Honors Chemistry
Mathematics Reading assignment

Chemistry is many things. It is a science class, a lab class, an applied mathematics class and is unlike any class you have had before. This packet is designed to give you a jump start on some of the mathematics that we will deal with in the course. This packet is to be completed by the deadline specified in class and submitted to your honors chemistry teacher. The more effort you put forth now, the easier the school year will be for you. This packet is graded as one of your first homework assignments. It is OK to find it difficult, just do the best that you can and be prepared with questions as the need arises. The grade on this assignment will be largely based on the dimensional analysis section and how the problems are set up to show all work and the units factoring. Even if the answer is correct, the set up on those 4 problems will be examined for the grade. Do your best.

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See "Resource Information" below for notes on how to get to Blackboard as well as resources for solving the problems in this packet.

<u>Everything in this packet will be covered in class!!!</u>
<u>Scratch Paper</u>

Use the attached resource pages and the Internet to complete and/or derive the answers to following problems. Record answers in this packet and attach all work on a separate piece of paper.

S.I. Units

1. 2×10^{-3} seconds = 2 milliseconds = 2 ms
2. 3.4×10^{-9} grams = _____ = _____
3. 6.0×10^{-6} seconds = _____ = _____
4. 7.5×10^{6} meters = _____ = _____
5. $1.2\ \mu L$ = 1.2 microliters = 1.2×10^{-6} liters
6. 8 cm = _____ = _____
7. 9.1 Mg = _____ = _____
8. 4.6 nm = _____ = _____

PREFIX WORD PLAY

9. M tons = 10^{6} ton = mega ton
10. μ scope = 10^{-6} scope = _____
11. c pede = 10^{-3} pede = _____
12. d mate = 10^{-1} mate = _____
13. T pins = 10^{12} pins = _____
14. G lo = 10^{9} lo = _____
15. p boo = 10^{-12} boo = _____

Scientific Notation ~ Express each number in scientific notation.

1. 456,000,000 = 4.56×10^{8}
2. 0.000020 = _____
3. 0.045 = _____
4. 60,000 = _____
5. 0.000000235 = _____

Standard Notation ~ Express each number in standard notation.

1. 3.03×10^{-7} = _____
2. 9.7×10^{10} = _____
3. 1.6×10^{3} = _____
4. 4.8×10^{-3} = _____
5. 4.0×10^{-8} = _____

Use the attached resource pages and the Internet to complete and/or derive the answers to the following problems. Record answers in this packet and attach all work on a separate piece of paper.

<u>Significant Digits</u> ~State the number of significant digits in each measurement

1.	1405 m	___4___
2.	2.50 km	_____
3.	0.0034 m	_____
4.	12.007 kg	_____
5.	5.8×10^6 kg	_____

6.	3.03×10^{-5} mL	_____
7.	100,500.1 m	_____
8.	9834.05 m	_____
9.	2.3550 s	_____
10.	10,000 g	_____

<u>Rounding Numbers</u> ~ Round each number to the number of significant digits shown in parentheses.

1.	1405 m (2)	=	__1400_m_
2.	2.51 km (2)	=	_____
3.	0.0034 m (1)	=	_____
4.	12.007 kg (3)	=	_____
5.	100,500.1 m (4)	=	_____
6.	10.000 g (3)	=	_____
7.	2.35500 s (2)	=	_____
8.	0.05000 s (3)	=	_____
9.	0.000657030 m (2)	=	_____
10.	9834.05 m (3)	=	_____

Dimensional analysis ~ Solve each of the following by dimensional analysis. **Set up the problems as shown in the examples in the reference pages.**

1. The density of gold is 19.3 g/mL. How many grams are there in 400.0 mL of gold?

2. How many grams of carbon are present in 6.87 moles of carbon if the following equality is true:
    1 mole of carbon = 12.01g of carbon

3. At standard temperature and pressure (STP), 1 mole of a gas is equal to 22.4 L in volume. How many moles are present in 901 L of a gas at STP?

