

This approximation for A gets better and better as the layer of rubber gets thinner and thinner. As r gets near zero, the last two terms in the formula above also get near zero. The limiting result is the formula

$$A = 4\pi r^2.$$

This is exactly what we would expect, since the surface area of a ball clearly does not depend at all on the thickness of the rubber, but only on the size of the radius.

Classroom Exercises

Copy and complete the table for spheres.

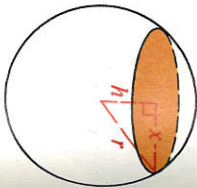
Radius	1	2	4	?	?	?
Area	?	?	?	36π	100π	?
Volume	?	?	?	?	?	$\frac{4000\pi}{3}$

A plane passes h cm from the center of a sphere with radius r cm. Find the area of the circle of intersection, shaded in the diagram, for the given values.

7. $r = 5$
 $h = 3$

8. $r = 17$
 $h = 8$

9. $r = 7$
 $h = 6$



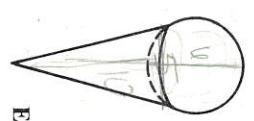
Written Exercises

Copy and complete the table for spheres.

Radius	3	5	$\frac{1}{2}$	$\frac{3}{4}$?	?	$\sqrt{2}$?
Area	?	?	?	?	64π	324π	?	?
Volume	?	?	?	?	?	?	?	288π

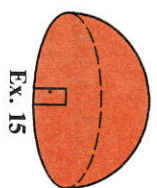
- If you double the radius of a sphere, the area of the sphere is multiplied by $\frac{?}{?}$ and the volume is multiplied by $\frac{?}{?}$.
- If you triple the radius of a sphere, the area of the sphere is multiplied by $\frac{?}{?}$ and the volume is multiplied by $\frac{?}{?}$.
- Find the area of the circle formed when a plane passes 2 cm from the center of a sphere with radius 5 cm.

- Find the area of the circle formed when a plane passes 7 cm from the center of a sphere with radius 8 cm.
- A sphere has radius 2 and a hemisphere has radius 4. Compare their volumes.
- A scoop of ice cream with diameter 6 cm is placed in an ice-cream cone with diameter 5 cm and height 10 cm. Is the cone big enough to hold all the ice cream if it melts?



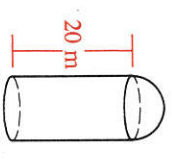
Ex. 14

- An experimental one-room house is a hemisphere with a floor. If three cans of paint are needed to cover the floor, how many cans will be needed to paint the ceiling? (Ignore door and windows.)

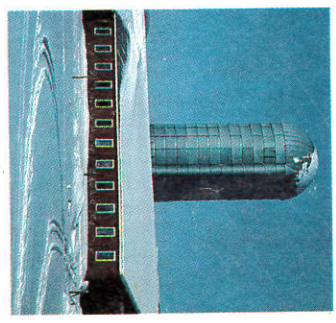


Ex. 15

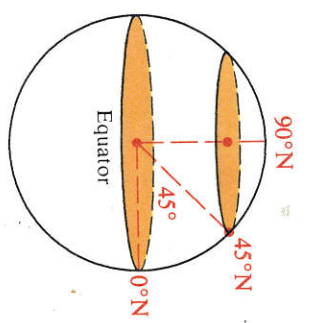
- A silo of a barn consists of a cylinder capped by a hemisphere as shown. Find the volume of the silo.
- Two cans of paint cover the hemispherical dome of the silo shown. Approximately how many cans are needed to paint the rest of the silo's exterior?



Exs. 16, 17



- A hemispheric bowl with radius 25 contains water whose depth is 10. What is the area of the water's surface?
- The circle containing points midway between the Earth's equator and the North Pole is at latitude 45°N . What is the ratio of the area of this circle to the area of the circle at the equator?



- A metal ball with radius 8 cm is melted down and recast as a cone with the same radius. What is the height of the cone?

$A = 4\pi r^2$
 $V = \frac{4}{3}\pi r^3$

- Four metal balls fit snugly inside a cylindrical can. A geometry student claims that two extra balls of the same size can be put into the can, provided all six balls can be melted down and the molten liquid poured into the can. Is the student correct? (*Hint:* Let the radius of the balls be r .)

