§13.3 Volumes of Solid Shapes.

Volume - the amount of space *inside* a solid shape.

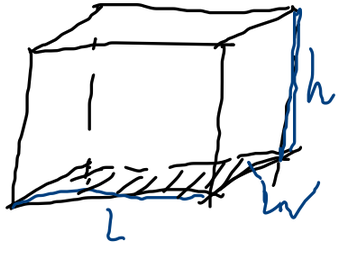
Area: Amt of space in 2-D.

↓

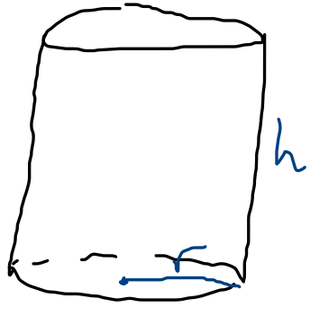
Volume: Amt of space in 3-D

What is the general formula for volume of a Prism and Cylinder?

Prism.



Cylinder.

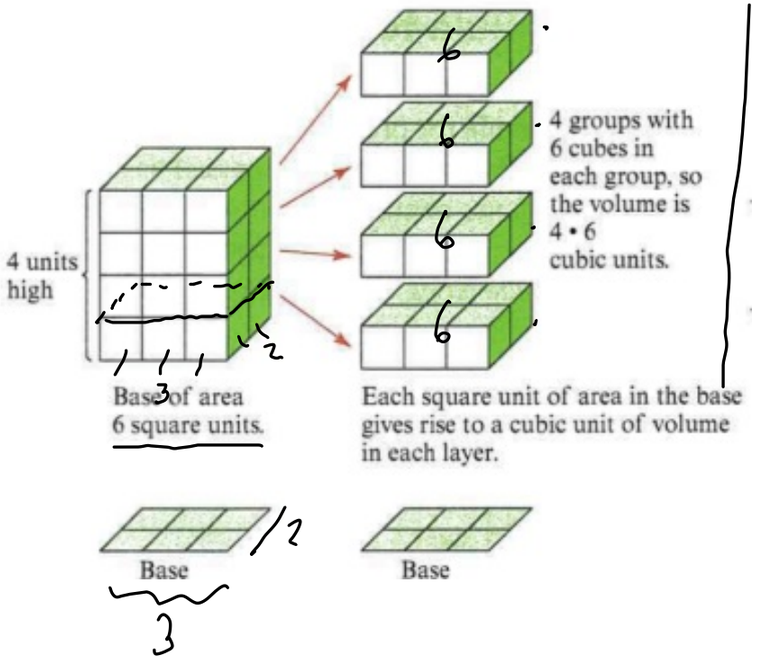


for a Prism $V = L \times W \times h$.

$$V = (\text{Area of base}) \cdot h.$$

Cylinder: $V = (\text{Area of base}) \times h = \pi r^2 h.$

Pg 600, Figure 13.32.



4 layers of the base.

Area of base = 6 units.

Volume: $6 * 4 = \boxed{24 \text{ units}^3}$

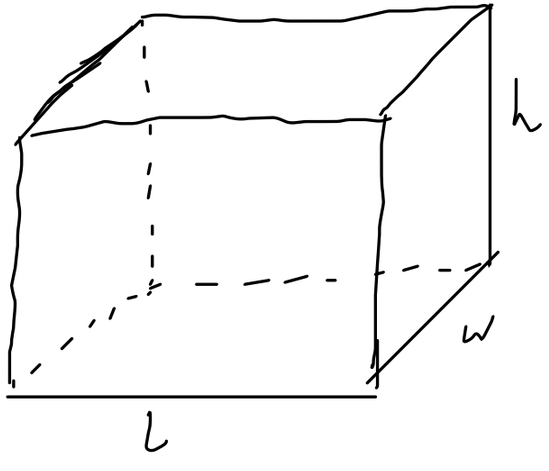
How does Cavalieri's Principle apply to Volume?

For 2-D Shapes.

