CHAPTER 10: SURFACE AREA AND VOLUME

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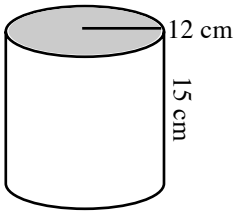
MATH NOTES

VOLUME OF A CYLINDER

The volume of a cylinder can be calculated in exactly the same way as the volume of a prism. First divide the cylinder into layers that are each one unit high. Then, to calculate the total volume, multiply the volume of one layer by the number of layers it takes to fill the shape.

The volume of a cylinder can also be calculated by multiplying the area of the base (B) by the height (h).



Volume = (area of base)(height)

$$V = Bh = (r^2\pi)(h)$$

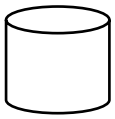
For example, for the cylinder at right:

Area of the base: $B = (12)^2\pi = 144\pi$ cm^2

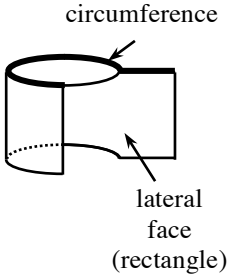
Volume: $V = 144\pi(15) = 2160\pi \approx 6785.84$ cm^3

SURFACE AREA OF A CYLINDER

A **cylinder** has two congruent, circular bases. The **lateral surface** of the cylinder, when opened flat, forms a rectangle with a height equal to the height of the cylinder and a width equal to the circumference of the cylinder's base.



The surface area of a cylinder is the sum of the two base areas and the lateral surface area. The formula for the surface area is:

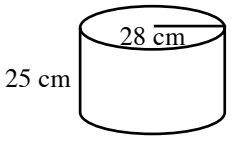


$$SA = 2r^2\pi + \pi dh$$

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

where r = radius, d = diameter, and h = height of the cylinder.

For example, to find the surface area of the cylinder below:



Area of the two circular bases:
$2(28 \text{ cm})^2\pi = 1568\pi$ cm^2

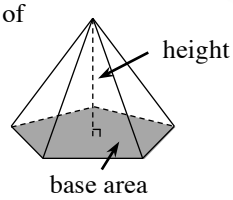
Area of the lateral face:
$\pi(56)(25) = 1400\pi$ cm^2

Total surface area = 1568π cm^2 + 1400π cm^2 = 2968π cm^2
≈ 9324.25 cm^2

VOLUME OF A PYRAMID AND A CONE

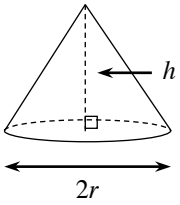
In general, the **volume of a pyramid** is one third of the volume of the prism with the same base area and height. Thus:

$$V = \frac{1}{3}(\text{base area})(\text{height})$$



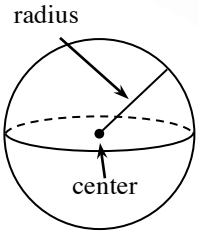
The **volume of a cone** is one third of the volume of the cylinder with the same radius and height. Therefore, the volume of a cone can be found using the formula shown below, where r is the radius of the base and h is the height of the cone.

$$V = \frac{1}{3}(\text{base area})(\text{height}) = \frac{1}{3}\pi r^2 h$$



VOLUME OF A SPHERE

A **sphere** is formed by a set of points that are equidistant from a fixed point, its center. It is three-dimensional.



The volume of a sphere is twice the volume of a cone with the same radius and height. Since the volume of a cone with radius r and height $2r$ is $V = \frac{1}{3}\pi r^2(2r) = \frac{2}{3}\pi r^3$, the volume of a sphere with radius r is:

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

Notes: