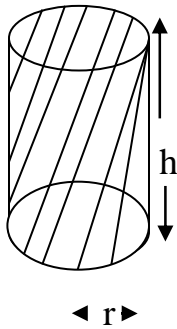


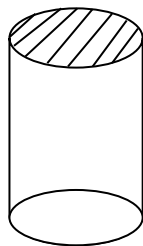
# **CHAPTER THIRTEEN**

## **CYLINDERS AND CONES**

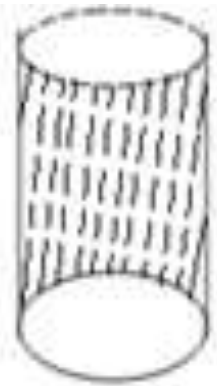
### **The cylinder:**



- The above figure is known as a cylinder.
- The height of this cylinder is  $h$  and its radius is  $r$ .
- The shaded portion is called the total surface area of the cylinder, also referred to as the area of the cylinder.
- The area of a cylinder is made up of three parts and these are:
  1. The top circular flat surface area, which is also referred to as the top surface area, and which is indicated in the next diagram, by means of shading:

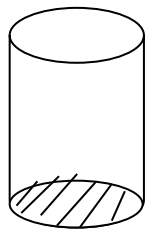


- The flat top circular surface area  $= \pi r^2$ , since it is circular in shape where  $r$  = the radius.
  2. The curved surface area, which is indicated by means of shading, in the next figure:



- The curved surface area =  $2 \pi r h$ , where  $h$  = the height.

The bottom circular surface area, which is indicated in the next diagram by means of shading:

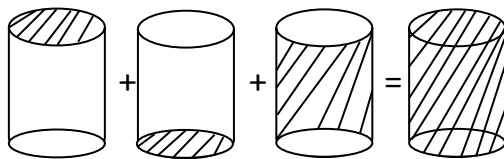


- The bottom surface area =  $\pi r^2$ , since it is also circular in shape.

### **The area of a cylinder:**

The total surface area of a cylinder is therefore had by adding together all these three surface areas,

i.e



$$\pi r^2 + \pi r^2 + 2\pi r h = 2\pi r^2 + 2\pi r h = 2\pi r(r + h).$$

Q1. The height of a cylinder is 5cm and its radius is 2cm. Calculate

- its flat top circular area.
- its flat bottom circular area.

c) its curved surface area.

d) its total surface area. [Take  $\pi = 3.14$ ].

Soln.

$h = 5\text{cm}$ ,  $r = 2\text{cm}$  and  $\pi = 3.14$ .

- a. The flat top surface area  $= \pi r^2 = 3.14 \times 2^2 = 3.14 \times 4 = 12.56\text{cm}^2$
- b. The flat bottom surface area  $= \pi r^2 = 3.14 \times 2^2 = 3.14 \times 4 = 12.56\text{cm}^2$
- c. The curved surface area  $= 2\pi rh = 2 \times 3.14 \times 2 \times 5 = 62.8\text{cm}^2$
- d. The total surface area = top surface area + bottom surface area + curved surface area  $= 12.56\text{cm}^2 + 12.56\text{cm}^2 + 62.8\text{cm}^2 = 87.9\text{cm}^2$ .

N/B: Also the total surface area  $= 2\pi r(r + h) = 2 \times 3.14 \times 2(2 + 5) = 12.56(7) = 87.9\text{cm}^2$ .

Q2. A cylinder has a height of 40m and a diameter of 12m. Determine

- a. its bottom circular area .
- b. its curved surface area.
- c. Its total surface area.

[Take  $\pi = 3.142$ ]

Soln:

Since  $d = 12\text{m} \Rightarrow r = \frac{12}{2} = 6\text{m}$ .

Also  $\pi = 3.142$  and  $h = 40\text{m}$ .

- a. The bottom circular surface area  $= \pi r^2 = 3.142 \times 6^2 = 3.142 \times 36 = 113\text{m}^2$
- b. The curved surface area  $= 2\pi rh = 2 \times 3.142 \times 6 \times 40 = 1508\text{m}^2$
- c. The total surface area  $= 2\pi r(r + h) = 2 \times 3.142 \times 6(6 + 40) = 1734\text{m}^2$ .

Q3. A water storage tank is to be constructed using aluminum. If it is to have a diameter of 40m and a height of 120m, determine the amount of aluminum that will be needed to construct

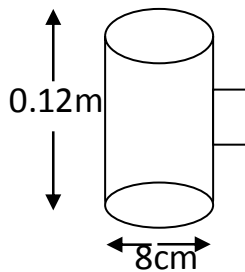
- a. its curved surface area .
- b. the whole tank. [ Take  $\pi$  or  $pie = 3.14$ ].

Soln.

Since  $d = 40m \Rightarrow r = \frac{40}{2} = 20m$ . Also  $\pi = 3.14$  and  $h = 120m$ .

