# Volume of Spheres

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### _Sphere_



Radius (r)
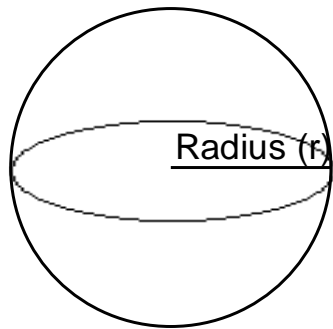
$$V = \frac{4 \pi r^3}{3}$$

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**_Example 1:_** Determine the volume of this sphere in ft$^3$.

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

$$= \frac{4 \pi (2)^3}{3}$$

$$= 33.5 \, ft^3$$

2 ft
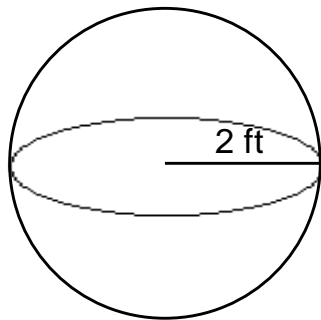
**_Example 2:_** Determine the volume of this basketball if the diameter is 30cm.

$$r = \frac{30}{2} = 15cm$$

$$V = \frac{4 \pi (15)^3}{3}$$

$$\approx 14137.2 \, cm^3$$

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**_Example 3:_** A soup bowl is in the shape of a hemi-sphere (half sphere). If the bowl is filled to the rim, and has a diameter of 6.5in, how much soup is there?

$$r = 6.5 \div 2 = 3.25 in$$

$$V = \frac{4 \pi r^3}{3} \div 2$$
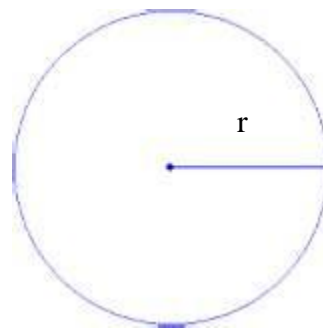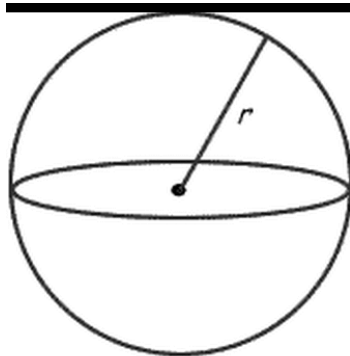
$$= \frac{4 \pi (3.25)^3}{3} \div 2$$

$$= 71.9 \, in^3$$

# Surface Area of Spheres

The surface area of a sphere is **four** times the surface area of one cross section through the centre of the sphere.

A= 4 πr$^2$

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



*Example 1:* Determine the surface area of the basketball if the diameter is 30cm.



$$r = \frac{30}{2} = 15$$

$$A = 4\pi r^2$$
$$= 4\pi (15)^2$$
$$= 2827.4 \ cm^2$$

*Example2:* This foam piece is in the shape of a hemisphere. You plan to paint the entire outer surface. Calculate the surface area if the radius of the circle base is 2.5cm.
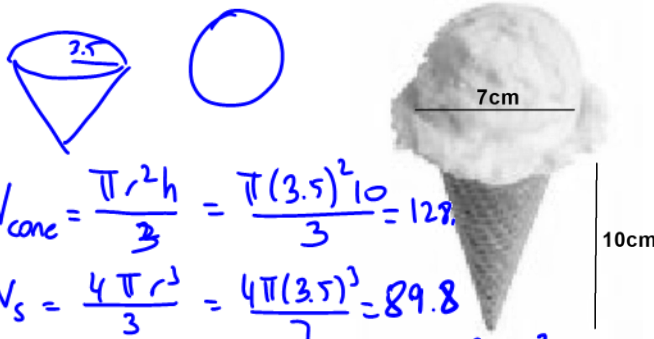


$$A = 4\pi r^2 \div 2$$
$$= 4\pi (2.5)^2 \div 2$$
$$= 39.3 \ cm^2$$

# Composite Volume of Prisms, Pyramids, Cylinders, Cones, and Spheres

Composite shapes are shapes that don't have a 'unique' name, but they are made up of other shapes we are familiar with. An icecream for example, is a cone with a hemisphere.

| | |
|---|---|
| a. How much icecream is here, assuming the cone is filled with icecream? | b. How much air is inside this empty house, which is made up of a rectangular prism base and a triangular prism roof? |

**a.** (with diagram, 7.5, 7cm, 10cm)
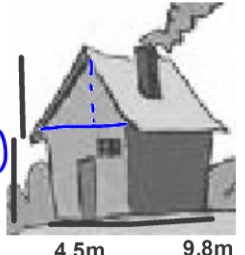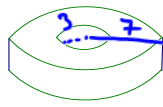
$V_{cone} = \dfrac{\pi r^2 h}{3} = \dfrac{\pi (3.5)^2 10}{3} = 128$

$V_s = \dfrac{4\pi r^3}{3} = \dfrac{4\pi (3.5)^3}{3} = 89.8$

$V_{Total} = 218.08 \text{ cm}^3$

**b.**

$V_{house} + V_{roof}$

$= (2.4)(4.5)(9.8) + \dfrac{(2.4)(4.5)(9.8)}{2}$

$= 105.84 + 52.92$

$= 158.76 m^3$

(house diagram: 2.4m, 4.5m, 9.8m, 4, 4.5)

