Summer Assignment – IB Chemistry SL

*The purpose of this summer assignment is to review key information and skills from Chemistry I. This will help refresh your memory on topics you may have forgotten, so you will be prepared for IB Chem SL. Please complete the problems in order in a bound notebook. If you complete the assignment at the assigned pace (~1 hour per week), the work will be manageable and you will be well-prepared for the coming school year. If you procrastinate, you will be **completely overwhelmed** and **unprepared** for the coming school year. If you need additional information, your Chemistry I notes or internet resources should help.*

THIS ASSIGNMENT IS DUE THE FIRST DAY OF SCHOOL: MONDAY, AUGUST 10, 2020.

REVIEW! You will have homework quizzes at least once per week. Your first quiz will be over elements 1-56 (you must be able to match each element name with its symbol). Also, review monatomic and polyatomic ions.

This ion list contains many of the polyatomic ions you'll come across in IB Chemistry. You must memorize the ones in bold. You are expected to know common oxidation states of monatomic ions (based on families) and stock system notation (for most transition metals, lead, and tin).

CATIONS

***Ammonium**		**NH_4^+**
Cadmium		Cd^{2+}
Hydronium		H_3O^+
Lead	(II)	Pb^{2+}
	(IV)	Pb^{4+}
Silver		Ag^+
Strontium		Sr^{2+}
Tin	(II)	Sn^{2+}
	(IV)	Sn^{4+}
Zinc		Zn^{2+}

ANIONS

Amide	NH_2^-
Arsenate	AsO_4^{3}
Borate	BO_3^{3-}
Bromate	BrO_3^-
Bromite	BrO_2^-
***Carbonate**	**CO_3^{2-}**
Chlorate	ClO_3^-
Chlorite	ClO_2^-
Chromate	CrO_4^{2-}
Chromite	$Cr_2O_4^{2-}$
Cyanide	CN^-
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	$C_2H_3O_2^-$
= (Acetate)	= CH_3COO^-
Hydride	H^-
***Hydrogencarbonate**	
= (bicarbonate)	**HCO_3^-**
Hydrogensulfate	
= (bisulfate)	HSO_4^-
Hydrogensulfide	
= (bisulfide)	HS^-
Hydrogensulfite	
= (bisulfite)	HSO_3^-

***Hydroxide**	**OH^-**
Hypobromite	BrO^-
Hypochlorite	ClO^-
Hypoiodite	IO^-
Iodate	IO_3^-
Iodite	IO_2^-
***Nitrate**	**NO_3^-**
Nitrite	NO_2^-
Oxalate	$C_2O_4^{2-}$
Perbromate	BrO_4^-
Perchlorate	ClO_4^-
Periodate	IO_4^-
Permanganate	MnO_4^-
Peroxide	O_2^{2-}
***Phosphate**	**PO_4^{3-}**
Phosphite	PO_3^{3-}
***Sulfate**	**SO_4^{2-}**
Sulfite	SO_3^{2-}
Thiocyanate	SCN^-
Thiosulfate	$S_2O_3^{2-}$

Week One (May 25)

Significant figures, scientific notation, metric conversions, density, & nomenclature:

Significant figures (sig figs)

- Non-zeros are ALWAYS significant. Zeros between non-zeroes are ALWAYS significant. Trailing zeroes are ONLY significant when the number has a decimal (otherwise, the zero is just a placeholder). Leading zeroes are NEVER significant (placeholders).
- Addition and subtraction: The position of the last significant digit in the answer (e.g. tens place, ones place, tenths place) is the same as the position of the last significant digit of the least precise number in the problem.
- Multiplication and division: The number of sig figs in the answer is the same as the number of sig figs in the value (from the problem) with the fewest sig figs.

Scientific notation

- Coefficient: move the decimal until you obtain a coefficient between 1 and 10 ($1 \leq$ coefficient < 10).
- Exponent: count the number of places moved the decimal. If the |original number| was >1, the exponent is positive. If the |original number| was <1, the exponent is negative.
  - E.g.: $105000 = 1.05 \times 10^{5}$, $0.0032 = 3.2 \times 10^{-3}$
- Addition and subtraction: Since decimal places must line up, exponents must be the same. Then add or subtract the coefficients (exponents do not change).
- Multiplication: Multiply the coefficients, and add the exponents.
- Division: Divide the coefficients, and subtract the exponents.

Metric conversions & Dimensional analysis

- Review metric units and prefixes
- Line up conversion factors so the units you are trying to get rid of divide away and you are left with the desired units
  - If units are squared or cubed, the entire conversion factor must be squared or cubed.