- The amount of aluminum which is needed to construct the curved surface area = the curved surface area =  $2\pi rh = 2 \times 3.14 \times 20 \times 120 = 15072m^2$
- The amount of aluminum needed to construct the whole tank = the total surface area =  $2\pi r(r + h) = 2 \times 3.14 \times 20(20 + 120) = 126(140) = 17640m^2$

Q4.



The given figure is that of a drinking cup, which is to be constructed using plastic. If it is to be 0.12m long and have a diameter of 8cm, determine the quantity of plastic needed for its construction. [Take  $\pi = 3.142$ ].

N/B:

- A drinking cup has no top surface area  $\Rightarrow$  plastic will only be needed to construct the curved surface area and the bottom surface area.
- Also since the height is given in metres and the diameter in centimetres, the metres must be converted into centimetres.

Soln.

$$h = 0.12m = 0.12 \times 100 = 12cm.$$

$$D = 8cm \Rightarrow r = 4cm.$$

The amount of plastic needed to construct the curve surface area =  $2\pi rh = 2 \times 3.142 \times 4 \times 12 = 302cm^2$ .

The amount of plastic needed to construct the bottom surface area = bottom surface area =  $\pi r^2 = 3.142 \times 4^2 = 3.142 \times 16 = 50cm^2$ .

The quantity of plastic needed to construct the cup = amount of plastic needed to construct the curved portion + the amount of plastic needed to construct the bottom surface =  $302 + 50 = 352\text{cm}^2$ .

Q5. The curved surface area of a cylinder of height 80cm is  $2880\text{cm}^2$ . Calculate

- i. Its total surface area .
- ii. Its circular top surface area. [Take  $\pi = 3.14$ ]

Soln.

The curved surface area =  $2\pi rh$ , and since the curved surface area of the cylinder is given as  $2880\text{cm}^2 \Rightarrow 2\pi rh = 2880, \Rightarrow 2 \times 3.14 \times r \times 80 = 2880,$

$$\Rightarrow 502r = 2880, \Rightarrow r = \frac{2880}{502} \Rightarrow r = 5.7\text{cm}.$$

- i. The total surface area =  $2\pi r(r + h) = 2 \times 3.14 \times 5.7(5.7 + 80) = 36(85.7) = 3085\text{cm}^2$
- ii. The top circular surface area =  $\pi r^2 = 3.14 \times 5.7^2 = 102\text{cm}^2$ .

N/B: Since in the question the heights as well as the curved surface areas were given, we must first determine the radius.

- In the next question, the curved surface area is given as well as the radius. We must therefore first determine the height.

Q6. The curved surface area of a cylinder whose radius is 5cm is  $628\text{cm}^2$ . Determine its total surface area.

Soln.

$r = 5\text{cm}$  and  $h = ?$

Since the curved surface area =  $628\text{cm}^2$ , then  $2\pi rh = 628 \Rightarrow 2 \times 3.14 \times 5 \times h = 628, \Rightarrow 31.4h = 628 \Rightarrow h = \frac{628}{3.14} = 20$ .

Total surface area =  $2\pi r(r + h) = 2 \times 3.14 \times 5(5 + 20) = 31.4(25) = 785\text{cm}^2$

Q7. A cylinder has a top surface area of  $12.56\text{cm}^2$  and a height of 0.8m. Calculate

- a. its curved surface area.
- b. its total surface area.

[Take  $\pi = 3.142$ ]

Soln.

Top surface area =  $12.56\text{cm}^2$ ,  $h = 0.8\text{m} = 0.8\text{m} \times 100 = 80\text{cm}$ .

$\pi = 3.142$  and  $r = ?$

The top surface area is given by  $\pi r^2$ , and since this =  $12.56\text{cm}^2$ , then

$$\pi r^2 = 12.56, \Rightarrow r^2 = \frac{12.56}{3.142} = 4.$$

Since  $r^2 = 4 \Rightarrow r = \sqrt{4} = 2$ .

- a. Curved surface area =  $2\pi rh = 2 \times 3.142 \times 2 \times 80 = 1005\text{cm}^2$
- b. The total surface area =  $2\pi r(r + h) = 2 \times 3.142 \times 2(2 + 80) = 12.56(82) = 1030\text{cm}^2$ .

### **The volume of cylinder:**

- The volume of a cylinder is the amount of gas, liquid or solid which it can contain or hold.
- The volume of a cylinder is given by  $v = \pi r^2 h$ , where  $r$  = the radius and  $h$  = the height.

Q1. A cylinder has a height of 80cm and a diameter of 20cm. Calculate

- a. its volume
- b. the volume of air it will contain when it is
  - i. full
  - ii. half full.

[Take  $\pi = 3.143$ ]

Soln.

$$d = 20\text{cm} \Rightarrow r = 10\text{cm}.$$

a.  $\text{Volume} = \pi r^2 h = 3.14 \times 10^2 \times 80 = 25120\text{cm}^3.$

b. i. The volume of air it will contain when it is full =  $25120\text{cm}^3.$

ii. The volume of air it will contain when it is half full =  $\frac{1}{2} \times 25120 = 12560\text{cm}^2.$