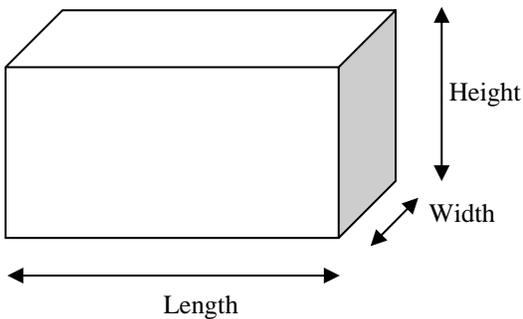


Estimate concrete volume = Explain volume formulas and use them to solve problems

Program Task: Estimate cubic yards of concrete for a foundation wall.

Program Associated Vocabulary:
DIMENSION, ESTIMATE, CUBIC FEET, CUBIC VOLUME, CUBIC YARDS

Program Formulas and Procedures:
Concrete is estimated and ordered in cubic yards. 1 cubic yard contains 27 cubic feet. A house foundation wall is related to a rectangular prism. A foundation wall has a length, width and height. When determining how much volume of cement is needed it is important to have the length, width and height in decimal feet.



To determine the volume needed in cubic yards use the following formula:

$$\text{Cubic yards} = \frac{L' \times W' \times H'}{27}$$

A foundation wall measures 27' 5" long, 8" wide and 9' high.

The length needs to be converted to decimal feet.

$$5'' \div 12 = .417'$$

The width needs to be converted to decimal feet

$$8'' \div 12 = .667'$$

$$\text{Cubic yards} = \frac{27.417' \times .667' \times 9'}{27} = \frac{164.58'}{27}$$

$$\approx 6.10 \text{ yrd.}^3$$

PA Core Standard: CC.2.3.HS.A.12

Description: Explain volume formulas and use them to solve problems.

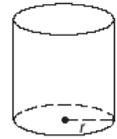
Math Associated Vocabulary:
AREA, VOLUME, LENGTH, WIDTH, HEIGHT, RECTANGULAR, ROUND, CYLINDRICAL, BASE, RADIUS, RECTANGULAR PRISM

Formulas and Procedures:

Volume:

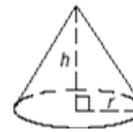
Cylinder:

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



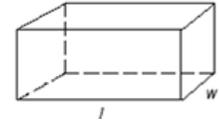
Cone:

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



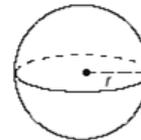
Rectangular Prism:

$$V = lwh$$



Sphere:

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

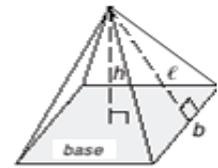


Pyramid:

$$V = \frac{1}{3}(\text{area of the base})h$$

h = height w = width

b = base ℓ = slant length or slant height



Example: How many cubic inches of air can a beach ball hold if it has a diameter of 14 inches?

Steps to finding volume:

1. Identify the solid (sphere).
2. Write the formula for calculating the volume of that solid using the formula sheet.

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

3. Identify the properties of the solid used in the formula.

$$d = 2r \text{ or } r = \frac{1}{2}d$$

$$r = \frac{1}{2} \times 14 = 7$$

4. Substitute the actual properties of the solid into the formula.

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

Perform the necessary mathematical operations to obtain your answer.

$$V = \frac{4}{3}\pi r^3 = \frac{4}{3}(3.14)(7^3) = 1436$$

5. Write the appropriate unit after your answer.

$$1436 \text{ in}^3$$

Carpentry (46.0201) T-Chart

Instructor's Script - Comparing and Contrasting

The Carpentry example on page one shows how volumes must be calculated for rectangular prisms to pour foundation walls. Carpenters also work with cylinders when they pour footers for posts as presented in problem # 2 on page three.

The mathematical formulas for volume indicate a certain type of orientation that may not match the application in question. For example, h will designate height of a cylinder, but if the cylinder is horizontal, h will be the same as the length!

Common Mistakes Made By Students

Using Incorrect Formula: Correctly identify the type of object you are dealing with and use the appropriate formula. Two formulas may be needed for complex objects.

Using Consistent Units: If the problem asks for the answer in square feet instead of square inches, be sure to either convert your given measurements into feet first (inches \div 12 = feet) or convert your square inch answer into square feet (sq. in. \div 144 = sq. ft.).

CTE Instructor's Extended Discussion

The first formula to determine cubic yards is $L' \times \frac{W'}{27} \times H'$. It is important that all numbers are in decimal feet.

Another formula for determining cubic yards of concrete is Length' x Width' x Thickness'' x .0031. Notice that the thickness is in inches. It is good practice to solve for cubic yards using both formulas and compare the information.

