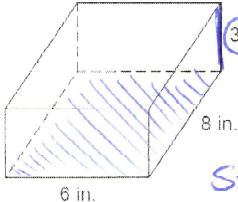


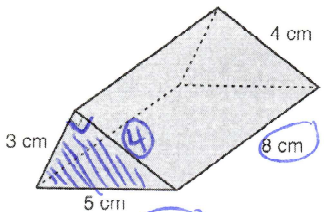
Level 1

$p = \text{perimeter of base}$, $B = \text{area of base}$

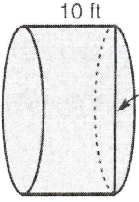
1. Find the Surface Area and Volume for each figure below.

a.  $p = 6 + 8 + 6 + 8 = 28 \text{ in}$
 $B = 6 \cdot 8 = 48 \text{ in}^2$
 $SA = p \cdot h + 2B = 28 \cdot 3 + 2 \cdot 48 = 84 + 96 = 180$
 $Vol = B \cdot h = 48 \cdot 3 = 144 \text{ in}^3$

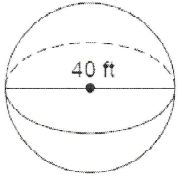
Surface Area 180 in²
 Volume 144 in³

b.  $V = B \cdot h = 6 \cdot 8 = 48$
 $p = 3 + 4 + 5 = 12$
 $B = \frac{1}{2} \cdot b \cdot h = \frac{1}{2} \cdot 3 \cdot 4 = 6$
 $SA = p \cdot h + 2B = 12 \cdot 8 + 2 \cdot 6 = 96 + 12 = 108$

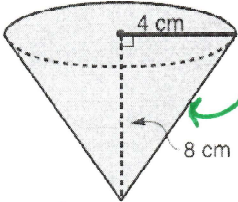
Surface Area 108 cm²
 Volume 48 cm³

c.  $d = 20$, $r = 10$
 $SA = \pi \cdot d \cdot h + 2\pi r^2 = \pi \cdot 20 \cdot 10 + 2 \cdot \pi \cdot 10^2 = 200\pi + 200\pi = 400\pi \text{ ft}^2$
 $Vol = \pi \cdot r^2 \cdot h = \pi \cdot 10^2 \cdot 10 = 1000\pi \text{ ft}^3$

Surface Area 400π ft²
 Volume 1000π ft³

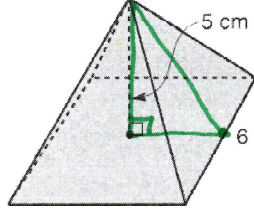
d.  $SA = 4\pi r^2 = 4 \cdot \pi \cdot 20^2 = 4 \cdot \pi \cdot 400 = 1600\pi \text{ ft}^2$
 $Vol = \frac{4}{3} \cdot \pi \cdot 20^3 = \frac{4}{3} \cdot \pi \cdot 8000 = 10,666.\bar{6}\pi \text{ ft}^3$

Surface Area 1600π ft²
 Volume 10,666.6π ft³

e.  $4^2 + 8^2 = x^2$
 $16 + 64 = x^2$
 $\sqrt{80} = x$
 $8.9 = x$
 $SA = \pi r L + \pi r^2 = \pi \cdot 4(8.9) + \pi \cdot 4^2 = 35.6\pi + 16\pi = 51.6\pi \text{ cm}^2$

Surface Area 51.6 cm²
 Volume 42.6π cm³

$Vol = \frac{1}{3} \cdot \pi \cdot r^2 \cdot h = \frac{1}{3} \cdot \pi \cdot 4^2 \cdot 8 = \frac{1}{3} \cdot \pi \cdot 16 \cdot 8 = 42.6\pi \text{ cm}^3$

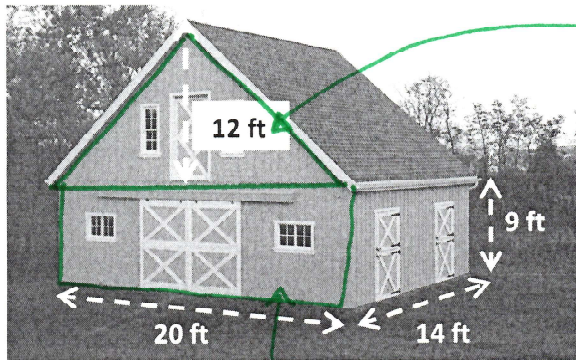
f.  $3^2 + 5^2 = x^2$
 $9 + 25 = x^2$
 $\sqrt{34} = x$
 $5.8 = x$
 $B = 6 \cdot 6 = 36$
 $P = 6 + 6 + 6 + 6 = 24$
 $h = 5, L = 5.8$

Surface Area 105.6 cm²
 Volume 60 cm³

$SA = \frac{1}{2} \cdot p \cdot L + B = \frac{1}{2} \cdot 24(5.8) + 36 = 69.6 + 36 = 105.6 \text{ cm}^2$
 $Vol = \frac{1}{3} \cdot B \cdot h = \frac{1}{3} \cdot 36 \cdot 5 = 60 \text{ cm}^3$

Level 2

2. If one gallon of stain covers 200 square feet, how many gallons of stain will be needed to cover the barn, not including the roof? If a gallon of stain costs \$28, about how much will it cost to paint the exterior of the barn (excluding the roof)? Show your work in an organized manner.



