Volume of a Sphere

Objective
To find the formula for the volume of a sphere with the help of an activity.

Prerequisite Knowledge
Volume of a cylinder = $\pi r^2 h$

Materials Required
A hollow hemispherical plastic ball, a cylinder with diameter and height both equal to the diameter of hemisphere, sand.

Procedure

1. Take a hollow hemisphere and fill it with sand and empty it into the cylinder.fig, (i).

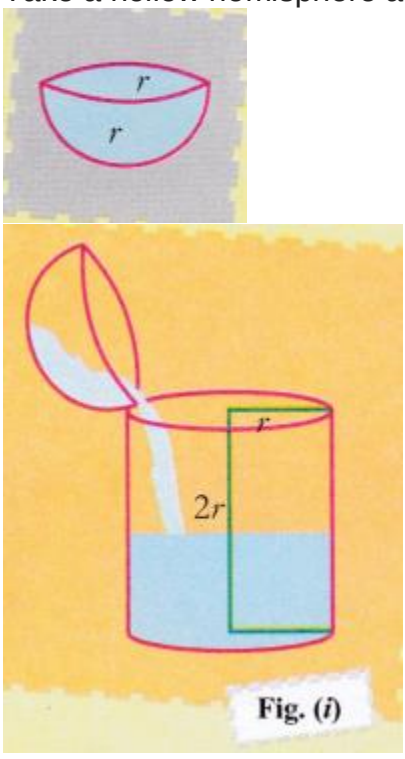
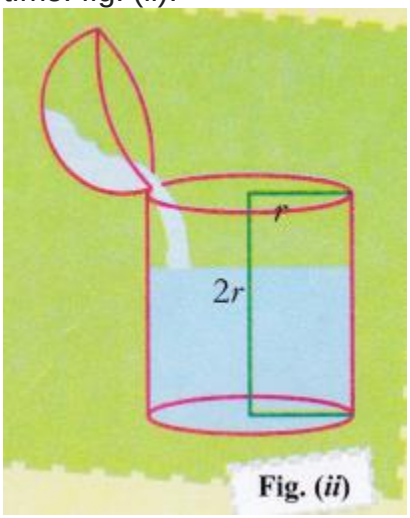
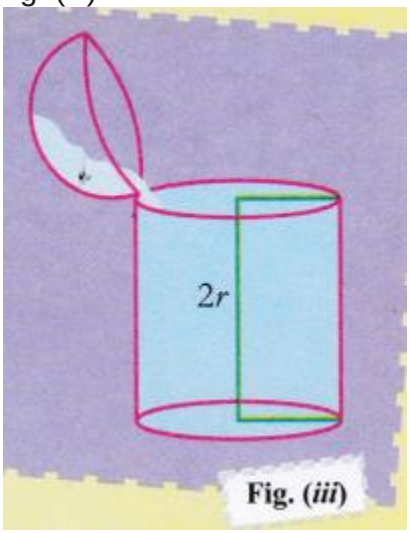


Fig. (*i*)

2. Again fill the hemisphere with sand and empty it into the same cylinder second time. fig. (ii).



3. Again fill the hemisphere with sand and empty it into the same cylinder third time., fig. (iii).



Observation

We observe that the cylinder is completely filled up by pouring sand three times through hemispherical ball.

∴3 x Volume of hemisphere = Volume of cylinder with radius r and height 2r

∴3 x Volume of hemisphere = $\pi r^2(2r) = 2\pi r^3$

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

∴ Volume of sphere = 2 x $\frac{2\pi r^3}{3}$ = $\frac{4\pi r^3}{3}$

Result

Volume of a sphere = $\frac{4\pi r^3}{3}$ (verified experimentally).

Learning Outcome

Smdents arrive at the formula for the volume of a sphere and they are able to relate it with the volume of a cylinder.

Volume of a sphere = volume of a cylinder.

$\Rightarrow \frac{4\pi r^3}{3} = \pi r^2 h$ (if they have same radius and volume)

$\therefore h = \frac{4}{3} r$

Activity Time

If the radius of the sphere is tripled, then what will be the effect on its volume ? Verify it by an activity.

Viva Voce

Question 1.

What is the formula for volume of a hemisphere ?

Answer:

$\frac{2\pi r^3}{3}$, where r = radius of hemisphere

Question 2.

If the number of square centimetres on the surface of a sphere is equal to the number of cubic centimetres in its volume. What is the radius of the sphere ?

Answer:

3 cm

Question 3.

What is the volume of a sphere ?

Answer:

$\frac{4\pi r^3}{3}$, where r is the radius of the sphere

Question 4.

How many balls each of radius 1 cm can be made from a solid sphere of lead of radius 8 cm ?

Answer:

512 balls

Question 5.

Metallic spheres of radii 3 cm, 4 cm and 5 cm respectively are melted to form a single solid sphere. Find the radius of the resulting sphere.

Answer:

6 cm

Question 6.
What is the ratio of the volume of a cube to that of a sphere which will exacdy fit inside the cube ?
Answer:
6 : π

Question 7.
What is the ratio of the volume of a sphere to that of a cone whose height and radius of base are same as radius of the sphere ?
Answer:
4:1

Question 8.
What is the ratio of the volume of a hemisphere to that of a sphere of same radius?
Answer:
1:2

Multiple Choice Questions

Question 1.
What is the ratio of the volume of a cube to that of a sphere which will exactly fit inside the cube ?
(a) 6 : π
(b) π : 6
(c) π : 3
(d) 3 : π

Question 2.
The largest sphere is carved out of a cube of side 7 cm. The volume of the sphere is
(a) 179.5 cm^3
(b) 197.5 cm^3
(c) 791.5 cm^3
(d) 971.5 cm^3

Question 3.
If the surface area of a sphere is 616 cm^3, then its volume is
(a) 1473.3 cm^3
(b) 1437.3 cm^3
(c) 1743.3 cm^3
(d) none of these

Question 4.
How many litres of milk can a hemispherical bowl of a diameter 10.5 cm hold ?
(a) 0.309 l

(b) 0.330 l
(c) 0.303 l
(d) 0.003 l

Question 5.
Find the volume of a sphere of radius 0.63 m.
(a) 1.05 m^3
(b) 2.05 m^3
(c) 3.05 m^3
(d) none of these

Question 6.
How many lead balls each of 3 cm radius can be made from a sphere of radius 12 cm ?
(a) 62
(b) 64
(c) 63
(d) 61

Question 7.
A hemispherical bowl has a radius of 3.5 cm. What would be the volume of water it would contain ?
(a) 64 cm^3
(b) 63 cm^3
(c) 62 cm^3
(d) none of these

Question 8.
A metallic sphere of diameter 21 cm is melted and recast into a number of smaller cones each of diameter 7 cm and height 3 cm. Find the number of cones so formed.
(a) 162
(b) 126
(c) 612
(d) 621

Question 9.
The diameter of a sphere is 42 cm. It is melted and drawn into a cylindrical wire of diameter 28 cm. Find the length of the wire.
(a) 63 cm
(b) 61cm
(c) 64 cm
(d) 60 cm

Question 10.
The diameter of the moon is approximately one-fourth the diameter of the earth. What

fraction of the volume of the earth is the volume of the moon ?
(a) 1 : 64
(b) 64 : 1
(c) 1 : 1
(d) none of these

Answers

1. (a)
2. (a)
3. (b)
4. (c)
5. (a)
6. (a)
7. (d)
8. (a)
9. (a)
10. (a)