Differentiated Chemistry: Review of Conversions and Dimensional Analysis Name: Answer Key

All problems on this paper will be solved using dimensional analysis. Non-credit will be assessed for any problem not including this set-up. Significant figures will also be strictly enforced.

1. Explain how you go about to solve a problem using dimensional analysis

Identify what you know and what you want to know first. Then plan out a set of conversions that will allow you to cancel out known units and convert to wanted units

2. Solve the following conversion problems

a. How many meters are there in 213 yards?

$$m \,||\, \frac{213\,yd}{} \left|\, \frac{3\,ft}{1\,yd} \right| \frac{12\,in}{1\,ft} \left|\, \frac{2.54\,cm}{1\,in} \right| \frac{1\,m}{100\,cm} = \boxed{195\,m}$$

b. A certain sports drink contains 125 mg of sodium per 350 mL serving. What is this in ounces per fluid ounce?

$$\frac{oz.}{fl\,oz.} \,||\, \frac{125\,mg}{350\,mL} \left|\, \frac{1\,kg}{1\times10^{6}\,mg} \right| \frac{2.2046\,lbs}{1\,kg} \left|\, \frac{16\,oz}{1\,lb} \right| \frac{29.57\,mL}{1\,fl.oz.} = \boxed{\frac{3.7\times10^{-4}\,oz.}{fl.oz.}}$$

c. The density of sapphire is 3.49 g/cm^3. What is this density in lbs/in^3?

$$\frac{lb}{in^3} \,||\, \frac{3.49\,g}{1\,cm^3} \left|\, \frac{1\,kg}{1000\,g} \right| \frac{2.2046\,lbs}{1\,kg} \left|\, \frac{(2.54)^3\,cm^3}{1\,in^3} \right| = \boxed{\frac{0.126\,lbs}{in^3}}$$

d. A reaction of 58.5 g of a certain compound released 3.169 x 10^3 joules of energy. How many calories of energy would 2.3 x 10^{-2} lbs of this material release in a similar process?

$$cal \,||\, \frac{2.3\times10^{-2}\,lbs}{} \left|\, \frac{1\,kg}{2.2046\,lbs} \right| \frac{1000\,g}{1\,kg} \left|\, \frac{3.169\times10^{3}\,J}{58.5\,g} \right| \frac{1\,cal}{4.184\,J} = \boxed{140\,cal}$$

3. Solve the following problems.

a. The density of an unknown liquid was performed using a graduated cylinder. If the cylinder is accurate to the nearest mL and the meniscus is half way between 6th and 7th marks past the 10 mL mark, what is the density if the mass of the liquid is 12.88 g?

$$\,||\, \frac{12.88\,g}{16.5\,mL} = \boxed{0.781\,g/mL}$$

b. A 1.5 inch cubic block of aluminum metal has a mass of 5.265 ounces. Find the density of this in g/cm^3. Is this pure aluminum or a mixture of aluminum and other metals?

$$\,||\, \frac{5.265\,oz}{1.5^3\,in^3} \left|\, \frac{1\,in^3}{2.54^3\,cm^3} \right| \frac{1\,lb}{16\,oz} \left|\, \frac{1\,kg}{2.2046\,lb} \right| \frac{1000\,g}{1\,kg} = \boxed{2.7\,g/cm^3} - \boxed{\text{pure Al}}$$

c. Archimedes was able to determine if a golden crown was made of pure gold or a mixture of gold with lesser metals. If a 1.54 kg golden crown was placed in a vat of pure water at 4°C, how much water should the crown displace if it is pure gold?

$$\,||\, \frac{1.54\,kg}{} \left|\, \frac{1000\,g}{1\,kg} \right| \frac{1\,cm^3}{19.3\,g} = \boxed{79.8\,cm^3}$$

d. If the 1.54 kg golden crown had displaced 68.5 mL of water, calculate the percent error in density of the mixture versus pure gold.

$$\frac{(79.8-68.5)\,cm^3}{79.8\,cm^3} \times 100 = \boxed{14.2\%\ \text{error}}$$