Reference Sheets – Honors Chem Intro and Unit #1

This is *hopefully* all the general reference sheets, and Unit #1 Reference Sheets we will use this week in Honors Chem. Due to the challenging logistics of this year, please offer grace if I miss a handout or if things change during the week.

You are not required to print! I understand that may not be possible for everyone. However, if you can print it will make things a little easier! The packet is set up to be printed double sided. Some printers don't print double sided, but you can tell it to print the odd pages first, take the papers that just printed and put them back in the printer tray, and then print the even pages. I am trying to figure out how I can print packets for students and hopefully leave them outside of school for people to pick up if they want a packet. As soon as I know whether or not this is allowed I will let you know!

Please note – I will never ask you to print this many pages in a single document again! These are all of the "reference pages" that we use all year long. All of these pages are on the class website, always! www.mychemistryclass.net

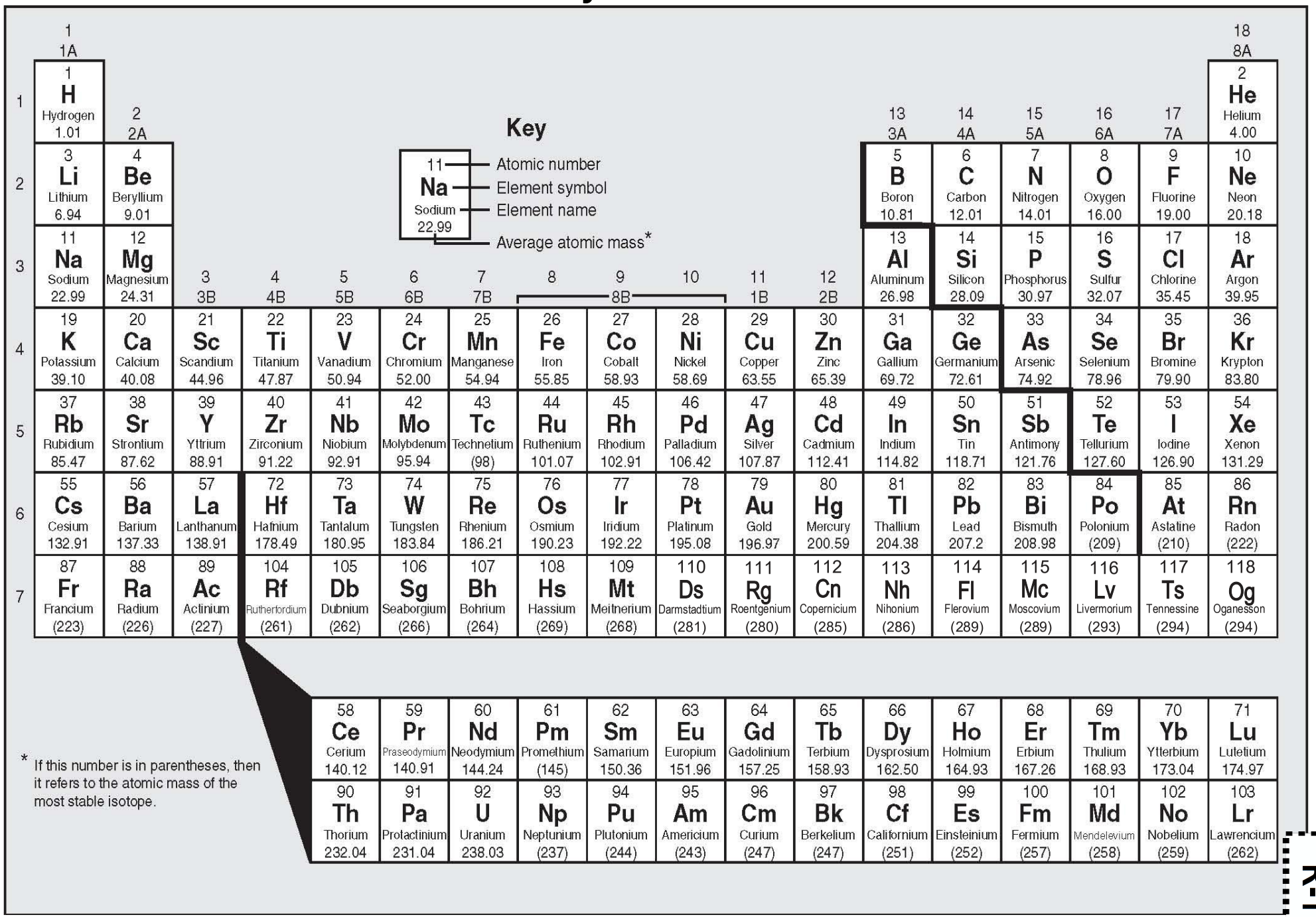
Please keep in mind that we are operating under the assumption that we will return to school at some point this year! So make sure you are *doing* your work, *keeping* your work, and keeping it *organized!* I will check your 3-ring binder and composition book when we return so you want to make sure you are setting yourself up for success by doing your work now!

Sections of your 3-ring Binder

R – reference section
S – study materials
WS – worksheet from a rainbow packet

N – notes, will be numbered N1, N2, etc (a glue in for your composition book)

Chemistry Reference Sheet



* If this number is in parentheses, then it refers to the atomic mass of the most stable isotope.

Memorize this stuff NOW!
Pop quizzes all year long!

Ion Sheet

+++ Positive Ions +++

1+	2+	3+	4+
Ammonium, NH_4^+ Copper(I), Cu^+ (*Cuprous)* Silver, Ag^+ Gold (I), Au^+ **And all elements in Group IA**	Cadmium(II), Cd^{2+} Chromium(II), Cr^{2+} Cobalt(II), Co^{2+} Copper(II), Cu^{2+} (*Cupric)* Iron(II), Fe^{2+} (*Ferrous*) Lead(II), Pb^{2+} (*Plumbous*) Manganese(II), Mn^{2+} Mercury(II), Hg^{2+} (*Mercuric*) Nickel(II), Ni^{2+} Tin(II), Sn^{2+} (*Stannous)* Zinc, Zn^{2+} Mercury(I), Hg_2^{2+} (*Mercurous*) **And all elements in Group 2A**	Chromium(III), Cr^{3+} Cobalt(III), Co^{3+} Gold(III), Au^{3+} Iron(III), Fe^{3+} (*Ferric*) Manganese(III), Mn^{3+} Nickel(III), Ni^{3+} Boron, B^{3+} Aluminum, Al^{3+} Gallium, Ga^{3+} Indium, In^{3+}	Lead(IV), Pb^{4+} (*Plumbic*) Manganese(IV), Mn^{4+} Silicon(IV), Si^{4+} Tin(IV), Sn^{4+} (*Stannic*) **And Group 4A can potentially make 4+ if under right circumstances**

--- Negative Ions ---

1-	2-	3-	4-
Acetate, $C_2H_3O_2^-$ Bicarbonate, HCO_3^- Chlorate, ClO_3^- Chlorite, ClO_2^- Cyanide, CN^- Hydroxide, OH^- Hypochlorite, ClO^- Nitrate, NO_3^- Nitrite, NO_2^- Perchlorate, ClO_4^- Permanganate, MnO_4^- Thiocyanate, SCN^- **And all elemens in Group 7A (Halogens)**	Carbonate, CO_3^{2-} Peroxide, O_2^{2-} Sulfate, SO_4^{2-} Sulfite, SO_3^{2-}Chromate, CrO_4^{2-}Dichromate, $Cr_2O_7^{2-}$Oxalate, $C_2O_4^{2-}$ Thiosulfate, $S_2O_3^{2-}$ **And all elements in Group 6A**	Phosphate, PO_4^{3-} Phosphide, P^{3-} Phosphite, PO_3^{3-} Arsenate, AsO_4^{3-} **And all elements in Group 5A**	Carbide, C^{4-} **And Group 4A can potentially make 4- if under right circumstances**

Prefixes		Common Molecular Gases	Common Acids	Diatomic Elements
One- mono Two- di Three- tri Four – tetra Five- penta	Six – hexa Seven – hepta Eight – octa Nine – nona Ten - deca	F_2, Cl_2, H_2, N_2, O_2, SO_2, SO_3, CO, CO_2, H_2S, NO, NO_2, NH_3, P_2O_3, P_2O_5, SiF_4, HCl, HBr, HI, HF, N_2O_5, N_2O_3, N_2O	Hydrochloric acid **HCl** Sulfuric acid **H_2SO_4** Nitric **HNO_3** Phosphoric **H_3PO_4** Acetic **$HC_2H_3O_2$** **Common Base** Ammonia **NH_3**	Hydrogen **H_2** Nitrogen **N_2** Oxygen **O_2** Flourine **F_2** Chlorine **Cl_2** Bromine **Br_2** Iodine **I_2**

Polyatomic Ions Containing Oxygen**		Acid Nomenclature*	
Per-……..-ate	Greatest number of oxygens	Per-……..-ic	Greatest number of oxygen atoms
……..-ate	Greater	……..-ic	Greater
……..-ite	Smaller	……..-ous	Smaller
Hypo……-ite	Smallest number of oxygens	Hypo……-ous	Smallest number of oxygen atoms

*Acids- Acids are molecular compounds that contain hydrogen bonded to a nonmetal to a group of atoms that behave like a nonmetal. Acids can be either binary or ternary compounds. The names of binary acids have the form Hydro-.....-ic acids. The names of ternary acids use a series of prefixes and suffixes to specify the relative number of oxygen atoms in the molecule.

