Honors Chemistry Summer Work

Hello Honors chemists! We hope all of you are enjoying your summer. While we begin the Honors class properly this fall, we have an assignment to complete before school starts next year. This will help prepare you for the rigors of HP Chemistry.

The assignment will reinforce some familiar concepts you need to be familiar with, as well as introduce you to some concepts you will want learn/memorize before class starts. Why should you learn these materials over the summer? Honors Chemistry is a fast-paced class, chock full of chemistry knowledge. Being familiar with the material will help you be prepared for the year ahead.

Directions: Complete the following assignments to the best of your abilities. **Use of a calculator is encouraged**. Recognize that calculators are tools, not crutches. Make sure your brain is engaged before you start mashing buttons on the calculator. Nevertheless, **show all your work** to demonstrate your knowledge of the topic.

This packet will be collected our 2nd day of class. Please give yourself ample time to work through the packet and to memorize the required lists. The packet will be graded, and you will be quizzed on the information by the end of the first week. Good luck!

Algebraic manipulation – Isolate and solve for the variable below. **Show all work.** Provide answers in decimal form. Round to the thousandths place when necessary.

1. $\frac{a}{3} = 9$	2. $5 = \frac{b}{13}$
3. $\frac{8}{c} = 32$	4. $6 = \frac{64}{d}$
5. $\frac{e+2}{4} = 5$	6. $1 = \frac{f-11}{80}$
7. $\frac{g}{6} = \frac{5}{3}$	8. $\frac{45}{2} = \frac{75}{h}$
9. $\frac{4i}{3} = \frac{i}{10}$	10. $\frac{16j}{4} = \frac{25}{j}$
11. $\frac{2k+1}{3} = \frac{k-5}{10}$	12. $-\frac{10L-8}{2L} = \frac{25}{7}$
13. $\frac{6(m-2)}{3m} = \frac{2}{7}$	14. $\frac{-13n}{13n+2} = -\frac{4}{9}$
15. $\frac{2(p-6)}{5} + 14 = \frac{p+1}{10}$	16. $\frac{3q+5}{2q+1} = \frac{4}{3}$

Isolating variables – Isolate the variable requested in problems below. Show all work

1. Solve for *m* when $d = \frac{m}{v}$	2. Solve for *v* when $d = \frac{m}{v}$
3. Solve for *T* when $PV = nRT$	4. Solve for *R* when $PV = nRT$
5. Solve for *m* when $n = \frac{m}{M}$	6. Solve for *M* when $n = \frac{m}{M}$
7. Solve for *m* when $E = mc^2$	8. Solve for *c* when $E = mc^2$
9. Solve for *T* when $\Delta G = \Delta H - T\Delta S$	10. Solve for *ΔS* when $\Delta G = \Delta H - T\Delta S$
11. Solve for *Δp* when $\Delta x \Delta p \geq \frac{h}{4\pi}$	12. Solve for *π* when $\Delta x \Delta p \geq \frac{h}{4\pi}$
13. Solve for *λ* when $\frac{1}{\lambda} = R(\frac{1}{n_1^2} - \frac{1}{n_2^2})$	14. Solve for n_2 when $\frac{1}{\lambda} = R(\frac{1}{n_1^2} - \frac{1}{n_2^2})$
15. Solve for *F* when $\varepsilon = \varepsilon_0 - \frac{RT}{nF} lnQ$	16. *Challenge:* Solve for *Q* when $\varepsilon = \varepsilon_0 - \frac{RT}{nF} lnQ$

Significant Figures - Significant figures are the meaningful digits in a number that tell us how precise a measurement or calculation is. This concept is important because it helps us communicate the reliability of our data and make sure we report measurements and calculations accurately in chemistry.

Measuring Significant Figures from Instruments (Rulers, Graduated Cylinders, etc.)

Example: For this measurement, the number 8.2 can be read off the ruler directly. There are only markings for the first decimal (the tenth's place). The second decimal (the hundredth's place) needs to be estimated since there are no markings for it. Therefore, the correct measurement would be 8.25 cm. Answers of 8.24 or 8.26 would also be acceptable since the last digit was an estimate. The certain digits, however, do not change from reader to reader, only the last digit.

This is a diagram of a graduated cylinder. Try to determine what volume of water is in this graduated cylinder using the correct number of significant figures. The answer is written below. Remember, record the certain digits first. The estimate just ONE LAST DIGIT. Don't forget the unit!