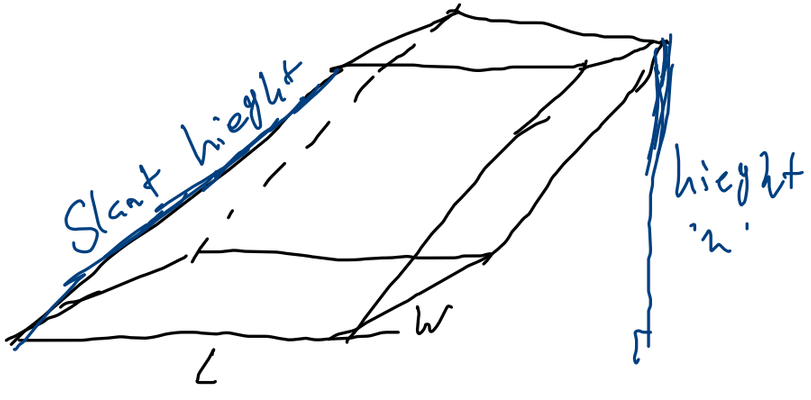
Does NOT Change AREA (and hight) but Perimeter does Change.

For 3-D Shapes.

Does NOT Change VOLUME but the Surface Area does Change.

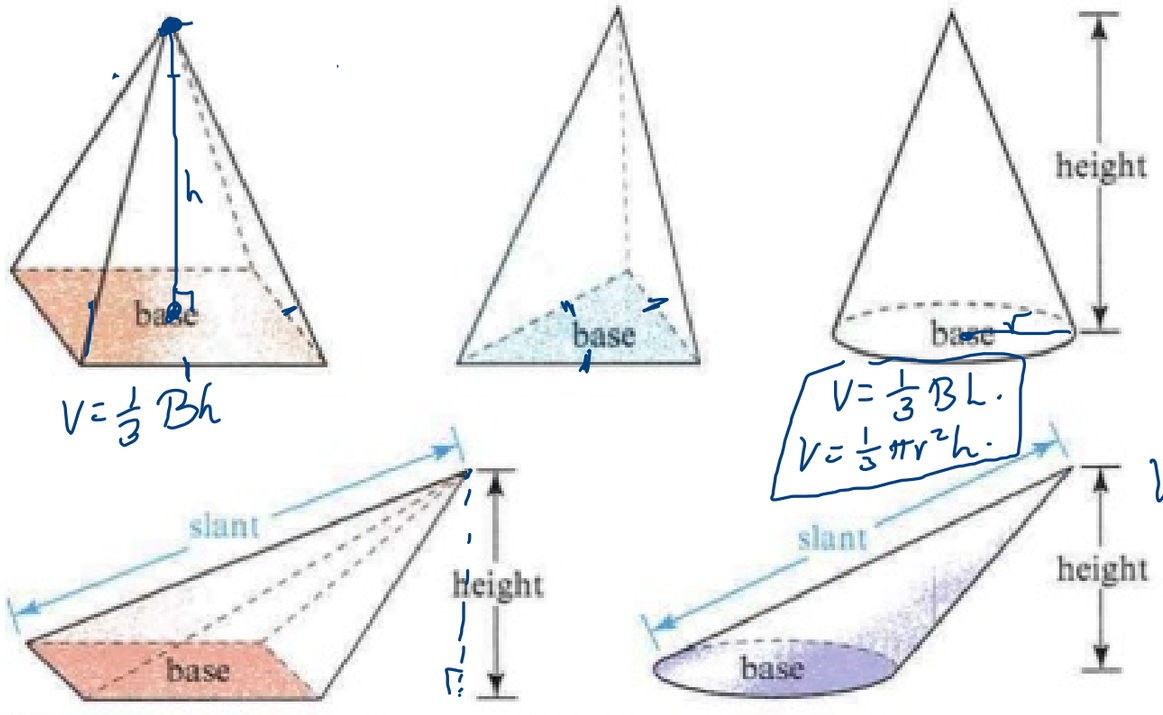


Shear it
Push it right



Pyramids and Cones.

B: Area of base



$V = \frac{1}{3}Bh$

$V = \frac{1}{3}BL$.

$V = \frac{1}{3}\pi r^2 h$.

Figure 13.33 The base and height of a pyramid or cone.

Basically, it takes up 1/3 of space in a Prism.

From video 3:1 ratio for Volume, Pyramid to Prism.

$$\frac{3}{3}V = \frac{(\text{Area of base}) \cdot h}{3}$$

$$V = \frac{1}{3}(\text{Area of base})h.$$

Volume of

Pyramid	Cone
$V = \frac{1}{3}B \cdot h$	$V = \frac{1}{3}B \cdot h$
	$= \frac{1}{3}\pi r^2 h$

Same case for cone.

