Obtain the Formula For the Surface Area Of a Sphere

Objective

To obtain the formula for the surface area of a sphere.

Materials Required

1. Cardboard/Wooden strips
2. Thick sheet of paper
3. Ruler
4. String
5. Measuring tape
6. Adhesive
7. A ball
8. Scissors/Cutter
9. A pin

Prerequisite Knowledge

1. Basic knowledge about shape of a sphere.
2. Basic concept of a circle and its area.

Theory

1. A sphere is three dimensional figure (solid figure) which is made up of all points in the space, which lie at constant distance, from a fixed point called the centre of the sphere and the constant distance is called its radius, (see Fig. 31.1)
   A line segment through the centre of a sphere and with the end p' into on the sphere is called a diameter of the sphere, (see Fig. 31.1)

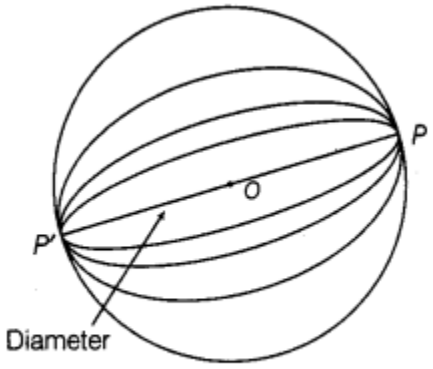

Fig. 31.1

2. For concept of circle refer to Activity 23.
   Area of a circle = πr^2

Procedure

1. Take a spherical ball and by placing it between two vertical boards or wooden strips, find its diameter (d). (see Fig. 31.2)

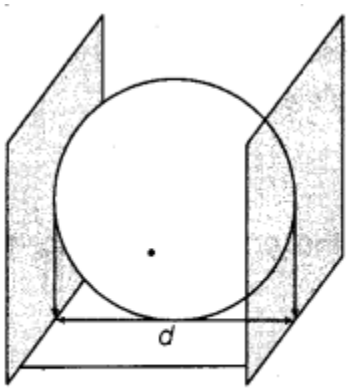

Fig. 31.2

2. Mark the topmost part of ball and fixing a pin. (see Fig. 31.3)

3. Wrap the ball (spirally) with string completely, by taking support of pin such that no space is left uncovered, (see Fig. 31.3)

4. Mark the starting and ending points on the string (for accuracy, it should be thinner) measure the length between these two marks and denoted by l.

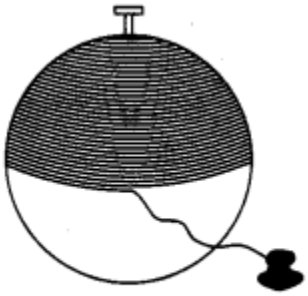

Fig. 31.3

5. Now, unwind the string from the ball.

6. Draw four circles on the thick sheet of paper with radius equal to the radius of the ball, i.e. r.

7. Now, fill the circles one-by-one with string which wound around the ball, (see Fig. 31.4)

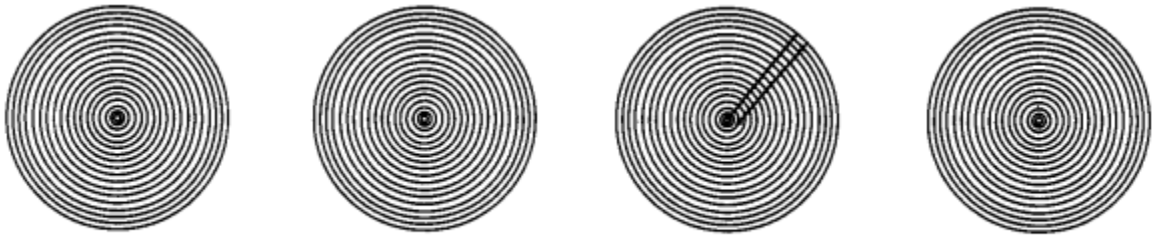

Fig. 31.4

Demonstration

Let the length of string which covers a circle (radius r) is denoted by a.
The string which had completely covered the surface area of the ball, has been used completely to fill the region of four circles. This conclude that
Length of string needed to cover sphere of radius r = 4 x (Length of string needed to cover one circle)
i.e. Surface area of sphere = 4 x Area of circle of radius r
Surface area of sphere = $4\pi r^2$

Observation

Diameter (d) of the spherical ball = …….. units
Radius (r) = …….. units
Length of string / used to cover ball = ……. units
Length of string a used to cover one circle = …….. units
Hence, l = 4 x ……
Surface area of a sphere of radius, (r) = 4 x Area of a circle of radius = $4\pi r^2$

Result

We have verified the formula for the surface area of sphere experimentally.
Note:

1. Measure the diameter of ball carefully.
2. Wrap the ball completely so that no space is left uncovered.
3. Thinner the string more is the accuracy.

Application

This activity is useful in finding the cost of painting, repairing, constructing spherical and hemispherical objects.

Viva-Voce

Question 1.
What is the formula for finding the surface area of a sphere having radius r units?
Answer:
$4\pi r^2$

Question 2.
Is a circle an another name of a sphere?
Answer:
No

Question 3.
What do you mean by a hemisphere?
Answer:
The equal half part of sphere is called a hemisphere.

Question 4.
Can we take a disk as an example of a sphere?
Answer:
No

Question 5.
Is sphere a two dimensional figure?
Answer:
No, sphere is a three dimensional figure.

Question 6.
Are the total surface area and curved surface area of a sphere equal?
Answer:
Yes

Suggested Activity

By using this activity, calculate the surface area of sphere of radius 10.5 cm.