AP Chemistry Problem Set #1 - ANSWERS

1. Perform the following mathematical operations, and express the result to the correct number of significant figures.
   a. $(6.022 \times 10^{23}) \times (2.33 \times 10^{3}) =$ **1.40×10^{27}**
   b. $1.00876 + 0.87206 - 0.0996 =$ **1.7812**
   c. $(7.915 - 7.908) \div 7.915 \times 100. =$ **0.09**
   d. $(3.000 \times 10^{5}) \div (4.00 \times 10^{-6}) =$ **7.50×10^{10}**
   e. $2.38 \div 55.8 \times (6.022 \times 10^{23}) =$ **2.57×10^{22}**

2. Convert each of the following.
   a. 8.57 micrograms to centigrams = **8.57×10^{-4} centigrams**
   b. 2.11×10^{-4} dekaliters to milliliters = **2.11 milliliters**
   c. 1.95×10^{11} nanometers to meters = **1.95×10^{2} meters**
   d. 2.27 kilograms to decigrams = **2.27×10^{4} decigrams**
   e. 6.19×10^{-8} megagrams to micrograms = **6.19×10^{4} micrograms**

3. Perform the following unit conversions. The unit conversions are on the last page of your text book and on the tools menu at http://www.sartep.com/chem.
   a. 809 oz to kilograms = **22.9 kilograms**
   b. 22.4 L to gallons = **5.92 gallons**
   c. 375 mL to quarts = **0.396 quarts**
   d. 221 pounds to grams = **1.00×10^{5} grams**
   e. 74° C to Kelvin = **347 Kelvin**

4. Solve the following using dimensional analysis. The unit conversions are on the last page of your text book and on the tools menu at http://www.sartep.com/chem. Show all of your work.
   a. A parsec is an astronomical unit of distance. 1 parsec = 3.26 light years (or the distance traveled by light in one year. Light speed = 186,282.397 miles per second. An object travels 9.6 parsecs. Calculate this distance in cm.

$$\frac{9.6 \text{ parsecs}}{1.0 \text{ parsec}} \times \frac{3.26 \text{ yr}}{1 \text{ year}} \times \frac{365.25 \text{ days}}{1 \text{ day}} \times \frac{24 \text{ hr}}{1 \text{ hr}} \times \frac{60 \text{ min}}{1 \text{ min}} \times \frac{60 \text{ sec}}{1 \text{ sec}} \times \frac{186282.397 \text{ miles}}{1 \text{ mile}} \times \frac{5280 \text{ ft}}{1 \text{ foot}} \times \frac{12 \text{ inches}}{1 \text{ inch}} \times \frac{2.54 \text{ cm}}{}$$

3.0×10^{19} cm

   b. The front edge of the pitcher's mound is 60'6" from the rear point of home plate. If a power pitcher like Roger Clemens throws a fast ball at 95 miles/hour, how many seconds will it take for the ball to reach the catcher's mitt?

$$\frac{60.5 \text{ ft}}{1} \times \frac{1 \text{ mile}}{5280 \text{ ft}} \times \frac{1 \text{ hour}}{95 \text{ miles}} \times \frac{60 \text{ min}}{1 \text{ hour}} \times \frac{60 \text{ sec}}{1 \text{ min}} = \textbf{0.43 seconds}$$

   c. The current cost of gasoline is $3.87/gallon. If my car gets 12.0 kilometers/liter, how many miles will I be able to travel if I put $18.35 of gasoline in my car? If my house is 10.85 miles away from school, how many **complete round trips** can I make on $18.35? At the above cost of gas, how much will I pay to make 194 **round trips** between home and work this year?

$$\frac{12.0 \text{ km}}{1 \text{ L}} \times \frac{0.62137 \text{ mi}}{1 \text{ km}} \times \frac{3.7854 \text{ L}}{1 \text{ gallon}} \times \frac{1 \text{ gallon}}{3.87 \text{ dollars}} \times \frac{18.35 \text{ dollars}}{1} = \textbf{134 miles}$$

$$\frac{134 \text{ miles}}{1} \times \frac{1 \text{ way trip}}{10.85 \text{ miles}} \times \frac{1 \text{ round trip}}{2 \text{ way trip}} = 6.16 = \textbf{6 complete round trips}$$

$$\frac{194 \text{ trips}}{1} \times \frac{21.70 \text{ miles}}{1 \text{ round trip}} \times \frac{1 \text{ gallon}}{28.23 \text{ miles}} \times \frac{3.87 \text{ dollars}}{1 \text{ gallon}} = \textbf{\$577}$$

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5. The density of pure platinum is 21.45 g/mL at 20°C. If 5.50 grams of pure platinum is added to 14.45 mL of water, to what volume will the level in the cylinder rise?

$$\frac{21.45\text{g}}{1\text{ mL}} = \frac{5.50\text{g}}{x\text{ mL}}$$

x = 0.256 mL
0.256 mL + 14.45 mL = 14.706 mL (rounded to) **14.71 mL**

6. The amount of mercury in a polluted lake is 0.35 μg Hg/mL, what is the total mass in kilograms of mercury in the lake? The lake has a surface area of 50. mi^2 and an average depth of 30. ft.)

$$\frac{50\text{ mi}^2}{1} \times \frac{(5280\text{ ft})^2}{1.00\text{ mi}^2} \times \frac{30\text{ ft}}{1} = 4.18176 \times 10^{10}\text{ ft}^3 \times \frac{(12\text{ in})^3}{1\text{ ft}^3} \times \frac{(2.54\text{ cm})^3}{1\text{ in}^3} = 1.184142564 \times 10^{15}\text{ cm}^3$$

$$1.184142564 \times 10^{15}\text{ cm}^3 = \frac{1.184142564 \times 10^{15}\text{ mL}}{1} \times \frac{0.35\ \mu\text{g}}{1\text{ mL}} \times \frac{1\text{ kg}}{10^9\ \mu\text{g}} = \mathbf{4.1 \times 10^5\ kg\ Hg}$$

7. A 20.00 gram sample of a solid is placed in a graduated cylinder and then filled to the 50.00 mL mark with benzene. The mass of the benzene and the solid together is 58.80 g. Assuming that the solid is insoluble in benzene and the density of benzene is 0.880 grams/cm^3, calculate the density of the solid.

Benzene mass = 58.80 g – 20.00 grams = 38.80 grams
Benzene density = 0.880 g/mL (given)
Benzene volume = 44.1 mL

Solid volume = 50.00 – 44.1 = 5.9 mL
Solid mass = 20.00 grams (given)
Solid density = **3.4 g/mL**

8. Cesium atoms are the largest naturally occurring atoms. The radius of a cesium atom is 2.62 Å (angstroms). How many cesium atoms would have to be laid side by side to give a row of cesium atoms 3.00 inches long? Assume that the atoms are spherical.

2.62 Å = radius of 1.0 atom
5.24 Å = diameter of 1.0 atom

$$\frac{3.00\text{ in}}{1} \times \frac{2.54\text{ cm}}{1.00\text{ in}} \times \frac{1.00\text{ m}}{100\text{ cm}} \times \frac{1.00\text{ Å}}{1 \times 10^{-10}\text{ m}} \times \frac{1\text{ atom}}{5.24\text{ Å}} = \mathbf{1.45 \times 10^8\ atoms}$$

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