

Task: Ceiling Height
Algebra 1

A local manufacturer is building an addition to their plant and is designing whip tanks to hold 11,511 gallons of a liquid toothpaste. Leo is working to determine what the height of the ceiling should be in the new plant. In order to find the height of what the new building should be, he must first determine the height of the tank. Leo is going to use the formula for volume of a cylinder to determine the height, since he already knows what the radius of the tank must be in order to fit the number of tanks needed in the square feet they have available.

- a) Convert gallons to cubic feet (1 cubic foot is equivalent to 7.481 gallons)
- b) Leo knows the formula for finding volume of a cylinder is $V = \pi r^2 h$. Solve the equation for h . Show your work and explain your reasoning of each step.
- c) The radius of the whipping tank is 8 feet. Using your conversion in part a, determine the height of the whipping tank (use 3.14 for pi).
- d) The stand of the whipping tank is 42 inches and the tank must have 6.5 feet of clearance above. How tall must the ceiling be in the addition? Explain your reasoning.

Common Core State Standards

(A-CED). 4- Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R .

(N-Q).3- Reason quantitatively and use units to solve problems. Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.

(A-REI).1- Understand solving equations as a process of reasoning and explain the reasoning. Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

1. *Make sense of problems and persevere in solving them.*
2. *Reason abstractly and quantitatively.*
3. *Construct viable arguments and critique the reasoning of others.*
4. *Model with mathematics.*
5. *Use appropriate tools strategically.*
6. *Attend to precision.*
7. *Look for and make use of structure.*
8. *Look for and express regularity in repeated reasoning.*

Essential Understandings

Students should be able to convert between different rates of measurement and solve for a specified value in a given equation while explaining their reasoning as they go.

Possible Solutions/Solution Paths

a) In order to do the conversion in part a, students can reason by dividing the total number of gallons by how many gallons are in one cubic foot OR they can set the problem up using a conversion factor.

$$11,511 \text{ gallons} = 1,538.7 \text{ cubic feet}$$

b) In order to solve for the height, students can either show their work by dividing by πr^2 , or by multiplying by the reciprocal of πr^2 . The division property of equality allows for this.

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

c) 7.7 feet- 92.4 inches (answers may slightly vary based off of rounding)

If students had all numbers right up until this point, they may not have multiplied the denominator and then divided the numerator by that answer or they could put the denominator in parentheses to ensure the correct operations are completed in the right order. If they were to make either of those mistakes, they would get either 31, 362 or 755 feet. In this case, the discussion can then occur whether either of these are a plausible answer.

d) The stand of the whipping tank is expressed in inches and the clearance needed above the tank is expressed in feet, so students would need to notice this and convert the measurements to the same units, whether it be feet or inches. The stand would be 3.5 feet + 6.5 feet clearance + a 7.7 feet high tank = a ceiling height of 17.7 feet or 212.4 inches

Additional Teacher Information

Misconceptions addressed in possible solutions or paths.