

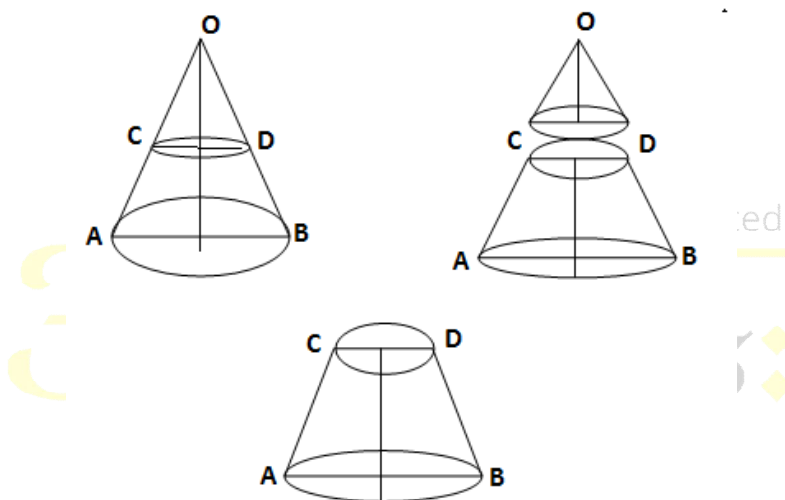
## DAY 9

In last section, we have discussed about solids, their conversion and combination. Here we shall discuss about new type of solid that is **Frustum of solid**. Frustum is a part of solid when it is cut by a plane parallel to ground. in this section, we shall discuss the Frustum of cone.

### FRUSTUM OF A RIGHT CIRCULAR CONE

In our daily life, we have a number of solids which are parts of regular solids. For example, a bucket or a glass tumbler is a part of a right circular cone.

If a right circular cone is cut by a plane parallel to its base-the cross-section will be a circle. Let a cone cut by a plane parallel to its base through some point on its axis and the portion containing the vertex is removed.



The left out ABDC of figure which is in the form of a bucket, usually called frustum of the cone. A frustum of a right circular cone has two unequal flat circular bases and a curved surface.

- Curved Surface Area of the frustum =  $\pi l(R + r)$  ..... (i)  
where  $l^2 = h^2 + (R - r)^2$
- Total surface Area of the frustum =  $\pi l(R + r) + \pi r^2 + \pi R^2$  ..... (ii)
- Volume of frustum of cone =  $\frac{1}{3}\pi h(R^2 + r^2 + Rr)$  ..... (iii)

#### **Note:-**

- If we eliminate upper base of frustum of cone then it becomes right circular cone means  $r = 0$  then (i), (ii), (iii) becomes respective formulas of right circular cone.
- If both radii of the frustum of cone are equal means  $R = r$  then it becomes cylinder and (i), (ii), (iii) becomes respective formulas of right circular cylinder.

1. If the radii of the ends of a bucket 45 cm high are 28 cm and 7 cm, determine its capacity and surface area.

**Sol:-** Here  $R = 28 \text{ cm}$ ,  $r = 7 \text{ cm}$ ,  $h = 45 \text{ cm}$

$$\begin{aligned}\text{Capacity of the bucket} &= \frac{1}{3}\pi h(R^2 + r^2 + Rr) \\ &= \frac{1}{3} \times \frac{22}{7} \times 45(28^2 + 7^2 + 28 \times 7) = \frac{22 \times 45}{21} \times (784 + 49 + 196) \\ &= \frac{22 \times 45}{21} \times 1029 = \mathbf{48510 \text{ cm}^3}\end{aligned}$$

$$\text{Now } l^2 = \sqrt{h^2 + (R - r)^2} = \sqrt{45^2 + (28 - 7)^2} = \sqrt{2025 + 441} = \sqrt{2466} = 49.7 \text{ cm (app)}$$

$$\begin{aligned}\therefore \text{Curved Surface Area} &= \pi l(R + r) \\ &= \frac{22}{7} \times 49.7 \times (28 + 7) = \frac{22}{7} \times 49.7 \times 35 = \mathbf{5467 \text{ cm}^2}\end{aligned}$$

2. The slant height of a frustum of cone is 4 cm and the perimeters of its circular ends are 18 cm and 6 cm. Find the curved surface area of the frustum. [Ex 13.4, Q2]

**Sol:-** Here  $l = 4 \text{ cm}$ , Let  $r$  and  $R$  be the radii of smaller and larger bases.

$$\begin{aligned}\text{Given, Perimeter of smaller base} &= 6 \text{ cm} \Rightarrow 2\pi r = 6 \Rightarrow r = \frac{3}{\pi} \\ \text{and Perimeter of larger base} &= 18 \text{ cm} \Rightarrow 2\pi R = 18 \Rightarrow R = \frac{9}{\pi}\end{aligned}$$

$$\begin{aligned}\text{Now Curved Surface Area} &= \pi l(R + r) \\ &= \pi \times 4 \times \left(\frac{9}{\pi} + \frac{3}{\pi}\right) = 4\pi \times \frac{12}{\pi} = \mathbf{48 \text{ cm}^2}\end{aligned}$$

3. A container made up of a metal sheet is in the form of frustum of a cone. Its height is 13 cm with radii of its lower and upper ends are 4 cm and 9 cm. Find the total surface area of the container.

**Sol:-** Here  $R = 9 \text{ cm}$ ,  $r = 4 \text{ cm}$ ,  $h = 13 \text{ cm}$

$$\text{Now } l^2 = \sqrt{h^2 + (R - r)^2} = \sqrt{13^2 + (9 - 4)^2} = \sqrt{169 + 25} = \sqrt{194} = 13.9 \text{ cm (app)}$$

$$\begin{aligned}\therefore \text{Total Surface Area} &= \pi l(R + r) + \pi r^2 + \pi R^2 \\ &= \frac{22}{7} \times 13.9 \times (9 + 4) + \frac{22}{7} \times 4 \times 4 + \frac{22}{7} \times 9 \times 9 \\ &= \frac{22}{7} \times 13.9 \times 13 + \frac{352}{7} + \frac{1782}{7} \\ &= \frac{39754}{70} + \frac{352}{7} + \frac{1782}{7} = \frac{61094}{70} = \mathbf{872.77 \text{ cm}^2}\end{aligned}$$

#### EXERCISE

1. A container is in the form of a cone. Its height is 10 cm with radii of its lower and upper ends as 3 cm and 5 cm. Find its capacity.
2. The 14 cm high bucket has radii 8 cm and 5 cm. Find the curved surface area of the bucket.

3. A container made up of a metal sheet is in the form of frustum of a cone. Its height is 8 cm with diameters of its lower and upper ends are 12 cm and 6 cm. Find the capacity and curved surface area.
4. Ex 13.4, Q1,3