4. In a chemical reaction 2 moles of magnesium react with 1 mole of oxygen gas (2 mol Mg = 1 mol O_2). How many moles of magnesium will react with 15 moles of oxygen?

Blackboard notes:

In class you will using Blackboard for the entire year. To find the icon go to the school's main webpage: **www.arundelhigh.org** and scroll down to

the middle of the page. Click on the icon

which will take you to a login page. Log in using the following:

username g.eheinemann

password guest1

From there you can click on the Honors Chemistry class and find announcements and other information (some of which may be useful in helping with this packet).

Once the classes have been established, each of you will have your own login for Blackboard and will submit lab reports and homework electronically.

SI UNITS

SI Units are the standard units of measurements accepted in science.
Below is four of the base units used in Chemistry.

Starting SI Base Units		
Base Quantity	**Base**	**Symbol**
Length	Meter	m
Mass	gram	g
Volume	Liter	L
Time	Seconds	s

Below are the prefixes used with the basic and derived SI units.
Derived units are a combination of base units
such as density is grams per milliliter (g/mL).

Prefixes Used with SI Units			
Scientific Notation	**Prefix**	**Symbol**	**Example**
10^{-15}	femto-	f	femtosecond (fs)
10^{-12}	pico-	p	picometer (pm)
10^{-9}	nano-	n	nanometer (nm)
10^{-6}	micro-	μ	microgram (μ g)
10^{-3}	milli-	m	milliamps (mA)
10^{-2}	centi-	c	centimeter (cm)
10^{-1}	deci-	d	deciliter (dL)
10^{3}	kilo-	k	kilometer (kg)
10^{6}	mega-	M	megagram (Mg)
10^{9}	giga-	G	gigameter (Gm)
10^{12}	tera-	T	terahertz (THz)

Scientific Notation

Very large and very small numbers are often expressed in scientific notation (also known as exponential form). In scientific notation, a number is written as a product of two numbers: a coefficient, and 10 rose to a power. For example, the number 84,000 written in scientific notation is 8.4×10^4. The coefficient in is the number 8.4. In scientific notation the coefficient is always a number that is greater than or equal to one and less than ten. The power of ten, or exponent, in this example is 4. The exponent indicates how many times the coefficient 8.4 must be multiplied by 10 to get the number 84,000 (or how many spaces the decimal place was moved).

$$8.4 \times 10^4 = 8.4 \times 10 \times 10 \times 10 \times 10 = 84,000$$

Exponential form   standard form
(scientific notation)

When writing numbers greater than ten in scientific notation, the exponent is equal to the number of places the decimal point has been moved to the left.

$$6,300,000 = 6.3 \times 10^6 \qquad\qquad 94,700 = 9.47 \times 10^4$$

⟵   ⟵

6 places   4 places

Numbers less than one have a negative exponent when written in scientific notation. For example, the number 0.00025 written in scientific notation is 2.5×10^{-4}. The negative exponent -4 indicates that the coefficient 2.5 must be divided four times by 10 to equal the number 0.00025, as shown below. The exponent equals the number of spaces the decimal has been moved to the right.

$$2.5 \times 10^{-4} = \frac{2.5}{10 \times 10 \times 10 \times 10} = 0.00025$$

Exponential form   standard form
(scientific notation)

Multiplication and Division of Scientific Notation

To multiply numbers written in scientific notation, multiply the coefficients and add the exponents. You may have to adjust the format so that the coefficient is still between one and ten which means you may have to change the exponent accordingly when the decimal is moved left or right.

To divide numbers written in scientific notation, divide the coefficients and subtract the exponents. Again the format may need to be adjusted.

Addition and Subtraction

If you want to add or subtract the numbers expressed in scientific notation, and you are not using a calculator, then the exponents must be the same.   For example, suppose you want to calculate the sum of 5.4×10^3 and 8.0×10^2. First rewrite the second number so that the exponent is 3.

$$8.0 \times 10^2 = 0.80 \times 10^3$$

Now add the numbers

$$5.4 \times 10^3 + 0.80 \times 10^3 = (5.4 + 0.80) \times 10^3 = 6.2 \times 10^3$$

Significant Digits Rules:

1. Nonzero digits <u>ARE</u> significant.
2. <u style="color:red">Final</u> zeros after a decimal point <u>ARE</u> significant.
3. Zeros between two significant digits <u>ARE</u> significant.
4. Zeros used only as placeholders are <u>NOT</u> significant.

