

Problem 4 (10 points)

One cubic centimeter of copper has a mass of 8.9 g.

What is the volume of a piece of copper with a mass of 1.23 kg? Explain your reasoning

For full credit, do not use algebra.

Dr. Saul's comments: The key to this problem is not finding the answer but understanding the process to get the answer. Here we find the volume of the piece with a mass of 1.23 kg by finding out how many 8.9 g pieces of copper it takes to make 1.23 kg and then multiplying by 1 cm³ per piece. Make sure that unit conversions like going from kg to g are explicit, i.e. show them. One way to do this is like this:

1.23 kg x 1000 g / kg = 1230 g (if you clearly showed how you went from kg to g and lost points, come show me to get those points back.)

Here are some of the better student solutions to this problem:

Student Solution 1

Given: 8.9g of copper has 1cm³ of volume

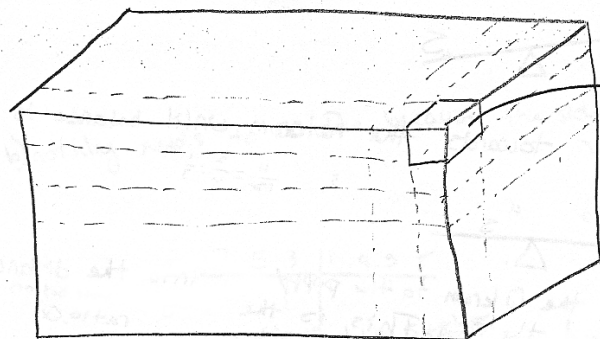
Procedure: convert 1.23 kg to 1230g

Divide $\frac{1230g}{8.9g}$ to find how many cm³ fit into the number of copper

Answer: 138.2cm³ = volume of a piece of copper with a mass of 1.23kg.

Handwritten calculations:

$$1000g = 1kg$$

$$\begin{array}{r} 1.23kg = 1230g \\ \times 1000 \\ \hline 1230g \end{array}$$


1 cm³ = 8.9 g

$$\frac{1230g}{8.9g} = 138.2$$

$$1230g = 138.2 cm^3$$

This is a pretty good solution but it could be improved if the reasoning behind the division step was clearer. (Technically if you want to do the calculation in one step you would have to divide 1,230 g by 8.9 g/cm³.) Also, since the density only has 2 significant figures, your answer should also only have 2 significant figures. So V = 140 cm³

Problem 4 (cont.)

Student Solution 2

$1 \text{ cm}^3 = 8.9 \text{ g}$

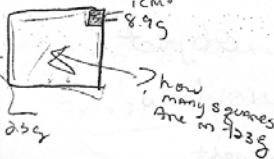
$\begin{array}{r} 100 \\ \times 1.23 \\ \hline 1230 \end{array}$
 to find 1.23 kg in grams

$123 / 8.9 = 13.820$ to find how many $1 \text{ cm}^3 / 8.9 \text{ g}$ pieces are in 123 grams of copper

Therefore, by dividing 123 g by 8.9 g you obtain 13.820 which is the volume b/c for every 8.9 g there is 1 cm^3

$13.820 \times 1 \text{ cm}^3 = 13.820 \text{ cm}^3$

Volume = 13.820 cm^3



Note that the reasoning in solution 2 above and solution 3 below in the division step is clearer.

Student solution 3:

A piece of copper with a mass of 1.23 kg is the same as 1,230 g b/c there are a thousand grams for every one kilo.

For every one cubic centimeter of copper there is a mass of 8.9 g. To find the volume of the 1,230 g piece of copper, I need to find out how many times 8.9 divides into 1,230, which is 138.2. Since $1,230 \div 8.9 = 138.2$ this gives us the volume of piece of copper. So, for every $1 \text{ cm}^3 : 8.9 \text{ g}$ there is $138.2 \text{ cm}^3 : 1.23 \text{ kg}$