Answer: The answer is 73.0 mL in my opinion but if you had 72.9 mL or 73.1 mL, your answer is also correct because the last digit was an estimate by the reader.

Determining the Number of Significant Figures When Given a Number

<u>RULES FOR SIG FIGS:</u>

Rule #1:Non-zeroes always significant – All non-zero digits are significant

Example: 3695.4 cm has 5 sig figs

Rule #2: Sandwich zeroes always significant – All zeroes located anywhere between significant digits are significant (also called the "Sandwich Rule" because the zeroes are sandwiched between two numbers)

Example: 3001 grams has 4 sig figs. The three and the one are significant because they are non-zero numbers (rule #1). Then both zeroes are significant because they fall somewhere between two significant digits (rule #2).

Rule #3 – **Leading zeroes never significant** - If there is no significant digit before the decimal, any zero before or after the decimal will be insignificant.

Example: 0.565 meters has 3 sig figs. The zeroes in this one are not significant because they are in front of the non-zero number (i.e. there is not a significant figure before them).

20.565 meters has 5 sig figs. The two makes the zero a sandwich zero.

0.0045 sec has 2 sig figs.

0.0002031 mL has 4 sig figs. The last zero is a sandwich zero

Rule #4 – **Trailing zero depends** - Any zero appearing after the **decimal** and after another significant figure is significant

Example: 0.004670 mm has 4 sig figs. The three zeroes at the beginning of the number are not significant because there is not a significant figure before them. The last zero is significant because it is after the decimal place and is after another significant figure.

Rule #5 – Trailing zero depends – Zeroes at the end of a number that does **not** contain a **decimal** are NOT significant

Example: 5000 mm has 1 sig fig

1350 cm has 3 sig figs. In both cases, the zero(s) are at the end of the number and there is no decimal point.

300. liters has 3 sig figs. The presence of the decimal indicates that both zeroes are significant.

(Addendum: This is the magic of significant figures. Say we were ratcatchers and you asked me to report on the number of rats we need to catch in a house. I could tell you 300 or 300. (with the decimal). The number without the decimal suggests that the number of mice is somewhere between 200 and 400 mice. (Not a very exact number.) The 300. with the decimal suggests that we have between 299 to 301 mice. (Definitely more exact.) This would let you be much more comfortable when bringing your rat catching implements.

RULES FOR CALCULATING WITH SIG FIGS:

Rule #1 – **Exact Number** Rule - If an exact number is being used, that number does not affect the number of significant figures in the final answer.

Example: Conversion factors are exact numbers because they do not ever change. An example would be 1 ft = 12 in. These values are exact and do not impact our sig fig calculations.

Rule #2 – **Multiplication/Division** Rule - The measurement with the smallest number of sig figs determines how many sig figs will be in the final answer.

Example: 4.3 x 1.23 = 5.289 but this answer has 4 sig figs and that is not correct. According to the rule, 4.3 has 2 sig figs, so our answer must have 2 sig figs. Therefore, the answer is 5.3. We make sure to round the 2 to a 3 since the second decimal place was higher than 5.

Rule #3 – **Addition/Subtraction** Rule - The measurement with the smallest number of decimal places determines the number of decimal places in the final answer.

Example: 67.0+4.35534 = 71.35534 This is an unrounded answer. 67.0 has one decimal place. 4.35534 has five decimal places. Because one < five, the answer should have one decimal place so it should be 71.4. Remember to look at the number past the last significant digit to determine if you need to round.

Remember, **only the final answer is rounded** to the correct sig figs/decimal places. If a problem has multiple steps, only determine the number of sig figs at the end of the problem. If you round along the way, the number will be very different from the actual value.

Determine the number of significant figures for the following values.

1. ________ 555
2. ________ 5.55
3. ________ 0.555
4. ________ 5.550
5. ________ 5.055
6. ________ 5,550
7. ________ 5550.
8. ________ 50,550
9. ________ 5,500.5
10. ________ 0.0555
11. ________ 0.05505
12. ________ 50.0550
13. ________ 0.50550
14. ________ 505,050
15. ________ 5,005.05
16. ________ 555,000.