**Names of polyatomic ions containing oxygen- some elements form several polyatomic ions with oxygen. A series of suffixes and prefixes is used to specify the relative number of oxygen atoms.

Memorize this stuff NOW!
Pop quizzes all year long!

Common Ions

R-2

+++ **Positive Ions** +++

1+	2+	3+	4+
Ammonium, NH_4^+ Copper(I), Cu^+ (*Cuprous)* Silver, Ag^+ Gold (I), Au^+ **And all elements in Group IA**	Cadmium, Cd^{2+} Chromium(II), Cr^{2+} Cobalt(II), Co^{2+} Copper(II), Cu^{2+} (*Cupric)* Iron(II), Fe^{2+} (*Ferrous*) Lead(II), Pb^{2+} (*Plumbous*) Manganese(II), Mn^{2+} Mercury(II), Hg^{2+} (*Mercuric*) Nickel(II), Ni^{2+} Tin(II), Sn^{2+} (*Stannous)* Zinc, Zn^{2+} Mercury(I), Hg_2^{2+} (*Mercurous*) **And all elements in Group 2A**	Chromium(III), Cr^{3+} Cobalt(III), Co^{3+} Gold(III), Au^{3+} Iron(III), Fe^{3+} (*Ferric*) Manganese(III), Mn^{3+} Nickel(III), Ni^{3+} Boron, B^{3+} Aluminum, Al^{3+} Gallium, Ga^{3+} Indium, In^{3+}	Lead(IV), Pb^{4+} (*Plumbic*) Manganese(IV), Mn^{4+} Silicon(IV), Si^{4+} Tin(IV), Sn^{4+} (*Stannic*) **And Group 4A can potentially make 4+ if under right circumstances**

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**Names of polyatomic ions containing oxygen- some elements form several polyatomic ions with oxygen. A series of suffixes and prefixes is used to specify the relative number of oxygen atoms.

Dougherty Valley HS Honors Chemistry
Strong Acid, Strong Base Handout

7 Strong Acids (H^+) All other acids are weak			8 Strong Bases (OH^-) All other bases are weak	
Hydrochloric acid	HCl		Lithium hydroxide	LiOH
Hydrobromic acid	HBr		Sodium hydroxide	NaOH
Hydroiodic	HI		Potassium hydroxide	KOH
Perchloric acid	$HClO_4$		Rubidium hydroxide	RbOH
Chloric acid	$HClO_3$		Cesium hydroxide	CsOH
Nitric acid	HNO_3		Calcium hydroxide	$Ca(OH)_2$
Sulfuric acid	H_2SO_4		Strontium hydroxide	$Sr(OH)_2$
---	---		Barium hydroxide	$Ba(OH)_2$

Memorize these 15, ALL ELSE ARE considered WEAK

How to Set Up Your Warm-ups in Honors Chem

R-3

Warm-up #1

HW: *(You copy it down from the board/PowerPoint)*

Questions: *(provided for you - here is an example)*

1) What does temperature measure?
2) Convert 25°C into Kelvin

1) Molecular movement

Average movement! Don't forget!

2) K = C +273

K = 25C + 273 = 298 K

Warm-up #2

HW: *(You copy it down from the board/PowerPoint)*

Questions: *(provided for you - here is an example)*

1) What sign should Q be if you are heating something up?
2) What SI unit do we use for specific heat capacity?
3) What mass of water would absorb 2.5 kJ of energy while heating 40°C to 45°C?

1) +

2) J/g°C

Forgot to convert kJ to J - Check units!

3) $Q = mC\Delta T \rightarrow m = Q/(C\Delta T)$

$m = (2.5kJ)/(4.18\ J/g°C)(45°C-40°C) =$ ~~0.12g~~

$m = (2500\ J)/(4.18\ J/g°C)(45°C-40°C) =$ 119.6 g

- Warmups are graded assignments.
- If you are absent you are required to make up the missed Warmups.
- You are responsible for knowing, understanding, and following the formatting requirements.
- If you have questions about the formatting requirements it is your responsibility to ask.
- See the back of this paper for more details.

Warm-up slip glued in! ALWAYS!

Copy down your HW! ALWAYS!

Show all your work! ALWAYS!

Include Units! ALWAYS!

Box your # answers! ALWAYS!

Correct in GREEN pen! ALWAYS!

Highlighter to show end! ALWAYS!

New work under highlighter! ALWAYS!

Cross out with single line! ALWAYS!

More Details about WARMUPS

1) Warmups are to be completed in your composition book only. No paper(s) can be stapled, taped, etc. into the book and receive credit.
2) Student may only receive up to FULL credit if the work is done in the composition book on that date.
3) Composition books will be graded in class the same day whenever possible. You may sometimes leave them in class to be graded. Sometimes they will be graded later, or not at all.
4) When graded they may be graded for completion and/or accuracy. Sometimes part of the grade will be whether or not you finished your notes from the previous lesson.
5) Following instructions regarding formatting is not optional. If you do not follow the instructions you will not receive full credit.

Possible Situations:

1) **ABSENT**:
   - You can find the warmups on the class website. If possible, please print at home and glue into your notebook and complete at home before returning to school so you are not behind.
   - If you cannot print at home as described above, then you must get the warmup slip from the absent bin and do the warmup
   - **SHOW** me that it was completed according to the standard absent procedure – you get the number of days as you were absent. Absent one day, you get one day. Absent two days, you get two days.
   - If shown to me within the allotted number of days, I will stamp it.
   - If there is no stamp for being absent, the students will earn no more than 50% of the points possible.
2) **FORGOT TO BRING COMPOSITION BOOK TO CLASS:**
   - If a Warmup is completed on paper other than in the composition book, you cannot receive full credit.
   - When a Warmup is transferred into your composition book (as in written in), there will be no handwritten grade, but there will be a Transfer Stamp, therefore they may earn up to 75% of possible points for that specific Warmup.
   - You must show me your original graded Warmup in order to get a Transfer stamp to show that you have transferred the Warmup from binder paper into your composition book.
   - If there is no stamp for the transfer, you will only be eligible to earn 50% of the points possible.
   - Transfer of work into the composition book must occur by the **NEXT** school day.
   - *Transfer*: Means to re-write the information in the composition book, not staple, tape, etc… the paper into the composition book
3) **LOST COMPOSITION BOOK:**
   - Don't lose your composition book…
   - If you lose your composition book you will not have any of the handwritten grades, so there is no record of your scores. Therefore, your redone work will only be eligible to earn up to 50% of the points possible.
   - I strongly suggest you scan or take pictures of your composition book to keep a record of your scores just in case you may have lost it.
     - If you do this, YOUR FULL NAME and THE DATE in INK must be written on each page so I know it is your work.

**Requirements, formatting instructions, grading procedures, etc are subject to change at teacher's discretion. If changes are made you will be notified in class.*

** If a situation arises that is not discussed above, it is your responsibility to bring it to the teacher's attention immediately. If you have questions it is your responsibility to bring it to the teacher's attention immediately.*

R-4

How to Set Up Your Notes in Honors Chem

Warm-up #1

HW: *(You copy it down from the board/PowerPoint)*

Questions: *(provided for you - here is an example)*
1) What does temperature measure?
2) Convert 25°C into Kelvin

1) Molecular movement
2) K = C +273
   K = 25C + 273 = 298 K

Average movement! Don't forget!

Calorimetry – using one substance to find values for another substance

- Cant always know the values for everything
- Energy in = energy out
  - But opposite sign! Careful! Pay attention to sign
- Exothermic = – Endothermic = +
- Qwater = -Qmetal
  - mCΔT = -(mCΔT)

(15g)(4.18J/gC)(31C-20C) = -(5g)(0.75J/gC)(31C-Ti)
Ti = 214.92C

You can do calorimetry with two cups of water!
Instead of Qmetal and Qwater → Qw1 and Qw2

K	C	Q
Add any key terms, vocab words, equations, etc. Bullet points are fine!	*Add connections to other things you have learned about in the past. It could be from this class, another class, the news, a book, etc.*	*Add **two** questions that are representative of the material learned in the notes. Questions you want to ask me, you think someone else would ask, or that you think would be on a quiz/test*

- Notes are graded assignments.
- If you are absent you are required to make up the missed Notes.
- Your notes need to look readable to another person, and should not be cramped together. Use space!
- KCQ Boxes are required to be finished by the start of the next class period. All efforts will be made to post this on School Loop each day, but it is expected and required even if something happens and it is not posted. You now know it is a daily requirement!
- You are responsible for knowing, understanding, and following the formatting requirements.
- If you have questions about the formatting requirements it is your responsibility to ask.
- Notes should reflect effort, thought, detail, reflection, and should demonstrate processing and learning taking place.

Don't need a new page, just continue!

Highlighter to show separation btwn work

Descriptive underlined title for notes

Take notes in a format you like

Include ALL important details

Practice problems are required!

Add THREE additional colors

Add color in a meaningful way!

