

2.8: Units Raised to a Power

Learning Objectives

- To convert a value reported in one unit raised to a power of 10, to a corresponding value in a different unit raised to the same power of 10, using conversion factors.

Conversion factors for area and volume may also be produced using dimensional analysis. Just remember that if a quantity is raised to a power of 10, both the number and the unit must be raised to the same power of 10. For example, to convert 1500 cm^2 to m^2 , we need to start with the relationship between centimeter and meter. We know that $1 \text{ cm} = 10^{-2} \text{ m}$ or $100 \text{ cm} = 1 \text{ m}$, but since we are given the quantity in 1500 cm^2 , then we have to use the relationship:

$$1 \text{ cm}^2 = (10^{-2} \text{ m})^2 = 10^{-4} \text{ m}^2$$

CONCEPT MAP

$$\boxed{\text{cm}^2} \left(\frac{10^{-2} \text{ m}}{1 \text{ cm}} \right)^2 \boxed{\text{m}^2}$$

CALCULATION

$$1500 \text{ cm}^2 \times \left(\frac{10^{-2} \text{ m}}{1 \text{ cm}} \right)^2 = \boxed{0.15 \text{ m}^2}$$

or

$$1500 \text{ cm}^2 \times \left(\frac{1 \text{ m}}{100 \text{ cm}} \right)^2 = \boxed{0.15 \text{ m}^2}$$

or

$$1500 \text{ cm}^2 \times \frac{1 \text{ m}^2}{10,000 \text{ cm}^2} = \boxed{0.15 \text{ m}^2}$$

Example 2.8.1

What is the volume of a sphere (radius = 4.30 inches) in cubic centimeters (cm^3), given $V = \frac{4}{3}\pi r^3$?

Solution

Steps for Problem Solving	Result
Identify the "given" information and what the problem is asking you to "find."	Given: radius = 4.30 in Find: cm^3 (volume)
List other known quantities. Metric prefixes are found in 2.5: The Metric System . Other conversions may be found in Appendix 2: Conversions .	$V = \frac{4}{3}\pi r^3$ $= \frac{4}{3} \times 3.1416 \times (4.30 \text{ in})^3$ $= 333.04 \text{ in}^3$ $1 \text{ in} = 2.540 \text{ cm}$
Prepare a concept map and use the proper conversion(s).	$\boxed{\text{in}^3} \left(\frac{2.540 \text{ cm}}{1 \text{ in}} \right)^3 \boxed{\text{cm}^3}$

Steps for Problem Solving	Result
Calculate the answer.	$333.04 \text{ in}^3 \times \left(\frac{2.540 \text{ cm}}{1 \text{ in}} \right)^3 = \boxed{5.46 \times 10^3 \text{ cm}^3}$
Think about your result.	A centimeter is a smaller unit than an inch, so the answer in cubic centimeters is larger than the given value in cubic inches.



Exercise 2.8.1

Lake Tahoe has a surface area of 191 square miles. What is the area in square kilometers (km²)?

Answer

494 km²

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