Density

- Density = mass/volume

Nomenclature

- Ionic: metal + nonmetal AND/ OR involving polyatomic ions. Overall charge must be zero!
  - Name the cation first, then the anion.
  - For metals that have only one possible charge, simply name the metal
  - For metals that have more than one possible charge, use Stock System. Write the name of the metal followed by Roman numeral in parentheses to indicate the charge
    - E.g. iron (III)—Fe^{3+} vs. iron (II)—Fe^{2+}
  - For nonmetals, change the ending to -ide.
- Covalent: 2 nonmetals or a metalloid and a nonmetal
  - Name the elements in the order in which they appear.
  - First element ending does not change. Second element ending changes to –ide.
  - Add prefixes to each element name (e.g. mono-, di-, tri-, tetra-), but do NOT use mono- prefix on first element.
- Acids: Compounds beginning with hydrogen
  - Binary acids: hydrogen + one other element
    - Add the prefix "hydro-" and change the ending of the element to "-ic"
  - Oxyacids: hydrogen + a polyatomic ion containing oxygen
    - Do not add a prefix
    - If the polyatomic ion ends in –ite, change the ending to –ous. \
    - If the polyatomic ion ends in –ate, change the ending to –ic.

1. How many significant figures does each of the numbers contain?
   a. 0.0278 meter
   b. 1.3 centimeter
   c. 1.00 foot
   d. 8021 yards
   e. 7.98×10^{-3} pounds
2. Round the following numbers to three significant figures.
   a. 4325 b. 6.873×10^{3} c. 0.17354
3. Express the following numbers in scientific notation with the indicated number of significant figures:
   a. 0.0000098765 (5 sig. figs)
   b. 10,000 (2 sig. figs)
4. Express the following as ordinary numbers:
   a. 7.51×10^{-7}
   b. 5.43×10^{4}
5. Perform the indicated operations and round your answers to the proper number of significant figures. Assume that all answers were obtained from measurements.
   a. $(2.11 \times 10^{-3}) + (1.54 \times 10^{-3})$
   b. $(1.54 \times 10^{-3}) + (2.11 \times 10^{-2})$
   c. $(4.56 + 18.7)/(1.23 \times 10^{2})$
   d. $(1.23 \times 10^{-2})(4.56 + 1.87)$
6. Make the following conversions:
   a. How many cm/sec are in 50 km/hr?
   b. How many miles/hour are in 66 ft/sec?
7. Make the following conversions:
   a. 65 kg to grams
   b. 750 micrograms to grams
   c. 0.25 nanometers to cm
   d. 23.8 milligrams to kg
8. How many cubic meters (m^3) are there in 1.773×10^{5} cubic decimeters (dm^3)?
9. The density of silver is 10.5 g/cm^3. What volume of silver metal will have a mass of exactly 2500.0 grams?
10. What is the mass of 215 L of hydrogen sulfide gas if the density of hydrogen sulfide is 1.54 g/L?
11. 28.5 grams of iron shot is added to a graduated cylinder containing 45.5 mL of water. The water level rises to the 49.1 mL mark. From this information, calculate the density of iron.
12. A rectangular block of copper metal weighs 1896 grams. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm. From this data, what is the density of copper?
13. The helium gas stored inside a large weather balloon weighs 13.558 grams. What is the volume of this balloon if the density of helium is 0.1786 g/L?
14. Write the name of the following compounds:
   a. $CaSO_4$
   b. HCl
   c. $SbCl_3$
   d. As_4O_{10}
   e. NH_4Cl
   f. NH_4NO_3
   g. IF_5
   h. $NaHCO_3$
   i. $Ba(OH)_2$
   j. $FeCl_3$
   k. HF
   l. $PbSO_4$
   m. KrF_2
   n. $NaCl$
   o. P_2O_5
15. Write the formula for the following compounds:
   a. ammonium sulfide
   b. copper (II) bromide
   c. aluminum sulfate
   d. potassium nitrite
   e. iron (III) carbonate
   f. lead (II) phosphate
   g. diphosphorus pentoxide
   h. manganese (II) hydroxide
   i. calcium fluoride
   j. tin (II) nitrate
   k. silver cyanide
   l. ammonium sulfite
   m. zinc sulfate
   n. antimony (III) chloride
   o. silver sulfide
   p. magnesium hydroxide
   q. ammonium carbonate
   r. nickel (II) acetate

Week Two (June 1)

Atomic structure & chemical reactions:

Atomic structure:

- An atom is made up of protons, neutrons, and electrons.
- The atomic number of an element is equal to the number of protons.
- The mass number (different from the average atomic mass) is protons + neutrons.
- A charge written in the upper right corner indicates that electrons have been lost or gained.