①

$$\frac{1}{2} \left[\frac{1}{2} \cdot 12 \cdot 20 \right] = 240$$

$$2(120)$$

Front + Back

$$2 \left[9 \cdot 20 \right] = 2(180) = 360$$

Sides (2)

$$2 \left[14 \cdot 9 \right] = 2(126) = 252$$

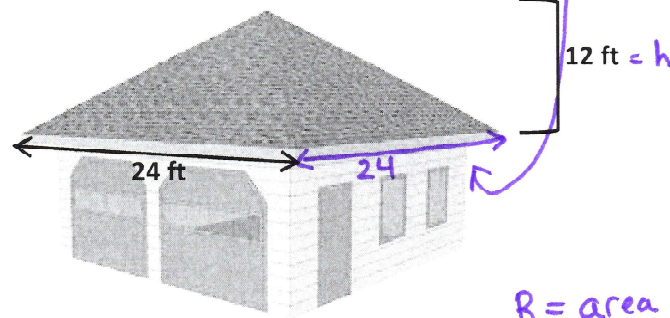
Total area of barn = $240 + 360 + 252 = 852 \text{ ft}^2 \text{ area}$

② How many gallons?
 $852 / 200 \rightarrow 4.26 \rightarrow$

Need to buy 5 gallons

③ Cost: $5 \text{ gal} \times \$28 = \140 total cost

3. A roof that encloses an attic is a square pyramid with base edge 24 feet and height 4 yards. What is the volume of the attic in cubic feet?



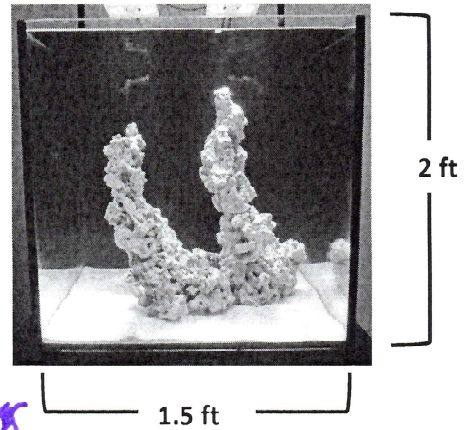
Pyramid Volume: $\frac{1}{3} \cdot B \cdot h$
 $\frac{1}{3} \cdot 576 \cdot 12 = 2304 \text{ ft}^3$

Volume of attic only

$B = \text{area of base of pyramid} = 24 \cdot 24 = 576$

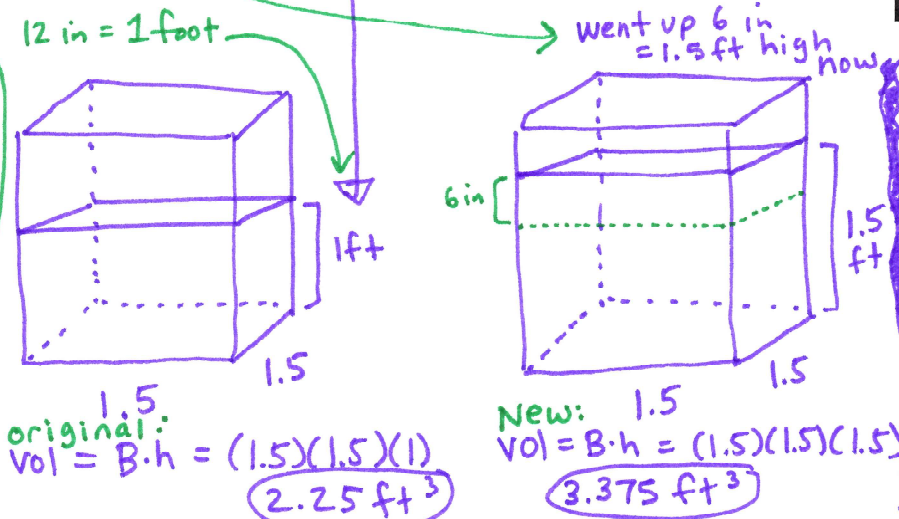
Level 3

4. Displacement can be used to find the volume of an irregularly shaped object, such as a stone or piece of coral. The tank below is 2 ft tall with an 1.5 ft square base. Suppose the tank shown is filled with water to a depth of 12 in. Two pieces of coral are placed in the tank so that they are completely covered, causing the water level to rise by 6 in. Find the volume of the pieces of coral.