KCQ Boxes at the end of the set of notes

EXAMPLE GRADING RUBRIC

This example gives you an idea of the types of things I look for when grading notebooks. This is not a guaranteed format or amount of points, it is simply an example to help guide you into doing complete and quality work. Notebook checks will be announced and unannounced. No points will be awarded if you fail to have your notebook on a collection day, either announced or unannounced.

Chapter 14 Composition Notebook Grade Sheet			
Name:		**Period:**	**Seat #:**

ITEM	**COMMENTS**		**SCORE**
N46 Acids and Bases and pH calculations pH Calculations Chart pH Square x 2	☐ No title ☐ Non-descriptive/obvious title ☐ Incomplete notes lacking info ☐ No color	☐ Min. Color &/or not used meaningfully ☐ No KCQ boxes ☐ KCQ incomplete/lacking effort/detail ☐ Other	10
N47 Nomenclature, Strong Acids/Bases, Ionization of Water Naming Glue In	☐ No title ☐ Non-descriptive/obvious title ☐ Incomplete notes lacking info ☐ No color	☐ Min. Color &/or not used meaningfully ☐ No KCQ boxes ☐ KCQ incomplete/lacking effort/detail ☐ Other	10
Warmup #22	☐ Missing ☐ Not graded	☐ No transfer stamp ☐ Other	5
N48 Weak Acids and Bases Glue In Practice Problems x 2	☐ No title ☐ Non-descriptive/obvious title ☐ Incomplete notes lacking info ☐ No color	☐ Min. Color &/or not used meaningfully ☐ No KCQ boxes ☐ KCQ incomplete/lacking effort/detail ☐ Other	10
Warmup #223	☐ Missing ☐ Not graded	☐ No transfer stamp ☐ Other	5
Warmup #24	☐ Missing ☐ Not graded	☐ No transfer stamp ☐ Other	5
N49 Salts Steps Glue In Chart Glue in x 2	☐ No title ☐ Non-descriptive/obvious title ☐ Incomplete notes lacking info ☐ No color	☐ Min. Color &/or not used meaningfully ☐ No KCQ boxes ☐ KCQ incomplete/lacking effort/detail ☐ Other	10
N48 Titrations Hands On Lecture	☐ No title ☐ Non-descriptive/obvious title ☐ Incomplete notes lacking info ☐ No color	☐ Min. Color &/or not used meaningfully ☐ No KCQ boxes ☐ KCQ incomplete/lacking effort/detail ☐ Other	10
		Total 65	

Dougherty Valley High School Chemistry

Pre-Lab Assignment and Post-Lab Assignment

R-5

ONLY BLACK OR BLUE PEN

GENERAL GUIDELINES

- All sections must be clearly labeled.
- Sections must be done in the order listed here.
- Headers must be filled out at the top of every page used in your lab notebook.
- This will be collected prior to the beginning of lab (except the data tables which are made before the lab, but on a separate page in your lab notebook so you can fill them out during lab).
- You may not participate in a lab without having it completed.
- Will sometimes be graded for completion and/or accuracy. Not all completed sections will necessarily be graded every time, one section might be chosen, or all might be chosen for grading.
- Professionalism matters – If I can't read it, if it looks like you did it last minute walking to class, if it looks like you put no thought, effort, care, detail into your work, that will be reflected in your score.
- You must use adequate spacing between sections to keep your work clear and understandable. Do NOT try to save space. You have plenty of pages in your lab notebook. Clearly communicating your work matters more than saving a few pages in your lab notebook.

PURPOSE OF THE EXPERIMENT

a. State the general principle being studied
b. State any specific results to be obtained

REAGENTS TABLE

Name	Formula	Molecular Weight (g/mol)	Physicals Properties			State @ Room Temp (°C)	Safety Concerns
			B.P. (°C)	M.P (°C)	Density (g/cm^3)		

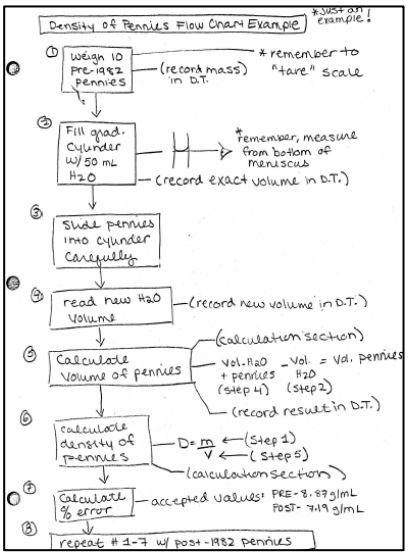
a. Provide the above info for the state (s, l, g, aq) that is being used in the lab.
b. Note safety/cleanup points (if provided, all should be – BE DESCRIPTIVE)
c. Googling MSDS is how to do this! We don't really use physical MSDS books anymore.

MATERIALS

a. List all needed chemicals, materials, and equipment in a bullet list.

PROCEDURE

a. Rewrite the procedure in your own words and in FLOW CHART STYLE!
b. Do not copy directly from lab handout!
c. Full sentences not needed.
d. Do not combine steps. Keep the original numbering system in the lab handout. This is important in case we need to make changes before the lab, or if you need help you can tell me what step you are on.
e. Included drawings of lab setups when applicable. Label the drawings with equipment names.
f. Add reminders, equations, notes to yourself etc.
g. The intention of this section is to get you to *think about* the steps by putting it in your own shortened version.
h. You should be able to do the lab with nothing but your notebook!



PRE-LAB QUESTIONS

a. Complete any listed pre-lab questions.
b. Number all questions.
c. Must show all work for calculations.
d. Do not recopy the question. Paraphrase it into your answers so a reader can infer what the question was.
e. Full sentence answers are not needed, but complete and detailed answers and thoughts are required!
f. Box any final numerical or short phrase like answers.

DATA SECTION

a. **Must be done on a NEW sheet of paper in your lab notebook! It cannot be on the same page as the rest of your pre-lab because you will be tearing out the carbon copy pages of your pre-lab and turning that in before you start the lab.**
b. Set up your data table(s) BEFORE the lab starts. This is part of your pre-lab assignment even though it is not turned in with the rest of the sections. It may be checked even though it is not turned in until after the lab.
c. Must include sections for QUANTATATIVE and QUALITATIVE data.
d. Make it large – does not have to be an entire page, but needs to be sufficiently large. You will be docked points for any work that is "squished," as that is not professional work and hinders the reader's ability to learn from it.
e. You must give your data table(s) a descriptive title. It should specifically mention any reaction(s) that is/are occurring as part of the title.
    a. Bad titles – Data Table, Table for My Lab, Table of Lab Numbers, Lab Data, etc.
    b. Better titles – Effect of Concentration on Absorbance, pH of Common Household Substances, etc.
f. You must have units in the headers of the columns/rows.
g. Your data collection should reflect the significant figures that are appropriate for each piece of equipment you are using. Remember that our equipment is inherently limited in precision!
h. Your qualitative observations must be descriptive and detailed. It is not sufficient to say "it changed colors," or "it reacted." Qualitative data is as important as quantitative data!

CALCULATIONS SECTION

a. Must show ANY calculation or manipulation of numbers done during and/or after the lab. If it is not a direct measurement, there should be evidence of it in the calculation section.
b. Sometimes results of calculations are put into your data tables. You still need to show the calc's here!
c. Even "simple" calculations need to be shown. This includes subtracting, adding, metric conversions, etc.
d. Number and label all calculations. Make sure to give short label so people know what the calculation is.
e. Make sure you include units everywhere!

POST LAB

a. Post Lab Questions – in lab notebook.
    a. Number all questions.
    b. Do not recopy the question. Paraphrase in your answers so a reader can infer what the question was.
    c. Complete sentences not needed unless asked for. Complete thoughts and answers ARE needed!
b. Post Lab Two Pager – worksheet given to you.
    a. Summarizes what you learned.
    b. Imagine you are making a "cheat sheet" for a lab quiz! You may or may not be allowed to use these Two Pagers on Post Lab Quizzes. It will be announced at the start of the quiz if you can use it or not.
c. Formal Lab Report Sections
    a. Not always given. You will be told if/when to do one or more of these formal sections.
    b. Expectations will be given to you at the time. General expectations are on the Lab Guidelines Check List.
d. Post Lab Quiz
    a. Pop quizzes that can happen any time after a quiz.
    b. Will assess whether you actually *learned* from the lab. It is imperative that you do not just copy lab work from classmates. Lab questions may appear on pop quizzes, chapter quizzes, tests, finals etc.

The lab assignments and expectations can change at teacher's discretion

Dougherty Valley HS Chemistry
Post Lab Two Pager

Worksheet #____

Name: **Period:** **Seat#:**

Lab Title	**Topic**
Purpose/Question/Problem/Goal/Hypothesis	
Key Vocab Terms	**Key Equations**
Key Concept Explained	
Important or Unique Lab Equipment, Set Up, or Named Lab Techniques	**Sig Figs Related to Lab Equipment**
Your Experimental Results	
Accepted Value/Results	**Percent Error Calculation**

Dougherty Valley HS Chemistry
Post Lab Two Pager

Sample Calculations for Each Type of Calculation Done	
Possible Lab Errors	**Mathematical Impact of Lab Errors on Results**
Example Test Question on this Topic	**Solved Example Test Question on this Topic**

Things to Turn In

- **Prelab –** Done in lab notebook, carbon papers turned in *before* the lab.
- **Post Lab** – Turned in after the lab. Due dates will be told to you in class.
  - **Page 1 – Post Lab Two Pager** – Done on this template.
  - **Page 2 – Data Tables** – Done in lab notebook, carbon papers turned in.
  - **Page 3 – Calculation Section –** Done in lab notebook, carbon papers turned in.
  - **Page 4 – Post Lab Questions** – Questions on lab sheet, answers done in lab notebook, carbon papers turned in.
  - **Page 5 – Formal Post Lab Section** - If asked for. Will be given specific instructions at the time.
- **Post Lab Quiz –** Will be done and turned in during class.