Calculate the following expressions. Provide answers with the correct number of significant figures. Round the last digit correctly

1. 3.42 + 8.132 = __________
2. 4.9 + 3.822 = __________
3. 17.8 + 12.115 = __________
4. 4.55 + 3.45 = __________
5. 1.966 + 3.4422 = __________
6. 4.894 - 2.03 = __________
7. 11.22 - 8.8 = __________
8. 99.4230 + 0.79 = __________
9. 2.16 x 1.8 = __________

10. 1.408 x 2.2 = _________

11. 0.021 x 0.09330 = _________

12. 4.3324 x 1.2 = _________

13. 32.88 / 4.38 = _________

14. 16.590 / 1.8 = _________

15. 84.99 / 2.03 = _________

16. 0.990 / 3.4484 = _________

SCIENTIFIC NOTATION

Science can deal with very large and very small numbers. For example, there are 602,000,000,000,000,000,000,000 molecules in a mole. We use scientific notation to simplify these large (and also small) numbers.

Scientific Notation contains three parts:

1. a number greater than or equal to 1 but less than 10. The number usually contains a decimal

2. a multiplication sign

3. a power of 10 (Ex: 10^4)

Instead of writing 602,000,000,000,000,000,000,000 we can write 6.02×10^{23} making the number MUCH easier to deal with.

To determine how to write the number in scientific notation, follow these steps:

1. To determine what digits should appear in Part 1, write all the digits from the number that are significant, placing a decimal immediately after the first number. For the above number, that would be the 6.02 without any of the zeros (they are at the end of a number with no decimal place so they are not significant).

2. Then place a multiplication sign after the number … 6.02 x

3. To determine the power of ten, see how many times you needed to move the decimal so it would fall immediately after the first number from Part 1. For the above example, we had to move the decimal place 23 times to left.

i. Moving the decimal to the right makes the exponent negative.

ii. Moving the decimal to the left makes the exponent positive.

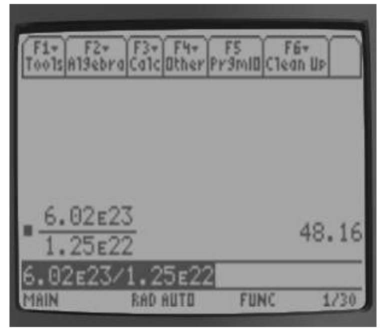
This example has the decimal moving to the left therefore making it a positive exponent. The final answer is 6.02×10^{23}

Quick Calculator Lesson (for any of the TI calculators):

1. Type in part 1 of the number

2. Press the “second” key and hit the comma key. A small upper case “E” will appear.

3. Then type in the power of the 10 (do not type the 10, just the number of its superscript)



Complete the questions below. Use rules for significant figures as appropriate.

1. Express 6,500,000 in scientific notation.
2. Express 0.000025 in scientific notation.
3. Express 3.75×10^{4} in standard notation.
4. Express 9.2×10^{-6} in standard notation.
5. Express 450,000,000,000 in scientific notation.
6. Express 7.8×10^{-2} in standard notation.
7. Express 0.000000092 in scientific notation.
8. Express 2.15×10^{8} in standard notation.

Use a calculator to solve the following expressions. Apply rules for signifcant figures as appropriate.

9. $(3.23\times10^{4})\times(5.7\times10^{2})$
10. $(6.802\times10^{7})/(1.54\times10^{3})$
11. $(9.62\times10^{5})\times(2.31\times10^{-2})$
12. $(4.1\times10^{-3})/(7.288\times10^{8})$

13. $(5.53\text{x}10^{-4})+(5.90\text{x}10^{-3})$
14. $(1.42\times10^{-71})-(7.10\times10^{-70})$
15. $(1.01\times10^{3})+(9.934\times10^{2})$
16. $(5.83\times10^{7})-(4.84\times10^{-3})$

METRIC SYSTEM

The metric system, also known as the International System of Units (SI), is a standardized system of measurement based on decimal multiples and submultiples of units. It encompasses seven base units, including the meter for length, kilogram for mass, liter for volume and second for time. While the USA uses the imperial system frequently, SI forms the foundation for consistent and universally accepted measurements across scientific disciplines and countries.

Below is a list of common metric prefixes. **Memorize** the prefixes, the abbreviations, and the relation to the base unit. You will be quizzed on this information the first week of school.