Examples:

5.0 g has two significant digits.

14.90 g has four significant digits.

0.01 has one significant digit.

300.00 mm has five significant digits.

5.06 s has three significant digits.

304 s has three significant digits.

0.0060 mm has two significant digits (6 & the last 0)

140 mm has two significant digits (1 & 4)

Multiplying and Dividing with Significant Digits

When measurements are used in calculation, the answer you calculate must be rounded to the correct number of significant digits (significant figures). In multiplication and division, the answer can have *no more significant digits* than the least number of significant digits in any measurement in the problem.

4.5 x 1.245 x 5 x 12 = 336.15 = 300

Since the number "5" has only one significant digit we must
round so that the answer only has one significant digit.

Adding and Subtracting with Significant Digits

In addition and subtraction, the answer can have *no more decimal places* than the least number of decimal places in any measurement in the problem.

23.5 + 2.1 +7.26 = 32.86 = 32.9

Since 23.5 and 2.1 both only have one decimal place, our
answer can only have one decimal place.

When adding or subtracting it is important to note that units on the numbers must also match or the mathematical function cannot be performed. Sometimes it is necessary to first convert units using dimensional analysis before adding or subtracting.

Unlimited Significant Digits

There are two cases in which numbers are considered <u>EXACT</u>, and thus, have an infinite number of significant digits.

1. Counted numbers have an infinite number of significant digits.
2. Universally agreed upon conversion factors have an infinite number of significant digits.

Conversion Problems and Dimensional Analysis

Many problems in both everyday life and in the sciences involve converting measurements. These problems may be simple conversions between the same kind of measurement. For example:

    a. A person is five and one-half feet tall. Express this height in inches.
    b. A flask holds 0.575 L of water. How many milliliters of water is this?

In other cases, you may need to convert between different kinds of measurements.

    c. How many gallons of gasoline can you buy for $15.00 if gasoline cost $2.87 per gallon?
    d. What is the mass of 254 cm^3 of gold if the density of gold is 19.3 g/cm^3?

More complex conversions problems may require conversions between measurements expresses as ratios of units. Consider the following:

    e. A car is traveling at 65 miles/hour. What is the speed of the car expressed in feet/second?
    f. The density of nitrogen gas is 1.17 g/L. What is the density of nitrogen expressed in micrograms/deciliter (μg/dL)?

Problems a. through f. can be solved using a method that is known by a few different names—dimensional analysis, factor label, and unit conversion. These names emphasize the fact that the dimensions, labels, or units of the measurements in a problem—the units in the given measurement(s) as well as the units in the desired answer—can help you write the solution to the problem.

Dimensional analysis makes use of ratios called conversion factors. A conversion factor is a ratio of two quantities equal to one another. For example, to work out problem a., you must know the relationship 1 ft = 12 in. The two conversions factors derived from this equality are shown below.

$$\frac{1 \text{ ft}}{12 \text{ in}} = 1 \text{ (unity)} = \frac{12 \text{ in}}{1 \text{ ft}}$$

To solve problem a. by dimensional analysis, you must multiply the given measurement (5.5 ft) by a conversion factor (ratio) that allows for the *feet* units to cancel, leaving only *inches*—the unit of the requested answer.

$$\left(5.5 \text{ ft}\right)\left(\frac{12 \text{ in}}{1 \text{ ft}}\right) = 66 \text{ in}$$

Note that ft divided by ft factors out (cancels).

If you needed to solve a problem when given 132 in and you need feet, you can solve using the same method but use the other of the two ratios above.

$$\left(132 \text{ in}\right)\left(\frac{1 \text{ ft}}{12 \text{ in}}\right) = 11 \text{ ft}$$

(Again, notice how the inches unit factors.)