# 7   Area and Volume of Cylinder

◆ **Let us learn new :**

● **Activity 1 :**

Dear children, take a rectangular piece of paper as shown in the figure. Stick side $\overline{AB}$ of this rectangle with the side $\overline{CD}$ such that a figure shown below is obtained.

Above and below the surface of this figure are circular while the middle surface is curved surface. Water pipe, grainary tank, power box, drum, *Bhunglu*, etc. have the same type of shape. This shape is known as cylinder. Two ends of cylinder are circular, while other surfaces are curved which is known as curved (lateral) surface of cylinder.
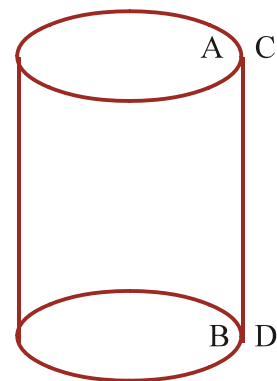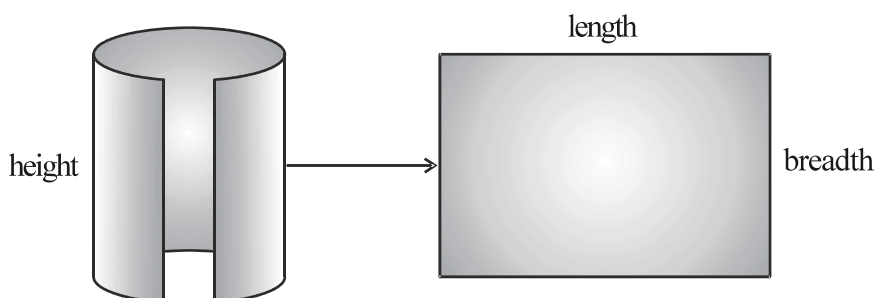
Curved surface area of cylinder :

● **Activity 2 :**

- Take a tin, metal or plastic, scissors and a paper.

- Wrap the paper all around the tin.

- Mark with pencil on the paper which is totally wrapped to cylinder.

- Cut the extra paper with the help of scissors.

- Now take the paper from cylinder and open it as shown in the figure.

The wrapped paper on cylinder is the curved surface area of cylinder. If you want to find the curved surface area of cylinder, then you will have to find the area of wrapped paper.

- Curved surface area of cylinder on the basis of figure = Area of rectangular paper.

- Now breadth of rectangular paper becomes the height of cylinder and length of rectangular paper becomes the circumference of circular part.

- Let's see the above reality in the formula :

$$\text{Curved surface of cylinder} = \text{Area of rectangular paper}$$
$$= \text{Length} \times \text{Breadth}$$
$$= \text{Circumference} \times \text{Height}$$
$$= 2\pi r \times h$$
$$= 2\pi rh$$

We know that circumference $= \pi \times$ diameter $= \pi d$

Curved surface area of cylinder $= \pi d \times h = \pi dh$

Curved surface area of cylinder = $2\pi rh = \pi dh$

- An open cylinderical thing with base which is closed from one side.

  For example, water filling tin is such type of thing in which there are two surfaces : (1) circular base and (2) curved surface.

  Total surface area of open cylinder with base

  = Curved surface area + Area of base

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

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

Therefore, total surface area of open cylinder with base = $\pi r(2h + r)$

- Such a cylinderical thing which is closed on both sides (base with cover)

  For example : A tin of grain have (1) circular base (2) curved surface and (3) circular top, such three surfaces.

- Total surface area of closed cylinder :

  = Curved surface area + Area of base + Area of top

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

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

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

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

- **Keep in mind :**

  - 1 metre = 100 cm, 1 sq metre = 10000 sq cm

  - We take value of π as $\frac{22}{7}$. The value of π up to two decimal places is 3.14 approximately. In this chapter if value of π is not given then take value of π as $\frac{22}{7}$.

Example 1 : The radius of base is 14 metre and height is 20 metre of a cylinder. Find curved surface area of this cylinder.