Nitrogen- 15 (+3) cation

Mass Number $^{15}N^{+3}$ ion charge

Atomic # 7

7 protons
8 neutrons (15-7)
4 electrons (normally 7 but +3 means loses 3 electrons)

Chemical reactions:

- Use coefficients to balance all equations.
- Remember the seven diatomic elements.
- Review how to classify the five reaction types and predict products: synthesis, decomposition, single replacement, double replacement, and combustion.

16. Make a table with the 6 column headings shown below. Add a row for each of the 7 elements/ ions listed, and complete the table.
    a. ^{1}H c. ^{12}C e. $^{35}Cl^{1-}$ g. $^{24}Mg^{+2}$
    b. $^{1}H^{1+}$ d. $^{7}Li^{1+}$ f. ^{39}K

Element/Ion	Atomic Number	Mass Number	# Protons	# Neutrons	# Electrons

17. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
    a. Aluminum nitrate (aq) + sodium hydroxide (aq) → aluminum hydroxide (s) + sodium nitrate (aq)
    b. Potassium chlorate (s) → potassium chloride (s) + oxygen (g)
    c. Phosphoric acid (aq) + magnesium hydroxide (aq) → magnesium phosphate (s) + water (l)
    d. Ammonium nitrite (s) → nitrogen (g) + water (l)
    e. Silver nitrate (aq) + potassium chloride (aq) → silver chloride (s) + potassium nitrate (aq)
18. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
    a. Lead (II) nitrate (aq) + copper (II) sulfate (aq) → lead (II) sulfate (s) + copper (II) nitrate (aq)
    b. Aluminum (s) + copper (II) chloride → aluminum chloride (aq) + copper (s)
    c. Iron (s) + silver acetate (aq) → iron (II) acetate (aq) + silver (s)
    d. Ammonium sulfide (aq) + iron (II) nitrate (aq) → ammonium nitrate (aq) + iron (II) sulfide (s)
19. Write the formula for the following compounds:
    a. zinc bicarbonate d. calcium chlorate g. copper (II) hydroxide
    b. potassium phosphate e. iron (II) bisulfite h. aluminum perchlorate
    c. lead (II) chloride f. iron (III) chromate
20. Write the name of the following compounds:
    a. $KMnO_4$ c. Cu_2CO_3 e. $Mg(NO_3)_2$ g. Hg_2O_2
    b. NiI_2 d. $AgClO_4$ f. $FeCrO_4$
21. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
    a. Calcium hydroxide (aq) + nitric acid (aq) →
    b. Zinc chloride (aq) + ammonium sulfide (aq) →
    c. Silver acetate (aq) + potassium chromate (aq) →
22. Express the following numbers with the indicated number of significant figures.
    a. 1000 (2 sig figs) b. 43,927 (3 sig figs) c. 0.000286 (3 sig fig)

Week Three (June 8)

Stoichiometry

Procedure

1. Write balanced chemical equation.
2. Line up conversion factors using dimensional analysis.
   a. grams ↔ moles of same substance: molar mass in g = 1 mol
   b. particles ↔ moles of same substance: 6.022×10^{23} particles = 1 mol
   c. volume of a gas ↔ moles of same substance at STP: 22.42 L = 1 mol
   d. volume of a solution ↔ moles: use molarity (molarity = moles of solute/ 1 liter of solution)
   e. moles one substance ↔ moles another substance: use mole ratio (use coefficients from balanced equation)

Limiting reactant

- When given information about more than one reactant, determine the mass or moles of product that can be made with each.
- Limiting reactant is the reactant that produces less product.
- Amount of product formed is determined by the limiting reactant.