Make-up Lab Sheet for Missed Lab Assignment

You can print copies of this on the "Labs" tab of the class website. You have one day longer than you were gone to complete this assignment. Gone one day, then you get two days to complete. Gone two days, then you get three days. If you were present for the lab but did not participate then it is due the next day.

Name:
Period:
Seat #:

Write the name of the missed lab here: _____
Write the date that the lab was originally performed here:

Instructions:

Interview at least three (3) students who were present for the lab activity and have them orally answer the questions listed below. Take notes while discussing the lab and staple them to this paper. Please have your interviewees provide their names ad signatures in the table below.

Name (Printed)	Period/Teacher	Signature

Now, YOU answer the following questions on this sheet:

1. What was the main idea that this lab activity was trying to demonstrate?

2. How did the lab activity demonstrate this idea (i.e., what did people do to find out the main idea?)

3. How does the information from questions 1 and 2 relate to what we are currently studying?

4. Identify at least one applicable (or use) for the information presented in the lab; that is, how could the information relate to you own personal use, an industrial use, or a societal application?

5. Write two test questions that would be fair to ask about this lab on a unit test or a quiz.

Generic Chemistry Lab Report Guidelines – Specifics given in class supersede these generic guidelines!

Please Note: *Labs grades are based on quality not just completion! Articulating ideas clearly is key to science!*

REQUIREMENTS	AREAS TO IMPROVE UPON
Format ☐ 10pt Times New Roman or Arial font ONLY ☐ 1.5 spaced ☐ Bold section headings for everything ☐ 8.5"x11" white paper ☐ 0.5" margins on all sides ☐ Abstract has 2" margins on each side and is single-spaced. ☐ Stapled in following order: o Title page o Lab report o Carbon Copy pages used during lab (Must have HEADER filled out on every page) o Carbon Copy pages used for lab report and post lab Q's ☐ THIRD PERSON, PAST TENSE, PASSIVE VOICE!!!! o We know you wrote it…your name is on the front…use third person o You already finished the lab before you did your report! Use past tense! o I know your English teachers don't like passive voice… but it is appropriate for lab reports! • Active voice: The hot plate stirred the reaction for three minutes. • Passive voice: The reaction was stirred by the hot plate for three minutes	**Formatting** 1 ☐ 2 ☐ 3 ☐ 4 ☐ 10pt correct font ☐ Yes ☐ No 0.5-in margins ☐ Yes ☐ No 1.5-in spacing ☐ Yes ☐ No Stapled In Order ☐ Yes ☐ No 3rd Person ☐ Yes ☐ No Past Tense ☐ Yes ☐ No Section Headings ☐ Yes ☐ No **Abstract Format** Justified both sides ☐ Yes ☐ No 2-in margins ☐ Yes ☐ No Single Spaced ☐ Yes ☐ No
Title Page ☐ It gets its own page! ☐ Title of lab ☐ Abstract (see below) ☐ Group members and how they contributed (Name, section worked on) ☐ Date of lab experiment ☐ Class and period	**Title Page** 1 ☐ 2 ☐ 3 ☐ 4 ☐ Own page ☐ Yes ☐ No Title ☐ Yes ☐ No Abstract present ☐ Yes ☐ No Group members ☐ Yes ☐ No Date ☐ Yes ☐ No Class and period ☐ Yes ☐ No
Abstract ☐ On Title Page (2-in margins) ☐ Justified on both sides, do not center on page! ☐ The following is to be articulated concisely in no more than 3-5 sentence sin the order below • Sentence 1: What was the purpose of the experiment? The question or statement. Do not copy from lab handout. • Sentence 2: What you found out (the results – the silver alloy beads were found to contain X% of silver) • Sentence 3: How the results were determined (Brief! Specific names of lab techniques if applicable) • Sentence 4: Report accepted value (if applicable) and percent error. • Sentence 5: Conclusions made (if applicable), what you drew from the experiment	**Abstract** 1 ☐ 2 ☐ 3 ☐ 4 ☐ Purpose ☐ Yes ☐ No Results ☐ Yes ☐ No How results were found ☐ Yes ☐ No Named techniques* ☐ Yes ☐ No Accepted value* ☐ Yes ☐ No Percent error* ☐ Yes ☐ No Conclusions made ☐ Yes ☐ No Short, concise and clear ☐ Yes ☐ No **if applicable*

Background – part of prelab if required

- ☐ Do NOT copy info from lab worksheet!
- ☐ Summary/explanation of the important chemistry topics covered in lab
- ☐ Explain how the topics relate directly to the lab
- ☐ What will your lab be discovering/testing related to the topics
- ☐ What is your experimental question/variables
- ☐ Include relevant chemistry vocabulary
- ☐ Include relevant chemical equations
- ☐ Include balancing and states for chemical equations
- ☐ Number each equation to make referencing easier
- ☐ Hypothesis if applicable
  - If _____, then _____, BECAUSE _____. Everyone forgets the BECAUSE portion!
  - Relate it back to the topics covered
- ☐ Be sure to site any references used including textbook, website, lab manual, etc. Below is a good explanation of ACS formatting.
  - https://libguides.williams.edu/citing/acs

Background 1 ☐ 2 ☐ 3 ☐ 4 ☐

In Own Words
- ☐ Yes
- ☐ No

Chem Topics Explained
- ☐ All
- ☐ Some
- ☐ None or incorrect

Connection to Lab
- ☐ All
- ☐ Some
- ☐ None or incorrect

Exp. Q/Variables
- ☐ All identified
- ☐ Some identified
- ☐ None

**if applicable*

Defined Vocab
- ☐ All
- ☐ Some
- ☐ None

Chem Rxns*
- ☐ All balanced w/ states
- ☐ Some or not bal/states
- ☐ None or wrong

Hypothesis*
- ☐ Yes and correct format
- ☐ Yes but lacking
- ☐ Not included

References*
- ☐ Yes and ACS format
- ☐ Yes but lacking
- ☐ Not included

Observations/Data

- ☐ Qualitative and quantitative! Must have both!
- ☐ Lab notebook paper only, with data tables and graphs made/collected DURING the lab
- ☐ Professional appearance
  - Clear, large, not squished!
  - Black or blue ink ONLY
- ☐ Descriptive titles
- ☐ Sig figs for measurements and calculations
- ☐ Label graphs/tables with name of measurement and units

Data Table 1 ☐ 2 ☐ 3 ☐ 4 ☐

Observations
- ☐ Significant, detailed, thorough
- ☐ Sufficient
- ☐ Lacking

Professionalism
- ☐ Total pro, ruler used, readable, etc
- ☐ Good
- ☐ Lacking

Titles
- ☐ Strong, descriptive, clear
- ☐ Good, attempt at being descriptive
- ☐ Unclear, not descriptive

Calculations

- ☐ Work shown completely
- ☐ Flow of work is clear
- ☐ Work set up correctly to solve actual problem
- ☐ Correct numbers used in work
- ☐ Units provided everywhere
- ☐ Correct answer

Calculations 1 ☐ 2 ☐ 3 ☐ 4 ☐

Work Shown
- ☐ Significant, detailed, thorough
- ☐ Sufficient
- ☐ Lacking

Organization of Work
- ☐ Clear
- ☐ Hazy
- ☐ Cloudy

Correctly Set Up
☐ All ☐ Most ☐ Some ☐ None

Units
- ☐ All
- ☐ Some
- ☐ None or wrong

Correct Answers
- ☐ All
- ☐ Most
- ☐ Some

Data Analysis

- ☐ Include table and graph of anything you calculated, manipulated or plotted AFTER the lab. Make sure tables and graphs are labeled correctly
- ☐ Explain data that you collected
- ☐ Include a few sentences explaining what the graphs/tables show or indicate
- ☐ Mention any errors and how they affect your data analysis. Remember "human error" is not an acceptable phrase.
- ☐ Include percent errors if applicable
- ☐ Include one sample calculation for each type of calculation performed
- ☐ Include equations, reactions, units, work, etc.
- ☐ Define symbols/variables used
- ☐ You may be graded on the accuracy of your lab data and/or whether your calculations are correct or not

Data Analysis 1 ☐ 2 ☐ 3 ☐ 4 ☐

Data/Graphs
- ☐ All included
- ☐ Missing some
- ☐ Not included

% Error
- ☐ Yes
- ☐ No
- ☐ Wrong

Labels
- ☐ All
- ☐ Some
- ☐ None or wrong

Sample Calculations
- ☐ All
- ☐ Some
- ☐ None or wrong

Explain Data/Graphs
- ☐ All
- ☐ Some
- ☐ None

Eq's, Rxns, Units, etc
- ☐ All
- ☐ Some
- ☐ None or wrong

Errors
- ☐ Significant errors
- ☐ Not significant ones
- ☐ Did not explain impact
- ☐ Not included

Accuracy
- ☐ Great
- ☐ Ok
- ☐ Poor

Discussion Questions

- ☐ Answers to provided lab questions, statements, or calculations with work shown and units when appropriate.
- ☐ Each Q is numbered and answered in complete sentences.
- ☐ Restate the question in your answer, do not just copy the Q!
- ☐ Will sometimes be done as part of a formal report as a group, or done individually on the carbon copy paper in your notebook.
  - If done on carbon copy paper but a formal lab report is also typed up, then you must include this section heading in the report but simply say "refer to carbon copy pages at the end of the report."
- ☐ Will sometimes be graded for completion, and sometimes will be graded for accuracy.