Radius of cylinder $r = 14$ m, Height of cylinder $h = 20$ m

Curved surface area of cylinder $= 2\pi rh$

$$= 2 \times \frac{22}{7} \times 14 \times 20$$

$$= 1760 \text{ m}^2$$

∴ **Curved surface area of cylinder = 1760 m^2**

Example 2 : The radius of base of a cylinder is 10 cm and its height is 40 cm. Find curved surface area of cylinder. ($\pi = 3.14$)

Radius of cylinder $(r) = 10$ cm, Height of cylinder $(h) = 40$ cm

Curved surface area of cylinder $= 2\pi rh$

$$= 2 \times 3.14 \times 10 \times 40$$

$$= 2 \times \frac{314}{100} \times 10 \times 40$$

$$= 2512 \text{ sq cm}$$

∴ **Curved surface area of cylinder = 2512 m²**

Practice 1

1. The radius of base of a cylinder is 7 cm and height is 10 cm, then find the curved surface area of this cylinder.

2. The radius of base of a cylinder is 3.5 cm and height is 40 cm, then find the curved surface area of cylinder.

3. The diameter of base of a cylinder is 50 cm and height is 20 cm, then find curved surface area of cylinder. (Take $\pi = 3.14$)

4. The radius of the base of cylinder is 20 cm and height is 30 cm, then find the curved surface area of cylinder. (Take $\pi = 3.14$)

5. The diameter of a cylinder is 28 cm and height is 10 cm. How much will be the curved surface area of this cylinder ?

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Example 3 : The diameter of a cylinderical chinmey of iron is 2 m and its height is 7 m. How much will be the cost of painting the chimney from outside at the rate of ₹ 160 per m² ?

Radius of chimney $r = \frac{d}{2} = \frac{2}{2} = 1$ m, height $h = 7$ m

Curved surface area of cylindrical chimney $= 2\pi rh$

$$= 2 \times \frac{22}{7} \times 1 \times 7 = 44 \text{ m}^2$$

Cost of painting 1 m² = ₹ 160

∴ Cost of painting 44 m² = 44 × 160 = ₹ 7040

The cost of painting the chimney from outside will be ₹ 7040.

Example 4 : The radius of cylinder having base is 7 cm and its height is 50 cm, then how much will be its area ?

Radius of base of cylinder $r = 7$ cm, Height of cylinder $h = 50$ cm

Here, base of cylinder is circular suface.

Area of base $= \pi r^2$

$$= \frac{22}{7} \times 7 \times 7 = 154 \text{ sq cm}$$

Curved surface area of cylinder $= 2\pi rh$

$$= 2 \times \frac{22}{7} \times 7 \times 50$$

$$= 2200 \text{ sq cm}$$

Curved surface area of cylinder with base

$=$ Area of base $+$ Curved surface area

$= 154 \text{ sq cm} + 2200 \text{ sq cm}$

$= 2354 \text{ sq cm}$

or

Second method :

Curved surface area of cylinder with base $= 2\pi rh + \pi r^2$

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

$$= \frac{22}{7} \times 7(2 \times 50 + 7)$$

$$= \frac{22}{7} \times 7(100 + 7)$$

$$= 22 \times 107$$

$$= 2354 \text{ cm}^2$$

∴ **Curved surface area of cylinder with base is 2354 cm².**

Example 5 : The diameter of a grain filling cylindrical tin with cap is 100 cm and its height is 2.5 m. Find the total surface area of this tin in sq cm. $(\pi = 3.14)$

Radius of cylinder $r = \dfrac{\text{diameter}}{2} = \dfrac{100}{2} = 50 \text{ cm} = 0.50 \text{ m}$

Height $h = 2.5 \text{ m}$
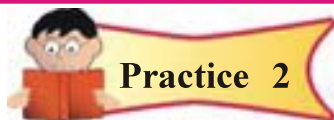
Total surface area of cylinder with cap $= 2\pi r(h + r)$

$$= 2 \times 3.14 \times 0.50 \,(2.5 + 0.50)$$

$$= 3.14 \times 3$$

$$= 9.42 \text{ sq m}$$

Total surface area of tin = 9.42 sq m

Practice 2

1. There is a cylindrical platform of 2 m radius 50 cm height in school playground. What will be the cost of white washing the curved surface of this platform at the rate of ₹ 1.25 per 100 sq cm. ($\pi = 3.14$)

2. The radius of a cylindrical tank of oil without cap is 1.40 m and height is 2.3 m. What will be the cost of painting this tank from outside at the rate of ₹ 160 per m ?