23. How many moles of barium bromate can be prepared from 7.000 moles of $HBrO_3$ and 7.000 moles of $Ba(OH)_2$ given this balanced equation: $2\ HBrO_3 + Ba(OH)_2 \rightarrow Ba(BrO_3)_2 + 2\ H_2O$
24. How many molecules of ammonia are produced when 13.4 grams of nitrogen gas react at STP?
    . $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3\ (g)$
25. Given the equation $6\ NaOH + 2\ Al \rightarrow 2\ Na_3AlO_3 + 3\ H_2$
    a. What mass of Na_3AlO_3 can be formed from 165.0 grams of sodium hydroxide?
    b. How many moles of NaOH are required to produce 3.0 grams of hydrogen?
26. Given the following balanced equation $4\ Hg\ (l) + O_2\ (g) \rightarrow 2\ Hg_2O\ (s)$
    What volume of oxygen gas is needed to produce 23.7 g of mercury (I) oxide at STP?
27. Given the equation $4\ FeCr_2O_7 + 8\ K_2CO_3 + O_2 \rightarrow 2\ Fe_2O_3 + 8\ K_2CrO_4 + 8\ CO_2$
    a. How many grams of iron (II) dichromate are required to produce 44.0 grams of carbon dioxide?
    b. If 300.0 grams of iron (II) dichromate react, how many grams of oxygen gas will be consumed?
28. If 5.00 grams of copper metal react with a solution containing 20.0 grams of $AgNO_3$, which reactant is limiting? $Cu\ (s) + AgNO_3\ (aq) \rightarrow Cu(NO_3)_2\ (aq) + Ag\ (s)$
29. If 20.0 grams of KOH react with 15.0 grams of $(NH_4)_2SO_4$, calculate the moles of K_2SO_4 produced. Identify the limiting reactant. $2\ KOH + (NH_4)_2SO_4 \rightarrow 2\ H_2O + 2\ NH_3 + K_2SO_4$
30. The thermite reaction has been used to weld railroad tracks. How many grams of aluminum oxide would be formed if 15.0 grams of iron are used? $Fe_2O_3\ (s) + 2\ Al\ (s) \rightarrow 2\ Fe\ (s) + Al_2O_3\ (s)$
31. Write the formula for the following compounds:
    a. Sodium phosphate
    b. Silver hypochlorite
    c. Ammonium phosphate
    d. Iron (II) chlorite
    e. Potassium sulfide
    f. Tin (IV) bromide
    g. Lithium chromate
    h. Iron (II) phosphate
    i. Aluminum acetate
    j. Cobalt (III) chloride
    k. Sulfurous acid
    l. Zinc bisulfite
    m. Sodium sulfite
32. Write the names of the following compounds:
    a. Hg_2SO_4
    b. KH
    c. $Co_2(SO_3)_3$
    d. N_2O_3
    e. N_2O
    f. $Fe(NO_3)_2$
    g. $Sn_3(PO_4)_2$
    h. H_2O_2
    i. $Be(OH)_2$

Week Four (June 15)

Periodic Table & Electron Configuration

Periodic Table

- Review trends: Ionization Energy, Electronegativity, Electron Affinity, and Atomic Radius.

Periodic Table

- Remember how to use your Periodic Table to determine s,p,d,f electron configuration.
  - Period indicates the main energy level being filled (subtract one for the d-sublevel; 2 for the f-sublevel)
  - "Block" indicates the energy sublevel being filled (s,p,d,f)
  - Column within the block indicates the number of electrons within the sublevel.

33. In what order are the elements listed on the CURRENT periodic table?
34. a. What name is given to the elements in a vertical column on the periodic table?
    b. What name is given to the elements in a horizontal row on the periodic table?
35. What is the most reactive nonmetal?
36. What is the most reactive metal?
37. What is the significance of the zig zag line running diagonally down and to the right near the right side of the periodic table?
38. What is electron affinity?
39. What element has the lowest ionization energy?
40. How many valence electrons are in the following families?
    a. the Halogens?
    b. the Oxygen family?
    c. the alkali metals?
    d. the boron family?
    e. the noble gases?
    f. the alkaline earth metals?
    g. the carbon family?
    h. the nitrogen family?
41. a. Why do atomic radii decrease from left to right within a period?
    b. Why do they increase down a group?
42. Arrange each of the following in order of increasing atomic radii:
    a. the alkaline earth metals
    b. the main group elements in the third period
    c. C, Si, Sn, Pb
43. Arrange the following in order of decreasing atomic radius: Br, I, Se, Li.
44. Why does ionization energy increase from left to right across a period?
45. Arrange the members of the following sets of elements in order of increasing first ionization energy:
    a. the alkali metals
    b. the halogens
    c. the elements in the second period
    d. Br, Cl, B, Ga, Cs, and H
46. Write the electron configuration (long way) for:
    a. palladium.
    b. sulfur
    c. francium
47. Write the orbital notation (boxes with arrows) for:
    a. scandium
    b. magnesium
    c. cadmium
48. Write the Noble Gas electron configuration (shorthand) for
    a. radium.
    b. lead
    c. californium
49. Find the mass of 250.0 mL of benzene. The density of benzene is 0.90 g/mL.

Week Five (June 22)

Review of percent composition, empirical formulas, and molecular formulas:

Percent composition:

1. Calculate the mass of the entire compound (molar mass).
2. Calculate the mass that the component in which you are interested contributes to the compound.
3. Divide (mass due to the component) by (molar mass) and multiply by 100.