Discussion Questions 1 ☐ 2 ☐ 3 ☐ 4 ☐

Questions
- ☐ All included
- ☐ Missing some
- ☐ Not included

Calculations w/ Work
- ☐ All
- ☐ Some
- ☐ None

Complete Sentences
- ☐ All
- ☐ Some
- ☐ None

Correct Answer
- ☐ All
- ☐ Most
- ☐ Few
- ☐ None

Questions Restated
☐ All ☐ Some ☐ None

Conclusion

- ☐ Complete sentences, paragraph form
- ☐ Report your final results
- ☐ Include accepted value and % error if applicable
- ☐ Explain why it turned out the way it did – sources of error, limits in lab design, etc.
- ☐ Relate findings back to basic principles of chemistry
- ☐ What further experiments might you do to keep studying this?
- ☐ How does it relate to real life if applicable?
- ☐ How could you make improvements to the lab?

Conclusion 1 ☐ 2 ☐ 3 ☐ 4 ☐

Complete Sentences ☐ Yes ☐ No

Relate to Chem Topics ☐ Yes ☐ No

Results Reported ☐ Yes ☐ No

Further Experiments ☐ Yes ☐ No

Accepted Value / % Error ☐ Yes ☐ No

Relates to Real Life ☐ Yes ☐ No

Errors ☐ Yes ☐ No

Improvements ☐ Yes ☐ No

Level of Detail ☐ Significant ☐ Sufficient ☐ Lacking

General Feedback about Pre-Labs

- Read ALL of R-5…not just the first page!
    - There are entire check lists and examples of how things are graded! Look at them!
- Fill out headers and footers
- Stop squishing things
- Include ALL asked for parts
    - Don't include things that weren't asked for
- DON'T COPY!
    - That means don't copy background info, procedures, etc
- Shorten procedures
    - Get right to the point! Just enough to jog your memory! Stop writing so much!
    - A Flow Chart is meant to be partially visual! Not just drawing boxes around a bunch of writing!
- Reagent tables need to be filled out!
    - Writing "don't eat it" in every safety concern box is not going to get you points…obviously don't eat ANYTHING in the lab. List things like flammability, skin irritant, etc. Actually look it up!
- Don't leave pre-labs until the very last minute…

Satisfied with your pre-lab score?

- Do not get complacent!
    - We need to show growth, improvement, and refinement as the year goes on.
    - Expectations do not remain stagnant – they grow as our skills should be growing as the year goes on!

Not satisfied with your pre-lab score?

- Rewrite the ENTIRE thing on binder paper
    - Not just the parts you lost points on
- Use homework pass to resubmit it
    - Don't forget to fill out Gold Form to attach to homework pass and redone pre-lab
    - You must staple the original to the back of your new one
        - Original may NOT leave the classroom – you may come in during brunch/lunch/access to look at it and to get it out of your folder to staple to the back of your new one before turning in.

Need help?

- Ask BEFORE the day it is due!
- Come see me during brunch/lunch/access or email me!
- Don't email me at a crazy hour of the night the day before it is due…that is not being responsible…

Add this to your R-5 lab info Reference Sheets!

Solubility of Some Ionic Compounds in Water

Always Soluble		
Alkali metals =	Li^+, Na^+, K^+, Rb^+, Cs^+	AAA CNP
Ammonium =	NH_4^+	
Acetate =	$C_2H_3O_2^-$	
Chlorate =	ClO_3^-	
Nitrate =	NO_3^-	
Perchlorate =	ClO_4^-	
Generally Soluble		
Cl^-, Br^-, I^-	Soluble *except*: Ag^+, Pb^{2+}, Hg_2^{2+}	AP-H
F^-	Soluble *except*: Ca^{2+}, Ba^{2+}, Sr^{2+}, Pb^{2+}, Mg^{2+}	CBS-PM
Sulfate = SO_4^{2-}	Soluble *except*: Ca^{2+}, Ba^{2+}, Sr^{2+}, Pb^{2+}	CBS-P
Generally Insoluble		
O^{2-}, OH^-	Insoluble *except*: Alkali metals and NH_4^+	AA
	Somewhat soluble: Ca^{2+}, Ba^{2+}, Sr^{2+}	CBS
CO_2^{2-}, CO_3^{2-} S^{2-}, SO_3^{2-} PO_4^{3-} CrO_4^{2-}, $Cr_2O_4^{2-}$	Insoluble *except*: Alkali metals and NH_4^+	AA

Not Soluble = forms precipitate

Soluble = dissolves in water (aqueous)

Activity Series Chart

Metals

Non-Metals

	Name	Symbol	Name	Symbol
Most Active	Lithium	Li	Fluorine	F
	Potassium	K	Chlorine	Cl
	Barium	Ba	Bromine	Br
	Strontium	Sr	Iodine	I
	Calcium	Ca		
	Sodium	Na		
	Magnesium	Mg		
	Aluminum	Al		
	Manganese	Mn		
	Zinc	Zn		
	Iron	Fe		
	Cadmium	Cd		
	Cobalt	Co		
	Nickel	Ni		
	Tin	Sn		
	Lead	Pb		
	Hydrogen	H		
	Copper	Cu		
	Silver	Ag		
	Mercury	Hg		
Least Active	Gold	Au		

***

Elements CANNOT replace anything ABOVE them.
The reaction DOES NOT OCCUR in this situation.

***

Examples: $ZnCl_2 + Mg \rightarrow MgCl_2$

Magnesium is above Zinc so the reaction happens

$ZnCl_2 + Cu \rightarrow$ No Reaction

Copper is below Zinc so no reaction happens

Useful and Necessary Formulas

R-7

http://www2.ucdsb.on.ca/tiss/stretton/Database/formulas_content.html

1. **Electromagnetic Radiation**
   - a) Speed of Light — $c = \lambda * v$
   - b) Wavelength — $\lambda = c / v$
   - c) Frequency — $v = c / \lambda$
   - d) Energy in a photon — $E = h * v$
2. **Concentration and Molar Mass**
   - a) Density (D) — $D = m / V$
   - b) Moles (n) — $n = g / mm$
   - c) Moles (# of particles) — $n =$ number of particles / Avogadro's number
   - d) Moles (solution) — $n =$ concentration • volume
   - e) Moles (gas equation) — $n = PV / RT$
   - f) Molarity (M) — $M = n /$ volume
   - g) Molar mass (mm) — $mm = m / n$
3. **Gases**
   - a) Boyle's Law — $P_1 \bullet V_1 = P_2 \bullet V_2$
   - b) Charles' Law — $V_1 \bullet T_2 = V_2 \bullet T_1$
   - c) Combined Gas Law — $P_1 \bullet V_1 / T_1 = P_2 \bullet V_2 / T_2$
   - d) Ideal Gas Law — $PV = nRT$
   - e) Dalton's Law of Partial Pressures — $P_T = P_1 + P_2 + P_3 + ... + P_n$
4. **Acids and Bases**
   - a) pH — $pH = -\log[H^{+1}]$
   - b) pOH — $pOH = -\log[OH^{-1}]$
   - c) $[H_3O^{+1}]$ — $[H_3O^{+1}] = 10^{-pH}$
   - d) $[OH^{-1}]$ — $[OH^{-1}] = 10^{-pOH}$
5. **Heat**
   - a) Quantity of Heat (Q) — $Q = m \bullet c \bullet \Delta t$
   - b) Quantity of Heat (fusion) — $Q = m \bullet L_f$
   - c) Quantity of Heat (vaporization) — $Q = m \bullet L_v$
   - d) Celsius to Kelvin — $K = {}^oC + 273.15$
   - e) Kelvin to Celcius — ${}^oC = K - 273.15$
6. **Mathematics**
   - a) Quadratic Equation — $x = -b \pm (b^2 - 4ac)^{-2} / 2a$