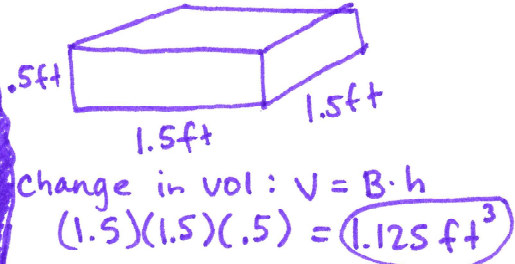


Answer: $3.375 - 2.25 = 1.125 \text{ ft}^3$ ← new - original

Method 1: Find original vol + new volume, then find the difference.



Method 2: just calculate the volume of how much the depth changed: 6 in



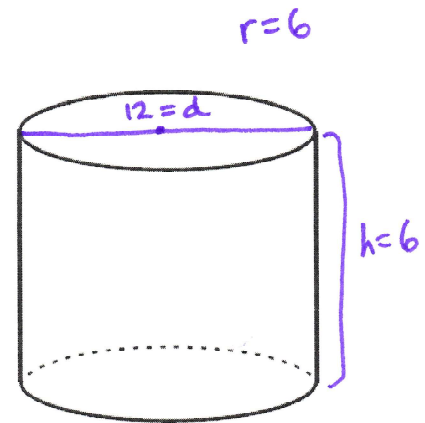
5. Allfish Emporium revealed their new 12-foot diameter, 6 foot high cylindrical predator tank in the fishroom dubbed, "The Deep". The monster tank contained four species of sharks, a stingray, moray eel, and various types of fish. Find the volume of the tank in cubic feet. If the approximate weight of the water in the tank is 42,208 pounds, find the density of the water in the tank (in pounds per cubic foot).



$$V = \pi \cdot r^2 \cdot h$$

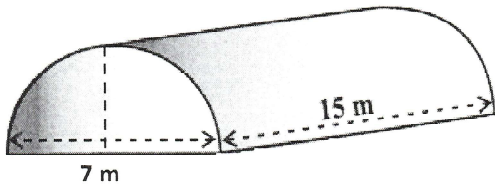
$$\pi \cdot 6^2 \cdot 6 = 216\pi \approx 678.6 \text{ ft}^3$$

$$D = \frac{M}{V} = \frac{42,208 \text{ lbs}}{678.6 \text{ ft}^3} = 62.2 \text{ lbs/ft}^3$$



Level 4

6. The tents below are made of nylon. How many square meters of nylon are required for each tent, excluding the bottom of each tent? Which shape requires more nylon, and by how much? Support your answer with mathematical reasoning and show your work!



Shape: $\frac{1}{2}$ cylinder

$$\frac{1}{2} (\pi \cdot d \cdot h + 2 \cdot \pi \cdot r^2)$$

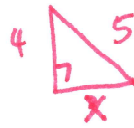
$$\frac{1}{2} (\pi \cdot 7 \cdot 15 + 2 \cdot \pi (3.5)^2)$$

$$\frac{1}{2} (105\pi + 24.5\pi)$$

$$\frac{1}{2} (129.5\pi) = \boxed{203.4 \text{ m}^2}$$

Do not add base because the bottom is excluded.

* The cylinder shape needs more material $\approx 39.4 \text{ m}^2$ more than the Δ shape

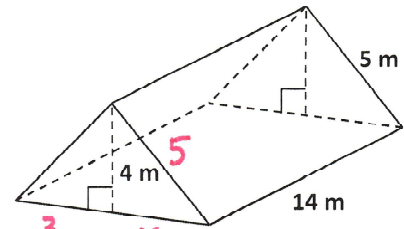


$$x^2 + 4^2 = 5^2$$

$$x^2 + 16 = 25$$

$$x^2 = 9$$

$$x = 3$$



Shape = Δ prism - rect base

$$= p \cdot h + 2B - \text{rect base}$$

$$= 16 \cdot 14 + 2(12) - (6)(14)$$

$$= 224 + 24 - 84$$

$$= \boxed{164 \text{ m}^2}$$

7. If two pieces of ice have the same volume, the one with the greater surface area will melt faster because more of it is exposed to the air. One piece of ice shown is a square prism (2.9 cm on each side), and the other is a sphere (radius 1.8 cm). Given that the volumes are approximately equal, which will melt faster?

$$SA = p \cdot h + 2B$$

$$p = 2.9(4) = 11.6$$

$$B = (2.9)(2.9) = 8.41$$

$$\boxed{(11.6)(2.9) + 2(8.41)}$$

$$33.64 + 16.82$$

$$\boxed{50.46 \text{ cm}^2}$$

$$SA = 4 \cdot \pi \cdot r^2$$

$$4 \cdot \pi \cdot (1.8)^2$$

$$4 \cdot \pi (3.24)$$

$$\boxed{40.7 \text{ cm}^2}$$

The cube will melt faster because it has the bigger surface area.

