Honors Chemistry - Summer Assignment

Name ____________________ **Date___________**

This packet must be completed and turned in to your chemistry teacher the second day class meets. There will be an in class quiz on this material during the third class meeting.

Significant Figures (Or “How many decimal places should I keep?”)

In science, all experimental measurements have some uncertainty involved. The accuracy of any measurement is expressed by the number of *significant digits* written when the measurement is reported.

There are several rules for determining the number of significant digits (or *significant figures*) in a measurement. In general, significant figures are determined starting with the **leftmost** digit.

1. All non-zero digits are significant.
2. The *leftmost* nonzero digit is the first or **most significant figure.** For example, in the number 0.02340, the first significant figure is the 2.
3. If there is a decimal point, the *rightmost* digit is the last or **least significant figure.** For example, in 0.02340 the first two zeros from the left are not significant but the zero after the 4 is significant.
4. If there is no decimal point explicitly shown, the rightmost non-zero digit is the **least significant figure.** For example, in 3400 the 4 is the least significant figure since neither zero is significant in this case.
5. All digits between the most significant figure and the least significant figure are significant. For example, 6.07 has three significant figures.

The general rule of thumb in this class is that calculated results can have no more than 3 significant figures (sig figs). This usually means that results shown on a calculator must be **rounded off** to 3 significant figures.

For example, 252,194,701 would be rounded to 252,000,000.

Sometimes more or fewer than 3 significant figures would be allowed according to the following rules:

<u>MULTIPLICATION or DIVISION</u>

- Keep the same number of significant figures as the factor with the *least* number of significant figures.

Example: 1.2 x 4.56 = 5.472 on the calculator. But since the one factor has only 2 significant figures, the answer must be rounded to 2 significant figures or 5.5.

ADDITION or SUBTRACTION

- Keep the same number of *decimal places* as the factor with the *least* amount.

Example: 1.234 + 5.67 = 6.904 on the calculator. But since the one factor has only 2 decimal places, so must the answer. Thus the result must be rounded to 6.90 (where the zero is significant. See rule 3 above.)

For another perspective, see : [Kahn Academy – Significant Figures]

Significant Figures Practice

1. How many significant figures in each of the following numbers?

   a. 0.0034 ___________

   b. 323.1009 ___________

   c. 20.000 ___________

   d. 26,000 ___________

   e. 10,001.0 ___________

2. Calculate the following products or quotients, recording your answer rounded to the appropriate number of significant figures…

   a. 27.003 • 2.2 = ___________

   b. 16.2 • 5.555 = ___________

   c. 14.7 ÷ 7.3 = ___________

   d. 81.99 ÷ 9. = ___________

3. Calculate the following sums or differences, recording your answer rounded to the appropriate number of significant figures…

    a. 27.003 + 2.2 = __________

    b. 16.2 + 5.555 = __________

    c. 14.7 - 7.312 = __________

    d. 81.99 - 9.7 = __________

Dimensional Analysis

Dimensional analysis is a method of solving problems by using the units, and a necessary skill for solving chemistry problems. One value is transformed by multiplying the original value by a ratio of equal measures.

Here are some steps to following in using dimensional analysis:

1. Identify the following from the context of the problem:
    a. given starting value and units
    b. desired units for the final answer
    c. equal measures needed
2. Write the starting value followed by a multiplication sign and a line for the ratio
3. Fill in the ratio so that the units that are unwanted units are in the denominator and the desired units are in the numerator
4. Do the arithmetic - multiply across, divide by denominator

Note: Additional steps may be strung together if necessary.

Example: Lisa has 3.5 dozen eggs. How many eggs does she have?

Step 1. Given starting value - 3.5 dozen eggs

Desired units - eggs

Equal measure - 1 dozen eggs = 12 eggs

Step 2. 3.5 dozen eggs × ________

Step 3. 3.5 dozen eggs $\times \frac{12\ eggs}{1\ dozen\ eggs}$

Step 4. 3.5 dozen eggs $\times \frac{12\ eggs}{1\ dozen\ eggs}$ = 42 eggs

The arithmetic works like this: 3.5 x 12 ÷ 1 = 42

Note that "dozen eggs" cancels out because the unit is being divided by itself. The next example shows how to use dimensional analysis for a multiple step problem.

Example: Lisa has 3.5 dozen eggs. She needs to make several cakes, each cake needs 4 eggs, how many cakes can Lisa make?