Empirical formula: (simplest whole number ratio of atoms in a compound)

1. Percent composition to mass: If percent composition is given, assume a 100g sample and change percent sign to grams.
2. Mass to moles: Convert the mass of each element to moles (using molar mass).
3. Divide by smallest: Divide all answers from step 2 by the smallest mole number from step 2.
4. Multiply until whole: If any of the answers from step 3 are not whole numbers, multiple all answers from step 3 by the same number to achieve whole numbers.

Molecular formula: (true formula)

1. Determine the empirical formula.
2. Calculate the mass of the empirical formula.
3. Divide (the molar mass of the compound) by (the mass of the empirical formula) to find the ratio between the molecular formula and the empirical formula.
4. Multiply all the subscripts in the empirical formula by this ratio, to find the molecular formula.

50. Calculate the percentage composition of each element in the following compounds:
    a. Iron (III) oxide b. Silver oxide
51. Calculate the percent composition of nitrogen in each of the following compounds:
    a. NH_4NO_3 b. $(NH_4)_2SO_3$ c. HNO_2
52. Determine the percentage of sodium in sodium sulfate.
53. Calculate the empirical formula of the compounds which have the following percentage compositions:
    a. 65.7% Sr, 10.4% Si, and 23.9% O
    b. 34.58% Na, 23.30% P, and 42.12% O
54. Chromium exists in four different oxide compounds. From the following data, calculate the empirical formula for a compound containing 0.765 grams Cr and 0.235 grams O.
55. One compound of chromium contains 57.9% chlorine and a second compound contains 67.3% chlorine. What are the empirical formulas of these two chromium chloride compounds?
56. Calculate the empirical formula for a compound containing 70.0 grams of Fe and 30.0 grams of O.
57. Perform the indicated operations and round off your answers to the proper number of significant figures.
    a. 18.56 + 1.233 b. 1.234 x 0.247 c. 4.3/8.87
58. Write the electron configuration (long way) for yttrium.
59. Write the electron configuration using the Noble Gas core method for mendelevium.
60. Calculate the density of sulfuric acid if 35.4 mL of the acid has a mass of 65.14 grams.
61. Write the formulas for the following compounds:
    a. sodium nitrite
    b. silver oxide
    c. nickel (II) bromide
    d. magnesium oxide
    e. mercury (II) perchlorate
    f. lithium hypochlorite
    g. oxygen difluoride
    h. acetic acid
    i. barium hypobromite
    j. ammonium hydroxide
    k. cobalt (II) iodide
    l. chromium (II) bicarbonate
    m. silver nitrate
    n. mercury (II) nitrate
    o. hydrochloric acid
    p. aluminum bisulfite
    q. cobalt (III) bisulfate
    r. iron (III) hydrogen carbonate
62. Write the name of the following compounds:
    a. N_2O_5 b. $SnCrO_4$ c. Al_2O_3 d. $CuCO_3$ e. ClO_2 f. CuS g. MgI_2 h. $NaCN$ i. Hg_3N_2

63. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
    a. cobalt(III) hydroxide (aq) + nitric acid (aq) →
    b. bromine (l) + sodium iodide (aq) →
    c. ammonium sulfate (aq) + calcium hydroxide (aq) →
64. Calculate the moles of the metal in each of the following compounds:
    a. 20.0 grams of chromium (II) chloride
    b. 20.0 grams of chromium (III) chloride
65. $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$
    a. If you have 78.00 grams of NaCl, how many grams of AgCl should be produced?
    b. How much AgCl can be produced from 107.0 grams of $AgNO_3$?

Week Six (June 29)

Solution Concentration

Molarity: Units are M = mol/dm^3 = mol dm^{-3}

- Molarity = (moles of solute) / (liters of solution)

Molality: Units are m = mol/kg = mol kg^{-1}

- molality = (moles of solute) / (kilograms of solvent)