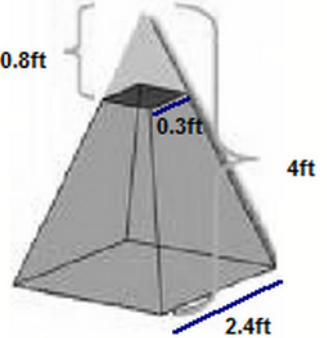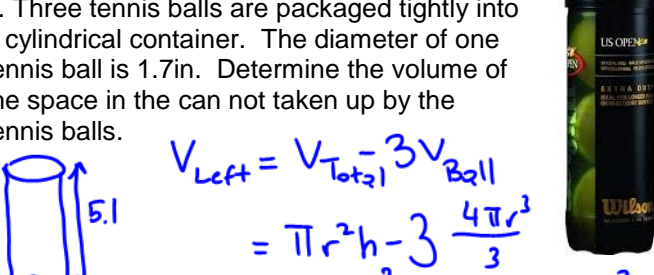| | |
|---|---|
| c. Pineapple can be bought in sliced rings that look like the sketch provided. If the outer ring has a radius of 7cm and the inner ring has a radius of 3cm, where the height is 1cm in both cases, find the **volume** of this pineapple slice. | d. The following shape is called a frustrum. It is a square-based pyramid with the tip cut off. Find the volume of the frustrum. |

**c.** (diagram: 3, 7)

$V_p = V_o - V_i$

$= \pi r_o^2 h - \pi r_i^2 h$

$= \pi (7)^2 (1) - \pi (3)^2 (1)$

$= 49\pi - 9\pi$

$= 40\pi = 125.7 \text{ cm}^3$

**d.** (diagram: 0.8ft, 0.3ft, 4ft, 2.4ft)

$V_F = V_T - V_{Tip}$

$= \dfrac{(2.4)^2 4}{3} - \dfrac{(0.3)^2 0.8}{3}$

$= 7.68 - 0.024$

$= 7.7 \text{ ft}^3$

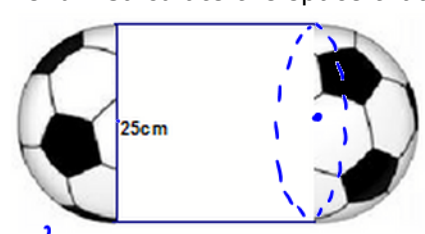| | |
|---|---|
| e. Three tennis balls are packaged tightly into a cylindrical container. The diameter of one tennis ball is 1.7in. Determine the volume of the space in the can not taken up by the tennis balls. | f. A shipping tube that ships 3-packs of soccerballs is made from a cylindrical center with a hemisphere at each end. Calculate the space that is inside the container. *watch for the units |

**e.** (diagram: 5.1, 0.85)

$V_{Left} = V_{Total} - 3V_{Ball}$

$= \pi r^2 h - 3\dfrac{4\pi r^3}{3}$

$= \pi (0.85)^2 (5.1) - 4\pi (0.85)^3$

$= 11.6 - 7.7$

$= 3.9 \text{ in}^3$
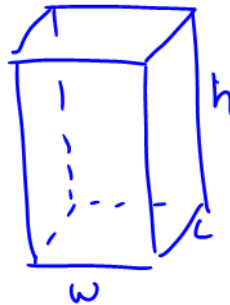
**f.** (diagram: 25cm, 0.8m = 80cm)

$V_T = V_{ball} + V_{cyl}$
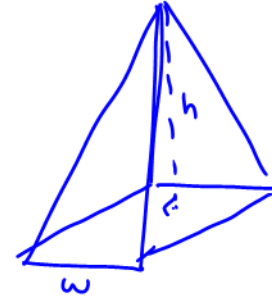
$= \dfrac{4\pi (12.5)^3}{3} + \pi (12.5)^2 .80$

$= 8181.23 + 39269.91$

$= 47451.1 \text{ cm}^3$

ANSWERS: a. ~~307.7cm³~~ **218.08cm³**, b. 158.76m³, c. 125.6cm³, d. 7.7ft³, e. 3.9in³, f. ~~47,427cm³~~ **47,451.1cm³**

h. A rectangular prism has a volume of $603cm^3$. If a rectangular pyramid has the same base and height as this prism, calculate the volume of the pyramid.

$V = 603$

$V = \dfrac{603}{3}$

$= 201 cm^3$

i. A rectangular prism has a volume of $73.6m^3$. If the length is 8m, the width is 4m, what is the height?

$V = L \cdot w \cdot h$

$73.6 = 8 \cdot 4 \cdot h$

$\dfrac{73.6}{32} = \dfrac{32h}{32}$

$h = 2.3 cm$

j. A cylinder has a volume of $2009.6cm^3$. If the radius is 8cm, find the height of this cylinder.

$V_c = \pi r^2 h$

$2009.6 = \pi (8)^2 h$

$\dfrac{2009.6}{201.1} = \dfrac{201.1 h}{201.1}$

$10 cm \doteq h$

ANSWERS: g. $12.6cm^3$, h. $201cm^3$, i. 2.3m, j. 10cm