Common Physical and Chemical Constants

http://www2.ucdsb.on.ca/tiss/stretton/Database/constants.htm

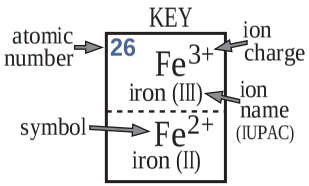
Avogadro's Number	**6.02217×10^{23} things/mole**
Planck's Constant	**$6.6260755 \times 10^{-34}$ Js**
1 atmosphere (atm)	**101,325 Pascals (Pa) = 101.325 kPa = 760 mm of Hg = 760 Torr = 1.01325 bar**
1 mole of any gas at STP	**22.4 L (0^{o}C, 1 atm)**
1 mole of any gas at SATP	**24.8 L (25^{o}C, 1 atm)**
Ideal Gas Law Constant (R)	**0.0821 L atm mol^{-1} K^{-1} = 8.31430 L kPa mol^{-1} K^{-1} = 8.31441 J mol^{-1} K^{-1}**
1 calorie (cal)	**4.184 J**
1 Cal	**1 kcal = 1000 calories**
1 atomic mass unit (amu)	**$1.6605665 \times 10^{-24}$ g**
1 tonne(t)	**1000 kg = 1 Mg**
Speed of light in a vacuum	**299792458 m s^{-1} (3.0×10^{8} m s^{-1})**
Rest mass of an electron (m_e)	**0.000548712 u = $9.1093897 \times 10^{-28}$ g**
Rest mass of a proton (m_p)	**1.00727605 u = $1.67262305 \times 10^{-24}$ g**
Rest mass of a neutron (m_n)	**1.008665 u = 1.674954×10^{-24} g**
1 kiloWattHour(kWh)	**3.6 MJ**
1 Joule (J)	**1 kg m^2 s^{-2} = 1.0×10^{7} erg**
1 Coulomb(C)	**6.24×10^{18} e^-**
Electronic charge on an electron	**$1.60217733 \times 10^{-19}$ C**
1 Ampere(A)	**1 Coulomb/s**
1 Volt(V)	**1 J/C = 96.5 kJ/mole**
1 electron volt (eV)	**1.60219×10^{-19} J**
Faraday's Constant	**96,486.7 C/mole e^-**

PERIODIC TABLE OF IONS

TABLE OF POLYATOMIC IONS

acetate	CH_3COO^-	dihydrogen phosphate	$H_2PO_4^-$	oxalate	$C_2O_4^{2-}$
arsenate	AsO_4^{3-}	hydrogen carbonate	HCO_3^-	perchlorate	ClO_4^-
arsenite	AsO_3^{3-}	hydrogen oxalate	$HC_2O_4^-$	periodate	IO_4^-
benzoate	$C_6H_5COO^-$	hydrogen sulfate	HSO_4^-	permanganate	MnO_4^-
borate	BO_3^{3-}	hydrogen sulfide	HS^-	peroxide	O_2^{2-}
bromate	BrO_3^-	hydrogen sulfite	HSO_3^-	phosphate	PO_4^{3-}
carbonate	CO_3^{2-}	hydroxide	OH^-	pyrophosphate	$P_2O_7^{4-}$
chlorate	ClO_3^-	hypochlorite	ClO^-	sulfate	SO_4^{2-}
chloride	Cl^-	iodate	IO_3^-	sulfite	SO_3^{2-}
chlorite	ClO_2^-	monohydrogen phosphate	HPO_4^{2-}	thiocyanate	SCN^-
chromate	CrO_4^{2-}	nitrate	NO_3^-	thiosulfate	$S_2O_3^{2-}$
cyanate	CNO^-	nitrite	NO_2^-	**POSITIVE POLYATOMIC IONS**	
cyanide	CN^-	orthosilicate	SiO_4^{4-}	ammonium	NH_4^+
dichromate	$Cr_2O_7^{2-}$			hydronium	H_3O^+

KEY



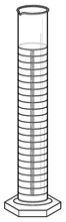
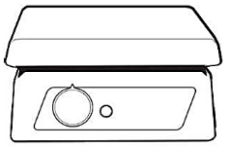
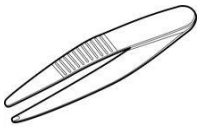
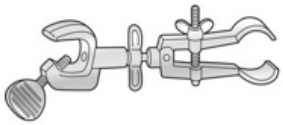
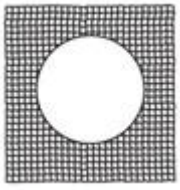
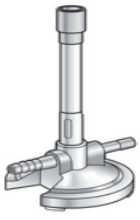
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1 H^+ hydrogen																1 H^- hydride	2 He helium
3 Li^+ lithium	4 Be^{2+} beryllium											5 B boron	6 C carbon	7 N^{3-} nitride	8 O^{2-} oxide	9 F^- fluoride	10 Ne neon
11 Na^+ sodium	12 Mg^{2+} magnesium											13 Al^{3+} aluminum	14 Si silicon	15 P^{3-} phosphide	16 S^{2-} sulfiide	17 Cl^- chloride	18 Ar argon
19 K^+ potassium	20 Ca^{2+} calcium	21 Sc^{3+} scandium	22 Ti^{4+} titanium (IV) Ti^{3+} titanium (III)	23 V^{3+} vanadium(III) V^{5+} vanadium (V)	24 Cr^{3+} chromium (III) Cr^{2+} chromium (II)	25 Mn^{2+} manganese(II) Mn^{4+} manganese(IV)	26 Fe^{3+} iron (III) Fe^{2+} iron (II)	27 Co^{2+} cobalt (II) Co^{3+} cobalt (III)	28 Ni^{2+} nickel (II) Ni^{3+} nickel (III)	29 Cu^{2+} copper (II) Cu^+ copper (I)	30 Zn^{2+} zinc	31 Ga^{3+} gallium	32 Ge^{4+} germanium	33 As^{3-} arsenide	34 Se^{2-} selenide	35 Br^- bromide	36 Kr krypton
37 Rb^+ rubidium	38 Sr^{2+} strontium	39 Y^{3+} yttrium	40 Zr^{4+} zirconium	41 Nb^{5+} niobium (V) Nb^{3+} niobium(III)	42 Mo^{6+} molybdenum	43 Tc^{7+} technetium	44 Ru^{3+} ruthenium(III) Ru^{4+} ruthenium(IV)	45 Rh^{3+} rhodium	46 Pd^{2+} paladium(II) Pd^{4+} paladium(IV)	47 Ag^+ silver	48 Cd^{2+} cadmium	49 In^{3+} indium	50 Sn^{4+} tin (IV) Sn^{2+} tin (II)	51 Sb^{3+} antimony(III) Sb^{5+} antimony(V)	52 Te^{2-} telluride	53 I^- iodide	54 Xe xenon
55 Cs^+ cesium	56 Ba^{2+} barium	57 La^{3+} lanthanum	72 Hf^{4+} hafnium	73 Ta^{5+} tantalum	74 W^{6+} tungsten	75 Re^{7+} rhenium	76 Os^{4+} osmium	77 Ir^{4+} iridium	78 Pt^{4+} platinum(IV) Pt^{2+} platinum(II)	79 Au^{3+} gold (III) Au^+ gold (I)	80 Hg^{2+} mercury (II) Hg^+ mercury (I)	81 Tl^+ thallium (I) Tl^{3+} thallium(III)	82 Pb^{2+} lead (II) Pb^{4+} lead (IV)	83 Bi^{3+} bismuth(III) Bi^{5+} bismuth(V)	84 Po^{2+} polonium(II) Po^{4+} polonium(IV)	85 At^- astatide	86 Rn radon
87 Fr^+ francium	88 Ra^{2+} radium	89 Ac^{3+} actinium															

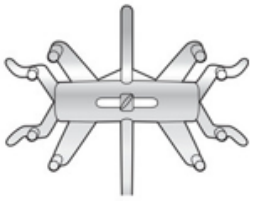
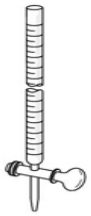
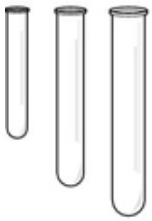
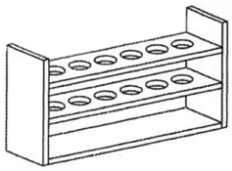
58 Ce^{3+} cerium	59 Pr^{3+} praseodymium	60 Nd^{3+} neodymium	61 Pm^{3+} promethium	62 Sm^{3+} samarium(III) Sm^{2+} samarium(II)	63 Eu^{3+} europium (III) Eu^{2+} europium (II)	64 Gd^{3+} gadolinium	65 Tb^{3+} terbium	66 Dy^{3+} dysprosium	67 Ho^{3+} holmium	68 Er^{3+} erbium	69 Tm^{3+} thulium	70 Yb^{3+} ytterbium(III) Yb^{3+} ytterbium(II)	71 Lu^{3+} lutetium
90 Th^{4+} thorium	91 Pa^{5+} protactinium(V) Pa^{4+} protactinium(IV)	92 U^{6+} uranium (VI) U^{4+} uranium (IV)	93 Np^{5+} neptunium	94 Pu^{4+} plutonium(IV) Pu^{6+} plutonium(VI)	95 Am^{3+} americium(III) Am^{4+} americium(IV)	96 Cm^{3+} curium	97 Bk^{3+} berkelium(III) Bk^{4+} berkelium(IV)	98 Cf^{3+} californium	99 Es^{3+} einsteinium	100 Fm^{3+} fermium	101 Md^{2+} mendelevium (II) Md^{3+} mendelevium (III)	102 No^{2+} nobelium(II) No^{3+} nobelium(III)	103 Lr^{3+} lawrencium