66. What is the molarity of 5.00 grams of NaOH in 750.0 mL of solution?
67. How many moles of Na_2CO_3 are in 10.0 mL of a 2.0 M solution?
68. What is the molality of 5.30 grams of Na_2CO_3 dissolved in 400.0 mL water? (water density = 1.00 g/mL)
69. What is the molality of 125.0 grams of H_2SO_4 dissolved in 500.0 mL of water?
70. Determine the molarity of these solutions:
    a. 4.67 moles of Li_2SO_3 dissolved to make 2.04 L of solution.
    b. 0.629 moles of Al_2O_3 to make 1.500 liters of solution.
71. Determine the final volume of these solutions:
    a. 4.67 moles of Li_2SO_3 is dissolved to make a 3.89 M solution.
    b. 4.907 moles of Al_2O_3 is dissolved to make a 0.500 M solution.
72. Determine the empirical formula of the compounds which have the following percentage compositions:
    a. 40.2 % K, 26.9% Cr, and 32.9% O
    b. 21.8 % Mg, 27.9% P, and 50.3% O
73. Perform the indicated operations and round your answers to the proper number of significant figures.
    a. $(1.54 \times 10^3) + (2.11 \times 10^3)$
    b. $(1.54 \times 10^3) + (2.11 \times 10^2)$
    c. $(1.23 \times 10^2)/(4.56 + 18.7)$
    d. $(4.56 + 8.7)/(1.23 \times 10^{-2})$
74. A flask built to hold exactly 2.5000 L is filled with nitrogen. The mass of the nitrogen in the flask at STP is 0.1250 grams. What is the density of the nitrogen?
75. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
    a. Sodium hydroxide (aq) + sulfuric acid (aq) → sodium sulfate (aq) + water (l)
    b. Magnesium (s) + oxygen (g) → magnesium oxide (s)
    c. Ammonium phosphate (aq) + barium hydroxide (aq) →
76. What is the percentage of carbon, nitrogen, and sulfur in methionine (an amino acid) if the formula is $CH_3SCH_2CH_2CHNH_2COOH$?
77. Write the electron configuration (long way) for barium.
78. Write the orbital notation (boxes) for selenium.
79. Write the electron configuration using the Noble Gas core method for protactinium.
80. Given the following balanced equation, how many grams of oxygen will be required to react with 67.3 grams of Hg? $4\ Hg\ (l) + O_2\ (g) \rightarrow 2\ Hg_2O\ (s)$

Week Seven (July 6)

Gases

Important to note!

- Temperature must be in Kelvin for all gas laws! Temp in K = Temp in ºC + 273
- Standard Temperature and Pressure (STP) is 273 K and 1 atm = 760 mmHg = 101.3 kPa

Combined gas law

- Use for changing conditions of a single gas (fixed number of moles).
- $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

Ideal gas law

- Use when mass or moles of a gas are referred to, and you are not at STP.
- PV = nRT
- R = 8.315 $\frac{L \cdot kPa}{mol \cdot K}$ = 0.08206 $\frac{L \cdot atm}{mol \cdot K}$

Dalton's law

- The total pressure of a mixture of gases = the sum of partial pressures of the individual gases.
- $P_{total} = P_1 + P_2 + P_3 \ldots$

81. A rigid container holds a gas at a pressure of 0.55 atm at –100ºC. What will the pressure be when the temperature is increased to 200ºC?
82. What is the volume of a sample of oxygen gas with a mass of 50.0 g and a pressure of 1.20 atm, at 27.0ºC?
83. How many moles of CO_2 are in a sample with a volume of 75.0 mL at 30.0ºC and 680 mm Hg?
84. If 20.0 dm^3 of methane, CH_4, react with 200.0 dm^3 of O_2 at STP, what mass of carbon dioxide is produced?
    CH_4 (g) + 2 O_2 (g) → CO_2 (g) + 2 H_2O (l)
85. If 20.0 grams of KOH react with 15.0 grams of $(NH_4)_2SO_4$, calculate the grams of NH_3 produced:
    2 KOH + $(NH_4)_2SO_4$ → 2 H_2O + 2 NH_3 + K_2SO_4
86. Determine the total pressure of a gas mixture that contains CO, Ne, and He if the partial pressures of the gases are P_{CO} = 1.53 atm, P_{Ne} = 0.82 atm, and P_{He} = 0.34 atm
87. What volume of ammonia is produced if 13.4 grams of hydrogen gas reacts at STP?
    N_2 (g) + 3 H_2 (g) → 2 NH_3 (g)
88. A mass of air occupies a volume of 5.7 L at a pressure of 0.52 atm. What is the new pressure if the same mass of air at the same temperature is transferred to a 2.0 L container?
89. Round off the following to three significant figures.
    a. 4.76200 b. 0.0299817 c. 506789.2
90. Write the electron configuration using the Noble Gas core method for gold.
91. How much boron can be obtained from 10.00 grams of diboron trioxide? How much magnesium?
    B_2O_3 + 3 Mg → 3 MgO + 2B
92. If 20.0 L of methane, CH_4, react with 200.0 L of oxygen, calculate the mass of water produced at STP.
    CH_4 (g) + 2 O_2 (g) → CO_2 (g) + 2 H_2O (l)
93. Nitrogen gas in a steel cylinder has a pressure of 150 atm at 27ºC. What will be the pressure in the tank if the temperature rises to 55ºC?
94. Determine the molarity of these solutions:
    a. 0.894 grams of $(NH_4)_2CO_3$ to make 250 mL of solution.
    b. 0.0348 grams of $PbCl_2$ to form 45.0 mL of solution.
95. Determine the empirical formulas for these two compounds:
    a. 0.89 grams K, 1.18 grams Cr, and 1.27 grams O
    b. 1.03 grams K, 0.69 grams Cr, and 0.84 grams O

Week Eight (July 13)

REVIEW! You will have homework quizzes at least once per week. Your first quiz will be over elements 1-56; you must be able to match each element name with its symbol. Also, review monatomic and polyatomic ions.