3. The length of a roller of levelling the soil is 91 cm and the radius of its circular part is 30 cm. This roller rolls 100 revolutions on the soil, then how much sq metre of soil is levelled ?

4. The diameter of base of a chimney of kiln is 80 cm and height is 12.5 m. What will be the cost of painting this chimney from outside at the rate of ₹ 140 per sq m ? ($\pi = 3.14$)

5. The radius of cylindrical tank with cap is 2.1 m and height is 2.9 m. Find its total surface area.

6. How much sq metre of sheet is required to make 50 cylinders of 20 cm height and diameter of 14 cm ? If cost of 1 sq m cost of sheet is ₹ 200 then how much will be expenditure ?

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● **Volume of cylinder :**

   ◆ The surface of one rupee coin is circular.

   ◆ By arranging coins on this rupee coin we get a pile of coin.
   If we see carefully the shape of this pile seems like a cylinder.

   ◆ The pile of coins occupies (covers) space on the surface of table, additionally occupied (covered) surface also covers space in the upper side. Therefore, the measure of space occupied by such cylinder in the space (universe) is called volume of cylinder.

   ◆ To find volume of cylinder we will have to multiply area of base and height. Cylinder also have equal shape from base to top. The base is circular.
   Therefore, Volume of cylinder = Area of base × height
   = Area of circle × height

- **Volume of cylinder = $\pi r^2 h$**

Keep in mind :

1 cubic metre	= 10,00,000 cubic cm	1 litre	= 1000 cubic cm
1 litre	= 1000 ml	1 cubic metre	= 1000 litre = 1 kilolitre
		1 cubic cm	= 1 ml

Example 6 : The radius of the base of a cylinder is 7 cm and height is 10 cm. Find volume of this cylinder.

Radius of cylinder r = 7 cm, Height of cylinder h = 10 cm

Volume of cylinder = $\pi r^2 h$

$$= \frac{22}{7} \times 7 \times 7 \times 10$$

$$= 1540 \text{ cm}^3$$

Volume of cylinder = 1540 cm³

Example 7 : The diameter of a rod of iron is 2 cm and height is 100 cm, find its volume. $(\pi = 3.14)$

Radius of rod $r = \frac{\text{diameter}}{2} = \frac{2}{2} = 1$ cm and height h = 100 cm

Volume of rod = $\pi r^2 h$

$$= 3.14 \times 1 \times 1 \times 100$$

$$= 314 \text{ cm}^3$$

$\therefore$ **Volume of iron rod = 314 cm³**

- **Practical problems based on volume of cylinder :**

Example 8 : The radius of a cylindrical tank of water is 35 cm and height is 1 m. How much maximum litres of water can be occupied by this tank ?

Radius of cylindrical tank r = 35 cm, height h = 1 m = 100 cm

Volume of cylindrical tank = $\pi r^2 h$

$$= \frac{22}{7} \times 35 \times 35 \times 100$$

$$= 3,85,000 \text{ cm}^3$$

$\therefore$ Volume of cylindrical tank = 3,85,000 cm³

1000 cm^3 = 1 litre

∴ 3,85,000 cm^3 = $\frac{385000}{1000}$ litre = 385 litre

Maximum 385 litres of water can be occupied by cylindrical tank.