Quick Example: Determine the volume of a cone with radius of 3 cm and height 5 cm.

$$V = \frac{1}{3}\pi r^2 h.$$

$$= \frac{1}{3} \cdot \pi \cdot (3\text{ cm})^2 (5\text{ cm})$$

$$= \frac{1}{3}\pi (9\ \underline{\text{cm}^2})(5\ \underline{\text{cm}})$$

$$= \frac{1}{3}\pi\, 45\ \text{cm}^3$$

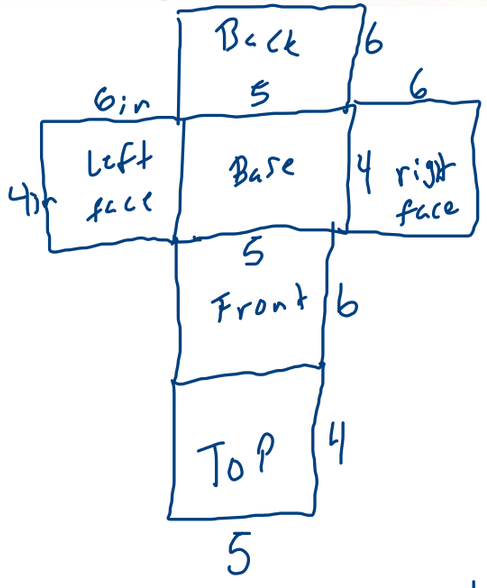
$$= 15\pi\ \boxed{\text{cm}^3}\ *$$

$$\approx 47.12\ \underline{\text{cm}^3}$$

Pg 604 Problem 2.

2. **a.** Students are sometimes confused about the difference between the *surface area* and the *volume* of a box. Explain the two concepts in a way that could help students learn to distinguish between them.

b. Determine the surface area and the volume of a closed box that is 5 in. wide, 4 in. deep, and 6 in. tall. Explain in detail why you calculate as you do. 148 in^2; 120 in^3.



Volume

$V = (5 \times 4) \cdot 6$.

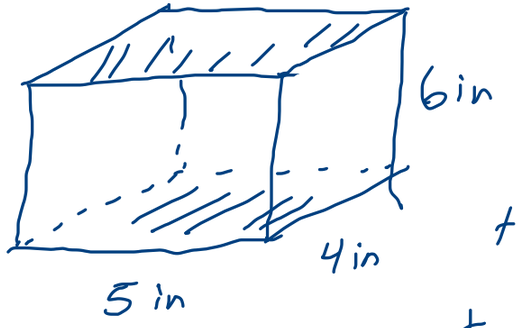
$V = (20)\,6$

$V = 120\ in^3$

2a) · Surface area measures the area of faces outside the box

· Volume measure amt of space inside the box.

b)



SA:

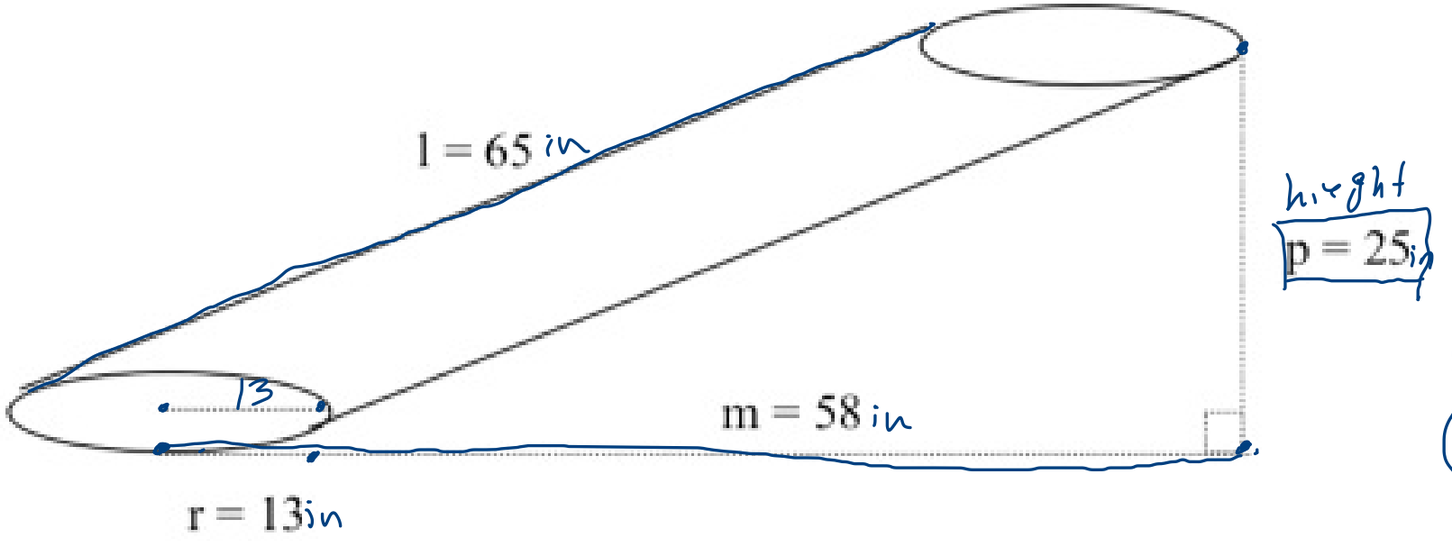
Area Top + Area Bottom + Area of left + Area of right + Area of Front and back.

