Conversion Factors and Road Maps **Name** _____

Answer the questions for the following problem.

> In the past, the grain (gr) was used to measure the mass of grains and precious stones. One carat (ct) is equivalent to 3.09 gr. The largest rough diamond ever found had a mass of 9598 gr. How many carats is the diamond? How much does the diamond weigh in mg if one carat is equivalent to 0.200 g?

a) determine the given and the desired units

Given: 9598 gr Desired: ct
Desired: mg

b) Set up a road map for the following problem:

This problem asks two questions, therefore 2 roadmaps

$gr \rightarrow ct$

$ct \rightarrow g \rightarrow mg$

c) Write the equivalences needed for the problem (these can be different depending on what you remember).

$gr \rightarrow ct$ 3.09 gr = 1 ct

$ct \rightarrow g \rightarrow mg$ 1 ct = 0.200 g
1 g = 1000 mg

d) Write the conversion factors from the equivalences

$\frac{3.09\ gr}{1\ ct}$ or $\frac{1\ ct}{3.09\ gr}$ $\frac{1\ ct}{0.200\ g}$ or $\frac{0.200\ g}{1\ ct}$ $\frac{1\ g}{1000\ mg}$ or $\frac{1000\ mg}{1\ g}$

e) Set up the problem and solve

$9598\ gr \times \frac{1\ ct}{3.09\ gr} = \boxed{3106\ ct}$

For part 2 we already know the number of carats

$$3106\ ct \times \frac{0.200\ g}{1\ ct} \times \frac{1000\ mg}{1\ g} = 6.212 \times 10^5\ mg$$

Answer the questions for the following problem.

The diameter of a gold atom is 166 pm. What is the volume in L of 2.83×10^{25} gold atoms. $V_{sphere} = 4/3\ \pi r^3$ (Hint: Treat the atom as a sphere)

a) determine the given and the desired units

Given: d = 166 pm Desired: L (volume)

b) Set up a road map for the problem:

diameter → radius → cm → V (cm3) → L

c) Write the equivalences needed for the problem (these can be different depending on what you remember).

radius = ½ diameter = ½ x 166 pm = 83 pm
1 pm = 10^{-10} cm
Next, convert pm to cm 83 pm x $\frac{10^{-10}\ cm}{1\ pm} = 8.3\ x\ 10^{-9}\ cm$

1000 cm^3 = 1 L

d) Set up the problem and solve

We solve for the volume using $V = 4/3\ \pi r^3$

$V = 4/3 \times \pi \times (8.3 \times 10^{-9}\ cm)^3 = 2.395 \times 10^{-24}\ cm^3$

The volume of one gold atom is $2.395 \times 10^{-24}\ cm^3$

$$2.83 \times 10^{25}\ Au\ atoms \times \frac{2.395 \times 10^{-24}\ cm^3}{1\ Au\ atom} \times \frac{1\ L}{1000\ cm^3} = 0.068\ L$$