R-8

Common Laboratory Equipment

R-9

Safety Splash Goggles 	Beaker 	Erlenmeyer Flask 	Graduated Cylinder 
Distilled Water Wash Bottle 	Beaker Tongs 	Crucible Tongs 	Test Tube Tongs 
Hot Plate 	Spatulas and Scoopulas 	Disposable Pipette 	Rubber Policeman 
Forceps 	Ring Stand 	Iron Support Ring 	Utility Clamp 
Wire Gauze with Clay Center 	Bunsen Burner 	Flint Striker 	Clay Triangle 

Crucible with Lid 	Evaporating Dish 	Burette Clamp 	Burette 
Filter Flask 	Buchner Funnel 	Aspirator for Sink 	Glass Funnel 
Test Tube Brush 	Test Tubes 	Test Tube Rack 	Morter and Pestle 
Volumetric Flask 	Glass Watch Glass 	Volumetric Pipette 	Rubber Pipette Bulb 
Rubber Stoppers 			

Reference Sheets for Unit #1 – Chemistry Basics and Atomic Structure

Scientific Notation

Used to express a very large or very small number.
Move the decimal place to the right or to the left to produce a number between 1 and 10.
If you move the decimal to the right, your exponent will be negative.
If you move the decimal to the left, your exponent will be positive.
Adding and Subtracting numbers that are expressed in scientific notation require you to change the numbers so that they have the same exponents, you can do this by moving the decimal around a bit.
You can also just use your calculator to add or subtract these numbers.
Multiplying numbers in scientific notation requires you to multiply the first factors then add the exponents.
Dividing numbers in scientific notation requires you to divide the first factors then subtract the exponents.

Dimensional Analysis

Dimensional analysis is a problem solving method that uses conversion factors.
A conversion factor is a ratio of equivalent values. For example; 1000m/1km
In solving dimensional analysis problems you always set the value you want over the value you already have. (What you want over what you got!)
You will cancel units and multiply to achieve your final value.

Accuracy and Precision

Accuracy refers to how close a measured value is to an accepted value.
Precision refers to how close a series of measurements are to one another.
Percent error is the ratio of an error to an accepted value.
Percent error = error/accepted value x 100 and should be expressed as a percentage.
It is irrelevant if the experimental value is larger or smaller than the accepted value.

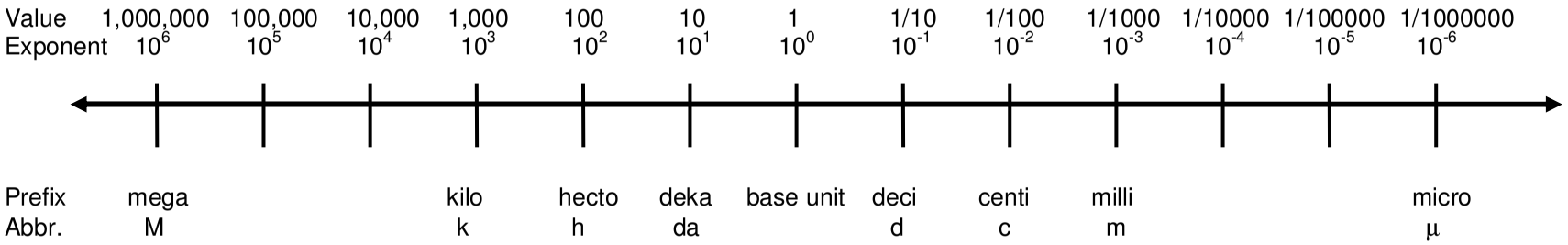
Significant Figures

Significant figures include all known digits plus one estimated digit.
Non-zero numbers are always significant.
Zeros between non-zero numbers are always significant.
All final zeros to the right of the decimal place are significant.
Zeros that act, as placeholders are not significant.
Counting numbers and defined constants have an infinite number of significant figures.

Rounding Numbers

If the remainder *beyond the last digit* to be reported is less than 5, drop the last digit.
Rounding to one decimal place, the number 5.3467 becomes 5.3.
If the remainder is greater than 5, increase the final digit by 1. The number 5.798 becomes 5.8 if rounding to 1 digit.
To prevent rounding bias, if the remainder is exactly 5, then round the last digit to the closest even number. Thus the number 3.55 (rounded to 1 digit) would be 3.6 (rounding up) and the number 6.450 would round to 6.4 (rounding down) *if rounding to 1 decimal*.

Metric Units and Conversions



Working with quantities that are not in Scientific Notation

1. Find the prefix with which you are beginning. If the unit has no prefix attached, you are beginning with the "base unit" at 10^0.
2. Find the prefix for the answer you are seeking. If the unit has no prefix attached, you are converting to the "base unit" at 10^0.
3. Count the number of places on the number line to get from where you are starting to where you are finishing.
4. Now, move the decimal in the number you are converting that same number of places, and in the same direction that you moved on the number line above (if you moved left three spaces, you move the decimal left three spaces to complete the conversion).

Example: Convert 0.035 decimeters (dm) to millimeters (mm)

Solution: The prefix "milli" is two places (two powers of ten) to the right of the prefix "deci." Move the decimal two places to the right.

Answer: 0.035 dm = 3.5 mm

Working with numbers that are in Scientific Notation

1. Find the prefix with which you are beginning. If the unit has no prefix attached, you are beginning with the "base unit" at 10^0.
2. Find the prefix for the answer you are seeking. If the unit has no prefix attached, you are converting to the "base unit" at 10^0.
3. Count the number of places on the number line to get from where you are starting to where you are finishing.
4. If you moved to the right on the line, add the number of spaces to the exponent on 10.
5. If you moved to the left, subtract the number of spaces from the exponent on 10.

Example: Convert 1.35×10^2 centigrams (cg) to kilograms (kg)

Solution: The prefix "kilo" is five places (five powers of ten) to the left of the prefix "centi." Subtract five from the exponent.

Answer: 1.35×10^2 centigrams = $1.35 \times 10^{2-5}$ kilograms = 1.35×10^{-3} kg

Significant Figures in Measurement and Calculations

A successful chemistry student habitually labels all numbers, because the unit is important. Also of great importance is the number itself. Any number used in a calculation should contain only figures that are considered reliable; otherwise, time and effort are wasted. Figures that are considered reliable are called *significant figures*. Chemical calculations involve numbers representing actual measurements. In a measurement, significant figures in a number consist of:

Figures (digits) definitely known + One estimated figure (digit)

In class you will hear this expressed as "all of the digits known for certain plus one that is a guess."

Recording Measurements

When one reads an instrument (ruler, thermometer, graduate, buret, barometer, balance), he expresses the reading as one which is reasonably reliable. For example, in the accompanying illustration, note the reading marked *A*. This reading is definitely beyond the 7 cm mark and also beyond the 0.8 cm mark. We read the 7.8 with certainty. We further *estimate* that the reading is five-tenths the distance from the 7.8 mark to the 7.9 mark. So, we estimate the length as 0.05 cm more than 7.8 cm. All of these have meaning and are therefore significant. We express the reading as 7.85 cm, accurate to three significant figures. All of these figures, *7.85*, can be used in calculations. In reading B we see that 9.2 cm is definitely known. We can include one estimated digit in our reading, and we estimate the next digit to be zero. Our reading is reported as 9.20 cm. It is accurate to three significant figures.

Rules for Zeros

If a zero represents a measured quantity, it is a significant figure. If it merely locates the decimal point, it is not a significant figure.

Zero Within a Number. In reading the measurement 9.04 cm, the zero represents a measured quantity, just as 9 and 4, and is, therefore, a significant number. A zero between any of the other digits in a number is a significant figure.

Zero at the Front of a Number. In reading the measurement 0.46 cm, the zero does not represent a measured quantity, but merely locates the decimal point. It is not a significant figure. Also, in the measurement 0.07 kg, the zeros are used merely to locate the decimal point and are, therefore, not significant. Zeros at the first (left) of a number are not significant figures.

Zero at the End of a Number. In reading the measurement 11.30 cm, the zero is an estimate and represents a measured quantity. It is therefore significant. Another way to look at this: The zero is not needed as a placeholder, and yet it was included by the person recording the measurement. It must have been recorded as a part of the measurement, making it significant. Zeros to the right of the decimal point, and at the end of the number, are significant figures.

Zeros at the End of a Whole Number. Zeros at the end of a whole number may or may not be significant. If a distance is reported as 1600 feet, one assumes two sig figs. Reporting measurements in scientific notation removes all doubt, since all numbers written in scientific notation are considered significant.

1 600 feet	1.6×10^3 feet	Two significant figures
1 600 feet	1.60×10^3 feet	Three significant figures
1 600 feet	1.600×10^3 feet	Four significant figures

Sample Problem #1: Underline the significant figures in the following numbers.

(a) 0.0420 cm	answer = 0.0420 cm	(e) 2 403 ft.	answer = 2 403 ft.
(b) 5.320 in.	answer = 5.320 in.	(f) 80.5300 m	answer = 80.5300 m
(c) 10 lb.	answer = 10 lb.	(g) 200. g	answer = 200 g
(d) 0.020 ml	answer = 0.020 ml	(h) 2.4×10^3 kg	answer = 2.4×10^3 kg

Rounding Off Numbers

In reporting a numerical answer, one needs to know how to "round off" a number to include the correct number of significant figures. Even in a series of operations leading to the final answer, one must "round off" numbers. The rules are well accepted rules:

1. If the figure to be dropped is less than 5, simply eliminate it.
2. If the figure to be dropped is greater than 5, eliminate it and raise the preceding figure by 1.
3. If the figure is 5, followed by nonzero digits, raise the preceding figure by 1
4. If the figure is 5, not followed by nonzero digit(s), and preceded by an odd digit, raise the preceding digit by one
5. If the figure is 5, not followed by nonzero digit(s), and the preceding significant digit is even, the preceding digit remains unchanged

Sample Problem #2: Round off the following to three significant figures.