↳ 2 Area top + 2 Area left + 2 Area front.

$2(5)(4) + 2(4)(6) + 2(5)(6)$

$= 148\ in^2$

10. a) Find the Volume of the oblique circular cylinder shown below. State the Volume formula.



height
p = 25in

$V = \pi r^2 h.$

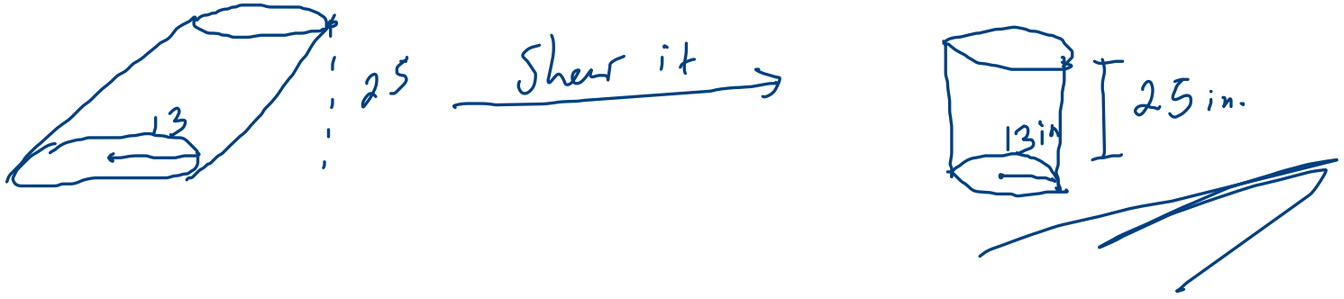
$V = \pi (13)^2 (25)$

$V = \pi (169)(25)$

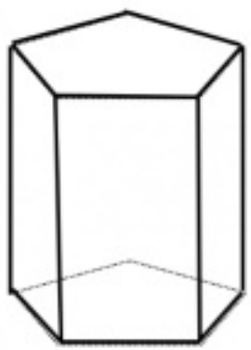
$V = 4225\pi \text{ in}^3$

$V = 13,273.22 \text{ in}^3.$

b) Using Cavalieri's Principle, shear the oblique circular cylinder shown above into a right circular cylinder. Draw the sheared cylinder in the space next to it, labeling its radius and height. [4p]



11. The pyramid and the prism as shown are "matching", that is, they share the same base and height. The volume of the pyramid is 270 cm^3. Find the volume of the prism. Hint: Recall the basic volume relationship between the two shapes. (5p)



$V = 270\ cm^3$

$V = 3(270\ cm^3)$

$V = 810\ cm^3$

* Pyramid and Prisms have a 3:1 ratio for their Volumes.

§13.4 Volume of Submerged objects and Weight of floating.

Archimedes Principle

(1) A non Porous object that Sinks displaces an amount of water that is equal to the volume of the Submerged object.

Example.

A non-Porous rock Sinks to the bottom of a beaker of water, as a result it displaces 5 cm^3 of water. What is the volume of the rock?

Ans: 5 cm^3

2nd Principle: A non-Porous object that floats displaces an amt of water. is equal to the wieght of the floating object. Fact: 1 cm^3 of water = 1 gram.

EX) When a turtle jumps into a tank, it floats and displaces 1045 cm^3 of water. What is the wieght of the turtle in Pounds? (1 cm^3 = 1 g, 454 g = 1 lb)

$$1045\,cm^3 = 1045\,g * \frac{1\,lb}{454\,g} = \frac{1045}{454}\,lb = 2.3\,lb$$