96. How many significant figures does each number contain?
    a. 0.2003 ton
    b. 4.69×10^4 tons
    c. 1×10^{12} atoms
    d. 1.73×10^{24} atoms
97. Make the following conversions:
    a. 0.002023 mg to kg
    b. 89.00 grams to cg
    c. 0.00031 grams to dg
    d. 62,000 mg to dkg
98. A book is found to have a mass of 0.6321 kg.
    a. Calculate its mass in grams
    b. Calculate its density if its volume is 12 cm^3.
99. Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 grams. From this information, calculate the density of the mercury.
100. Write the names for the following compounds:
    a. $KHCO_3$
    b. $SbCl_5$
    c. HgO
    d. PCl_3
    e. PBr_5
    f. IF_7
    g. Cl_2O
    h. CCl_4
    i. NO
101. Write the electron configuration (long way) for carbon.
102. Write the orbital notation (boxes) for chlorine.
103. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
    a. Iron (III) bromide (aq) + ammonium sulfide (aq) → iron (III) sulfide (s) + ammonium bromide (aq)
    b. Calcium oxide (s) + diphosphorus pentoxide (s) → calcium phosphate (s)
    c. Sodium carbonate (aq) + sulfuric acid (aq) → sodium sulfate (aq) + carbon dioxide (g) + water (l)
    d. Iron (II) sulfide (s) + hydrochloric acid (aq) → iron (II) chloride (aq) + hydrogen sulfide (g)
104. SnO_2 is reduced by carbon according to this reaction: $SnO_2 + C \rightarrow Sn + CO_2$.
    a. How many liters of CO_2 are produced if 300.0 grams of tin are produced at STP?
    b. How many grams of SnO_2 are required to produce 1800.0 grams of tin?
105. True or False: The ideal gas law allows us to solve for the number of moles of a contained gas when P, V, and T are known.
106. Determine the number of moles of solute needed to prepare these solutions:
    a. 2.35 L of a 2.00 M $Cu(NO_3)_2$ solution.
    b. 16.00 mL of a 0.415 M $Pb(NO_3)_2$ solution.
    c. 3.00 L of a 0.500 M $MgCO_3$ solution.
107. Sea water contains roughly 28.0 grams of NaCl per liter. What is the molarity of sodium chloride in sea water?
108. How many grams of water vapor will be produced when 1.18 grams of methane gas react completely with oxygen? $CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l)$
109. White lead contains 80.1% lead, 16.5% oxygen, 3.10% carbon, and 0.260% hydrogen. What is the empirical formula of this compound?
110. Compare the elements Na, B, Al, and C with regard to the following properties:
    a. Which has the largest atomic radius?
    b. Which has the largest electron affinity?
    c. Place the elements in order of increasing ionization energy.
111. Which has the largest ionization energy: N, P, or As? Why?
112. List the four quantum numbers and their symbols. Tell what property of the electron each quantum number describes.
113. What is the Pauli Exclusion Principle?

Week Nine (July 20)

REVIEW! You will have homework quizzes at least once per week. Your first quiz will be over elements 1-56; you must be able to match each element name with its symbol. Also, review monatomic and polyatomic ions.