Prefix	Symbol	Meaning	Scientific Notation
Mega-	M	1,000,000	10^6
Kilo-	k	1,000	10^3
Hecta-	h	100	10^2
Deca-	da	10	10^1
Base Unit		1	10^0
Deci-	d	0.1	10^{-1}
Centi-	c	0.01	10^{-2}
Milli-	m	0.001	10^{-3}
Micro-	μ	0.000 001	10^{-6}
Nano-	n	0.000 000 001	10^{-9}
Pico-	p	0.000 000 000 001	10^{-12}

POLYATOMIC IONS

Memorize the following polyatomic ions. While the ions don't mean much to you at this point, these are very important when it comes to naming and will be discussed throughout the year. I suggest you make notecards to study them and WORK ON THEM ALL SUMMER!!! You need to know the **name**, the **formula**, and the **charge**. The name is found on the column on the right (e.g. Acetate). The formula is the letters and subscripts (e.g. $C_2H_3O_2$). The charge is the superscript (e.g. -2) Starred ones can be more easily memorized using the primer shown below the polyatomic ion list.

Acetate	$C_2H_3O_2^{-1}$	Iodate	IO_3^{-1}
Ammonium	NH_4^{+1}	Iodite*	IO_2^{-1}
Bicarbonate*	HCO_3^{-1}	Hypoiodite*	IO^{-1}
Perbromate*	BrO_4^{-1}	Nitrate	NO_3^{-1}
Bromate	BrO_3^{-1}	Nitrite*	NO_2^{-1}
Bromite*	BrO_2^{-1}	Oxalate	$C_2O_4^{-2}$
Hypobromite*	BrO^{-1}	Permanganate	MnO_4^{-1}
Carbonate	CO_3^{-2}	Manganate	MnO_4^{-2}
Perchlorate*	ClO_4^{-1}	Phosphate	PO_4^{-3}
Chlorate	ClO_3^{-1}	Phosphite*	PO_3^{-3}
Chlorite*	ClO_2^{-1}	Sulfate	SO_4^{-2}
Hypochlorite*	ClO^{-1}	Sulfite*	SO_3^{-2}
Chromate	CrO_4^{-2}	Thiocyanate	SCN^{-1}
Dichromate	$Cr_2O_7^{-2}$	Cyanate	OCN^{-1}
Hydroxide	OH^{-1}	Peroxide	O_2^{-2}
Periodate*	IO_4^{-1}		

Quick primer to reduce the amount of memorization needed:

Oxyanions are polyatomic ions that contain oxygen. The prefixes and suffixes of oxyanions can be changed to reflect a change in the number of oxygens in the polyatomic ion. The charge on the polyatomic ion DOES NOT CHANGE!!

Prefix Suffix Meaning

-*ate* Standard form of the polyatomic ion

-*ite* One less oxygen than standard form

hypo- -*ite* Two less oxygens than standard form

per- -*ate* One more oxygen than standard form

Example:

ClO_3^{-1} is chlorate

ClO_2^{-1} is chlorite

ClO^{-1} is hypochlorite

ClO_4^{-1} is perchlorate

Answer Key

1. 27
2. 65
3. 0.25
4. 10.667
5. 18
6. 91
7. 10
8. 3.333
9. 0
10. ±2.5
11. -0.68
12. 0.467
13. 3.667
14. 2.211
15. 2.096
16. 3.667
17. -11

1. $m = dv$
3. $T = \frac{PV}{nR}$
5. $m = nM$
7. $m = \frac{E}{c^2}$
9. $T = \frac{\Delta G - \Delta H}{\Delta S}$
11. $\Delta p \geq \frac{h}{4\pi\Delta x}$
13. $\lambda = \frac{n_1^2 n_2^2}{R(n_1^2 - n_2^2)}$
15. $F = \frac{n(\varepsilon - \varepsilon_0)}{RT lnQ}$

1. 3

2. 3

3. 3

4. 4

5. 3

6. 3

1. 11.55
3. 29.9
5. 5.408
7. 2.4
9. 3.9
11. 0.0020
13. 7.51
15. 0.287

1. 6.5×10^{6}
3. 37,500
5. 4.5×10^{11}
7. 9.2×10^{-8}
9. 1.8×10^{7}
11. 2.22×10^{4}
13. 6.45×10^{-3}
15. 2.00×10^{3}