Step 1. Given starting value - 3.5 dozen eggs

Desired units - cakes

Equal measure - 1 dozen eggs = 12 eggs ***and*** 1 cake = 4 eggs

Step 2. 3.5 dozen eggs × __________ × ________

We know we need 2 ratios because we have 2 equal measures.

Step 3. 3.5 dozen eggs $\times \frac{12\ eggs}{1\ dozen\ eggs} \times \frac{1\ cake}{4\ eggs}$ = 10.5 cakes, which is rounded to 10 cakes

The arithmetic works like this: 3.5 x 12 x 1 ÷ (1 x 4) = 42 ÷ 4 = 10.5

The final answer needs be rounded to 10 cakes, since Lisa can't make 0.5 of a cake. Again, note that the units "dozen eggs" cancel out in the first ratio through division and the units "eggs" cancel out in the second ratio through division.

Dimensional Analysis Practice

Even though the problems given here as practice can be solved by other means, but you ***must*** use dimensional analysis to solve these problems. Show all work, round your answers according to the rules given in the Significant Figures section and provide the proper units with your answers.

1. Mrs. Petruzelli wants to do a project with an art class. The project requires 2625 sheets of drawing paper. There are 150 sheets of drawing paper in each package. How many packages of drawing paper does she need?

2. A particular cloth costs $3.25 per yard. Mrs. Vitiello is making a dress that needs 4.81 yards of material. How much money will she need to spend to purchase enough cloth?

3. A human body can shed approximately 3.50×10^4 skin cells an hour.
    a. How many skin cells do you shed during a typical day at school? (A school day is 6.77 hours long.)

    b. How many skin cells do you shed during a whole school year? (There are 180 days in a school year.)

4. Mr. Carson wants to make ice cream with his 3 chemistry classes. Each class has 21 students. Each student needs ½ cup of sugar to make the ice cream. How many cups of sugar are needed so that every student in all 3 of Mr. Carson's classes can make ice cream?

5. Mr. Newman has 5 classes. He wants to tell 3 new puns in every class, every week. How many new puns will he tell before the holiday break? (There are 14 weeks of school before the holiday break.)

6. Mrs. Kalapodakis wants to do an experiment with hydrochloric acid and calcium carbonate. She has 23 students. Each student must do 4 trials. Each trial requires 0.50 grams of calcium carbonate. How many grams of calcium carbonate are needed?

Density

Density is a physical property of a substance. Density can change if the temperature changes. This happens because, for most substances, particles come closer together when the temperature decreases. When particles are closer together, the material is more dense. Increases in temperature cause particles to move farther apart, making the material less dense.

Materials that are less dense will float in substances that are more dense, for example, a balloon full of helium (density = 0.179 g/L) will float in the air (density = 1.29 g/L.) Density can have a variety of units, such as g/mL, kg/m^3, or g/L. Density is calculated base on the equation below:

$D = \frac{mass}{volume}$

Density Practice Problems and Questions

For calculated answers, show all work, round the answer to the appropriate amount of significant figures and provide the correct units with your answer.

1. A student finds an unknown metal in the chemistry lab. The student measures the mass at 32.46 g and the volume at 2.87 cm^3. What is the density of the material?

2. The student finds another metal substance in the chemistry lab. The student measures the mass at 11.26 g and the volume at 4.17 cm^3. What is the density of the material?

3. The student finds yet another metal substance in the chemistry lab. The student measures the mass at 15.27 g and the volume at 1.94 cm^3. What is the density of the material?

4. The student finds a chart of densities, shown below, and uses it to identify the unknown metals. What are the identify of each of the three unknown metals?

Metal	Density (g/cm^3)	Metal	Density (g/cm^3)
Aluminum	2.70	Silver	10.49
Zinc	7.13	Lead	11.34
Iron	7.87	Gold	19.32
Copper	8.96		

5. A gold bar has a volume of 642 cm^3. Using the density from the chart in #4, calculate the mass of the gold bar.

6. A silversmith is making a silver serving tray and uses 112 g of silver to make it. Using the density from the chart in #4, calculate the volume of the silver serving tray.

7. Mr. Carson has 4 balloons, one is filled with methane (density = 0.716 g/L), the second is filled with neon (density = 0.900 g/L), the third is filled with argon (density = 1.784 g/L) and the fourth is filled with carbon dioxide (density = 1.98 g/L.) When he releases the balloons, which ones will float and which ones will sink? Why? Remember, the density of air is 1.29 g/L.

8. Solid water, ice, floats. Why? Explain in terms of density and in terms of particle arrangements. Draw diagrams of the arrangement of water molecules in liquid water and arrangement of water molecules in ice.