Problems	Career and Technical Math Concepts	Solutions
1. A customer has asked you to construct an above ground, rain water holding tank with $r = 12'$ and $h = 25'$. What will be the total volume of the water tank?		
2. You need to set 3 concrete piers to support an above ground deck. Each pier has the following dimensions: $d = 12''$ and $h = 60''$. Find the volume of one pier in in^3 , ft^3 & yd^3 ?		
3. A carpenter is pouring a cement walkway in front of a customer's house; the walkway is $35'$ long, $4'$ wide and $5''$ thick. How many cubic yards of cement did the carpenter order? Round up to the closest $1/2$ yard.		
Problems	Related, Generic Math Concepts	Solutions
4. One soup can has a diameter = $3''$ and height = $4''$; another soup can has a diameter = 4 and a height = 3 . Which can holds more soup?		
5. A size 7 regulation basketball has a diameter = $9.39''$. What is the volume of the basketball?		
6. How much water would you need to fill a rectangular fish tank with a height of $16.5'$, a length of $32''$, and a width of $8.5''$?		
Problems	PA Core Math Look	Solutions
7. Find the volume of a cylinder, $d = 12.75'$, $h = 28.75'$.		
8. Find the volume of a sphere, $d = 27.75''$.		
9. Find the volume of 4 sided pyramid with a square base, $b = 10$, $h = 25$.		

Problems	Career and Technical Math Concepts	Solutions
1. A customer has asked you to construct an above ground, rain water holding tank with $r = 12'$ and $h = 25'$. What will be the total volume of the water tank?	$V = \pi r^2 h$ $V = \pi \times (144) \times 25$ or $V = 3.14 \times (12^2) \times 25$ $V \approx 11,310\text{ft}^3$ (rounded from 11309.73355)	
2. You need to set 3 concrete piers to support an above ground deck. Each pier has the following dimensions: $d = 12''$ and $h = 60''$. Find the volume of one pier in in^3 , ft^3 & yd^3 ?	$V = \pi r^2 h$ $V = \pi \times 36 \times 60$ $V = 6,785.84\text{in.}^3$ $V = 6785.84 \div 1728$ $V = 3.9\text{ft.}^3$ $V = 3.9 \div 27$ $V = .25\text{yd.}^3$ (Rounded from 0.14)	
3. A carpenter is pouring a cement walkway in front of a customer's house; the walkway is $35'$ long, $4'$ wide and $5''$ thick. How many cubic yards of cement did the carpenter order? Round up to the closest $\frac{1}{2}$ yard.	Cubic yards = $\frac{L' \times W' \times H'}{27}$ Cubic yards = $\frac{35 \times 4 \times .417}{27} \approx 2.16$ Cubic yards $\approx 2.16 \longrightarrow 2.5$ cubic yards	
Problems	Related, Generic Math Concepts	Solutions
4. One soup can has a diameter = $3''$ and height = $4''$; another soup can has a diameter = 4 and a height = 3 . Which can holds more soup?	$V = \pi r^2 h$ Can 1 : $V = \pi(1.5)^2 4$ Can 2 : $V = \pi(2)^2 3$ $V \approx 28.27\text{in.}^3$ $V \approx 37.70\text{in.}^3$	
5. A size 7 regulation basketball has a diameter = $9.39''$. What is the volume of the basketball?	$V = \frac{4}{3} \times \pi \times r^3$ $V = 1.333 \times \pi \times 4.695^3$ $V = 1.333 \times \pi \times 103.5$ $V \approx 433.43\text{in}^3$	
6. How much water would you need to fill a rectangular fish tank with a height of $16.5''$, a length of $32''$, and a width of $8.5''$?	$V = lwh$ Volume = $(32)(8.5)(16.5) = 4,488\text{in}^3$	
Problems	PA Core Math Look	Solutions
7. Find the volume of a cylinder, $d = 12.5'$, $h = 28.75'$.	$V = \pi r^2 h$ $V = \pi \times 6.25^2 \times 28.75$ $V \approx 3528.155\text{ft}^3$	
8. Find the volume of a sphere, $d = 27.75''$.	$V = \frac{4}{3} \times \pi \times r^3$ $V = 1.333 \times \pi \times 13.875^3$ $V = 1.333 \times \pi \times 2,671.15$ $V \approx 11,186.09\text{in}^3$	
9. Find the volume of 4 sided pyramid with a square base, $b = 10'$, $h = 25'$.	$V = \frac{1}{3} (10^2 \times 25)$ $V = \frac{1}{3} \times 2500 \approx 833.33\text{in}^3$	