Example 9 : The radius of base of a cylindrical tank is 50 cm and its height is 100 cm. This tank is fully filled with kerosene. How many cans of 5 litres can be filled from this tank ? (π = 3.14)

Solution : Radius of cylindrical tank r = 50 cm and height h = 100 cm

Radius of cylindrical tank = $\pi r^2 h$

= 3.14 × 50 × 50 × 100

= 7,85,000 cm^3

Volume of cylindrical tank = 7,85,000 cm^3

1000 cm^3 = 1 litre

∴ 7,85,000 cm^3 = $\frac{785000}{1000}$ litre = 785 litre

Number of cans filled in 5 litres = 1

∴ Number of cans filled in 785 litres = $\frac{785}{5}$ = 157

∴ **157 cans of kerosene will be filled.**

Practice 3

1. The radius of base of cylinder is 20 cm and height is 21 cm, then find its volume.

2. The diameter of the base of a cylinder is 80 cm and height is 50 cm, then find its volume. (π = 3.14)

3. What will be the cost of digging a well of radius 3.5 m and height 4 m at the rate of ₹ 100 per cubic metre ?

4. A cylinder of diameter 70 cm and height 80 cm is fully filled with medicine. If 25 ml medicine is filled in one bottle, then how much bottles will be filled from the medicine of this cylinder ?

5. The radius of the base of a cylindrical tank is 25 cm. It is filled with milk upto 2 m height. How many bags of 500 ml can be filled from this milk ? (π = 3.14)

6. The radius of base of a metallic cylinder is 14 cm and height is 10 cm. If the weight of 1 cm^3 metal is 8 gm, then find total weight of the metal.

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● **What did you learn ?**

● Curved surface area of a cylinder = $2\pi rh$

● Total surface area of an open cylinder with base = $\pi r(2h + r)$

● Total surface area of closed cylinder = $2\pi r(h + r)$

● Volume of a cylinder = $\pi r^2 h$

Exercise

1. The diameter of a cylindrical tin is 80 cm and height is 1.5 m. How many square metre will be its curved surface area ? ($\pi = 3.14$)

2. The radius of a water filling cylindrical tank without cover is 1.4 m and height is 2 m. Find total surface area of this tin.

3. The base diameter of a closed cylinder is 3.6 cm and height is 8.2 cm, then find its total surface area. ($\pi = 3.14$)

4. How much sheet is required to prepare 50 open cylinders of height 15 cm and diameter 4 cm ? What Will be the total cost at the rate ₹ 20 for 100 sq cm sheet ? ($\pi = 3.14$)

5. What will be the labour cost of digging a well of radius 3.5 m and weight 10 at the rate of ₹ 60 per cubic metre ?

6. The radius of a cylindrical tank of Municipality is 7 m and height is 4 m. How much kilolitre of water can be occupied in the tank ?

7. The diameter of a cylinder is 20 cm. If its height is equal to its radius, then find its volume ? ($\pi = 3.14$)

👉 **Answers** 👈

Practice 1

1. 440 cm^2　　　　2. 880 cm^2　　　　3. 3140 cm^2

4. 3768 cm^2　　　　5. 880 cm^2

Practice 2

1. ₹ 7850　　　　2. ₹ 4224　　　　3. 171.6 m^2

4. ₹ 4396　　　　5. 66 m^2　　　　6. 4.4 m^2, ₹ 880

Practice 3

1. 26400 cm^3　　　　2. 251200 cm^3　　　　3. ₹ 15400
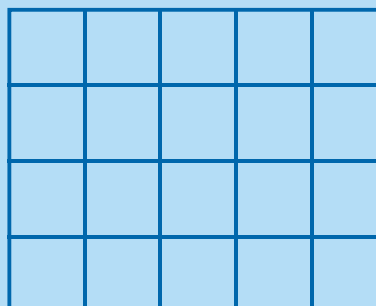
4. 12320 bottles　　　　5. 785 bags　　　　6. 49.280 kilogram

Exercise

1. 3.768 m^2　　　　2. 23.76 m^2　　　　3. 113.04 cm^2

4. 9420 cm^2, ₹ 1884　　　　5. ₹ 23,100　　　　6. 616 kilolitre

7. 3140 cm^3

Learn something special :

♦　How many total squares are there in this rectangle ?

Here a rectangle of size 5 × 4 is given.

∴　Number of squares = (5 × 4) + (4 × 3) + (3 × 2) + (2 × 1)

　　　　　　　　= 20 + 12 + 6 + 2

　　　　　　　　= 40