(a) 3.478 m	answer = 3.48 m	(c) 5.333 g	answer = 5.33 g
(b) 4.8055 cm	answer = 4.81 cm	(d) 7.999 in.	answer = 8.00 in.

Multiplication

In multiplying two numbers, when you wish to determine the number of significant figures you should have in your answer (the product), you should inspect the numbers multiplied and find which has the least number of significant figures. This is the number of significant figures you should have in your answer (the product). Thus the answer to 0.024 x 1244 would be rounded off to contain two significant figures since the factor with the lesser number of significant figures (0.024) has only *two* such figures.

Sample Problem #3: Find the area of a rectangle 2.1 cm by 3.24 cm.

Solution: Area = 2.1 cm x 3.24 cm = 6.804 cm^2

We note that 2.1 contains two significant figures, while 3.24 contains three significant figures. Our product should contain no more than *two* significant figures. Therefore, our answer would be recorded as 6.8 cm^2

Sample Problem #4: Find the volume of a rectangular solid 10.2 cm x 8.24 cm x 1.8 cm

Solution: Volume = 10.2 cm x 8.24 cm x 1.8 cm = 151.2864 cm^3

We observe that the factor having the least number of significant figures is 1.8 cm. It contains two significant figures. Therefore, the answer is rounded off to 150 cm^3.

Division

In dividing two numbers, the answer (quotient) should contain the same number of significant figures as are contained in the number (divisor or dividend) with the least number of significant figures. Thus the answer to 528 ÷ 0.14 would be rounded off to contain *two* significant figures. The answer to 0.340 ÷ 3242 would be rounded off to contain three significant figures.

Sample Problem #5: Calculate 20.45 ÷ 2.4

Solution: 20.45 ÷ 2.4 = 8.52083

We note that the 2.4 has fewer significant figures than the 20.45. It has only *two* significant figures. Therefore, our answer should have no more than two significant figures and should be reported as 8.5.

Addition and Subtraction

In adding (or subtracting), set down the numbers, being sure to keep like decimal places under each other, and add (or subtract). Next, note which column contains the first estimated figure. This column determines the last decimal place of the answer. After the answer is obtained, it should be rounded off in this column. In other words, round to the least number of decimal places in you data.

Sample Problem #6: Add 42.56 g + 39.460 g + 4.1g

Solution:

42.56 g
39.460 g
4.1 g
Sum = 86.120 g

Since the number 4.1 only extends to the first decimal place, the answer must be rounded to the first decimal place, yielding the answer 86.1 g.

Average Readings

The average of a number of successive readings will have the same number of decimal places that are in their sum.

Sample Problem #7: A graduated cylinder was weighed three times and the recorded weighings were 12.523 g, 12.497 g, 12.515 g. Calculate the average weight.

Solution:

12.523 g
12.497 g
12.515 g
37.535 g

In order to find the average, the sum is divided by 3 to give an answer of 12.51167. Since each number extends to three decimal places, the final answer is rounded to three decimal places, yielding a final answer of 12.512 g. Notice that the divisor of 3 does not effect the rounding of the final answer. This is because 3 is an exact number - known to an infinite number of decimal places.

Common English and Metric Conversions Chart

American Linear Units	
12 inches (in)	1 foot (ft)
3 feet	1 yard (yd)
36 inches	1 yard
63,360 inches	1 mile (mi)
5,280 feet	1 mile
1,760 yards	1 mile

Weight and Mass	
1 Ton (T)	2,000 pounds
1 pound (lb)	16 ounces (oz)
1 Ton	32,000 ounces
1 metric ton (t)	1000 kg
60 grains	1 dram

Converting American Units	
Larger unit → smaller unit	*Multiply*
smaller unit → Larger unit	*Divide*

American to Metric Units	
1 inch	2.540 centimeters
1 foot	0.305 meters
1 yard	0.914 meters
1 mile	1.609 kilometers
1 gallon	3.78 Liters
1 quart	0.95 Liter
1 pound	0.45 kilogram
1 ounce	28.35 grams
1 fluid ounce	29.57 mL
1 grain	60 milligrams (mg)
1 teaspoon (tsp)	5 mL
1 fluid dram	4 mL
1 tablespoon (tbsp)	15 mL
1 pint (pt)	500 mL (approx)
1 quart (qt)	1000 mL (approx)
1 pound (lb)	453.6 g

American Capacity	
8 fluid ounces (fl oz)	1 cup
16 fluid ounces	2 cups
2 cups	1 pint (pt)
16 fluid ounces	1 pint
2 pints	1 quart (qt)
4 quarts	1 gallon
8 pints	1 gallon
32 fluid ounces	1 quart
8 fluid dram	1 fluid ounce
3 teaspoon (tsp)	1 tablespoon (tbsp)
6 teaspoon	1 fluid ounce
2 tablespoon	1 fluid ounce
1 drop (gtt)	1 minim
60 drop	1 fluid dram
60 drop	1 teaspoon
60 minims	1 fluid dram

Metric Units

mega (M)	*	*	kilo (k)	hector (h)	deka (da)	unit (m, g, L)	deci (d)	centi (c)	milli (m)	*	*	micro (mc) (u)

When going from larger unit to smaller unit move decimal to the right

When going from smaller unit to larger unit move decimal to the left

Time	
1 day	24 hours
1 hour (hr)	60 minutes (min)
1 minute	60 seconds (sec)
1 year (yr)	365.25 days
1 week	7 days
1 year	12 months (mon)
1440 minutes	1 day
3600 seconds	1 hour
Stones	
1 carat (karat)	200 mg

Metric to American Units	
1 km	0.621 miles
1 meter	1.094 yards
1 meter	3.281 feet
1 meter	39.370 inches
1 cm	0.3937 inch
1 Liter	0.26 gallon
1 Liter	1.06 quarts
1 kg	2.20 lbs
1 gram	0.035 oz
1 gram	15 grains
1 milliliter (mL)	15 minims

Temperature Formulas	
$C = \frac{(F - 32)}{1.8}$	$F = 1.8 \cdot C + 32$

Medical Application (Micrograms)	
1,000,000 micrograms (mcg)	1 gram
1,000,000 micrograms	1,000 mg
1 mL = 1 cc = 1 cm^3	
1 gram = 1 cm^3	
Nursing students 1fl oz = 30 mL	
Nursing students 1 in. = 2.5 cm	

R-11

Significant Figures with Scientific Notation Addition and Subtraction

R-12

Speaking realistically, the problems discussed below can all be done on a calculator. However, you need to know how to enter values into the calculator, read your calculator screen, and round off to the proper number of significant figures. Your calculator will not do these things for you.

All exponents MUST BE THE SAME before you can add and subtract numbers in scientific notation. The actual addition or subtraction will take place with the numerical portion, NOT the exponent.

The student might wish to re-read the above two sentences with emphasis on the emphasized portions.

It might be advisable to point out again - DO NOT, under any circumstances, add the exponents.

Example #1: $1.00 \times 10^3 + 1.00 \times 10^2$

A good rule to follow is to express all numbers in the problem in the highest power of ten.

Convert 1.00×10^2 to 0.10×10^3, then add:

$$\begin{aligned} &1.00 \times 10^3 \\ +\ &0.10 \times 10^3 \\ =\ &1.10 \times 10^3 \end{aligned}$$

Example #2: The significant figure issue is sometimes obscured when numbers are in scientific notation. For example, add the following four numbers:

$$(4.56 \times 10^6) + (2.98 \times 10^5) + (3.65 \times 10^4) + (7.21 \times 10^3)$$

When the four numbers are written in the highest power, we get:

$$\begin{aligned} &4.56 \times 10^6 \\ &0.298 \times 10^6 \\ &0.0365 \times 10^6 \\ +\ &0.00721 \times 10^6 \\ =\ &4.90171 \times 10^6 \end{aligned}$$

The answer upon adding must be rounded to 2 significant figures to the right of the decimal point, thus giving 4.90×10^6 as the correct answer.

Generally speaking, you can simply enter the numbers into the calculator and let the calculator keep track of where the decimal portion is. However, you must then round off the answer to the correct number of significant figures.

Lastly, be warned about using the calculator. Students often push buttons without understanding the math behind what they are doing. Then, when the teacher questions their work, they say "Well, that's what the calculator said!" As if the calculator is to blame for the wrong answer. Remember, it is your brain that must be in charge and it is you that will get the points deducted for poor work, not the calculator.

Practice Problems

1) $(4.52 \times 10^{-5}) + (1.24 \times 10^{-2}) + (3.70 \times 10^{-4}) + (1.74 \times 10^{-3})$

2) $(2.71 \times 10^6) - (5.00 \times 10^4)$

Reminder: you must have the same exponent on each number of the problem.