} \times \frac{4400}{21} \text{ cm}^3 \\ &= \frac{1100}{21} \text{ cm}^3\end{aligned}$$

Also, given

Radius of each ball = 0.5 cm = $\frac{1}{2}$ cm

$$\begin{aligned}\text{Volume of a ball} &= \frac{4}{3} \pi r^3 \\ &= \frac{4}{3} \times \frac{22}{7} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \text{ cm}^3 \\ &= \frac{11}{21} \text{ cm}^3\end{aligned}$$

$$\text{Thus, the no. of balls} = \frac{1100}{21} \div \frac{11}{21} = 100$$



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