114. A piece of property is 499 decimeters long. What is this length in centimeters?
115. Write the names of the following compounds:
    a. XeF_4
    b. CaH_2
    c. As_4O_6
    d. CoS
    e. N_2O_4
    f. H_3BO_3
    g. I_2O_5
    h. PbO
    i. NaBr
    j. $Li_2Cr_2O_4$
    k. SO_3
    l. Hg_2O
    m. OsO_4
    n. XeF_2
    o. $Ca(C_2H_3O_2)_2$
    p. $Al(OH)_3$
116. Calculate the percentage composition of each element in the following compounds:
    a. HgO
    b. Na_2S
117. For the reaction $2\ KMnO_4 + H_2SO_4 \rightarrow K_2SO_4 + Mn_2O_7 + H_2O$,
    a. How many moles of Mn_2O_7 can be formed from 196.0 grams of $KMnO_4$?
    b. How many grams of Mn_2O_7 can be formed from 390.0 grams of $KMnO_4$?
118. 50.0 g potassium hydroxide reacts with 20.0 g sulfuric acid to form potassium sulfate and water.
    a. What is the limiting reagent?
    b. How many moles of potassium sulfate are produced?
    c. How many grams of water are produced?
119. What is the temperature of the gas inside a 750 mL balloon filled with 0.300 grams of H_2 gas? The pressure of the balloon is 1.2 atm.
120. How many grams of water vapor are produced when 1.18 grams of oxygen react completely with hydrogen to form water?
121. What mass of KCl is needed to make 2.50 L of a 0.50 M KCl solution?
122. What is the molarity of a solution containing 12.0 grams of NaOH in 250.0 mL of solution?
123. How many moles of NaCl are contained in 100.0 mL of a 2.00 M solution?
124. How does the charge of the ion relate to the element's position on the periodic table?
125. What are the trends down a family and across a period for:
    a. Atomic radius
    b. Ionization energy
    c. Electronegativity
    d. Electron affinity
    e. Metallic character
126. Arrange the members of each of the following sets of elements in order of increasing electronegativities:
    a. S, Na, Mg, Cl
    b. P, N, Sb, Bi
    c. Se, Ba, F, Si, Sc

Weeks Ten & Eleven (July 27 & August 3)

REVIEW! You will have homework quizzes at least once per week. Your first quiz will be over elements 1-56; you must be able to match each element name with its symbol. Also, review monatomic and polyatomic ions.

127. One mile = 5280 feet; 1 yard = 3 feet, 1 foot = 12 inches, and 1 meter = 39.3 inches.
    a. How many inches are in 800 meters?
    b. Which is longer, 800 meters or 880 yards?
    c. Which is longer, the 3200 meter relay or the 2-mile relay?
128. You fill a 1.00 L balloon with 0.054 grams of air. What is the density of the air in the balloon?
129. Write the formulas for the following:
    a. Mercury (II) fluoride
    b. Potassium chloride
    c. Potassium permanganate
    d. Potassium perchlorate
    e. Zinc oxide
    f. Barium hydroxide
    g. Calcium carbonate
    h. Barium phosphate
    i. Iron (III) oxide
    j. Carbonic acid
    k. Sodium bisulfate
    l. Phosphorus pentafluoride
    m. Silver oxide
    n. Lead (II) chlorite
    o. Copper (I) chromate
    p. Calcium perchlorate
    q. Acetic acid
130. Write the names of the following compounds:
    a. $Cr(OH)_3$
    b. $HClO$
    c. $HClO_2$
    d. $HClO_3$
    e. $HClO_4$
    f. $Al(MnO_4)_3$
131. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or synthesis/composition) for each of the following:
    a. aluminum acetate (aq) + sodium hydroxide (aq) → aluminum hydroxide (s) + sodium acetate (aq)
    b. Bromine (l) + calcium iodide (aq) → calcium bromide (aq) + iodine (s)
    c. Calcium hydroxide (aq) + phosphoric acid (aq) → calcium phosphate (s) + water (l)
132. A zinc sample, which has a mass of 40.0 grams, reacts with 20.0 grams of pure HCl. Zinc chloride and hydrogen gas are produced. Calculate the moles of $ZnCl_2$ produced.
133. A volume of 3.0 L of air is warmed from 50°C to 100°C. What is the new volume if pressure remains constant?
134. A sample of gas occupies a volume of 80 mL at a pressure of 0.50 atm and a temperature of 0°C. What will the new volume be at a pressure of 1.50 atm and a temperature of 50°C?
135. How many grams of silver iodide can be produced from 52.38 grams of iodine and unlimited silver? I_2 (s) + 2 Ag (s) → 2 AgI
136. Ammonia is produced by the reaction of nitrogen and hydrogen. What mass of ammonia would be produced if 13.4 grams of nitrogen gas reacted? N_2 (g) + 3 H_2 (g) → 2 NH_3 (g)
137. Determine the final volume of these solutions:
    a. 0.783 grams of Na_2CO_3 is dissolved to make a 0.348 M solution
    b. 8.97 grams of $(NH_4)_2CO_3$ is dissolved to make a 0.250 M solution
138. How does the number of valence electrons in an atom relate to the element's position on the periodic table?
139. Name the groups in the s block.
140. Name the groups in the p block.
141. Name the "families" of the f block.
142. Make the following conversions:
    a. 2.77 kg to mg
    b. 2.90 cm to nanometers
    c. 45.6 microliters to kiloliters
    d. 1.08 kg to µg
143. A block of lead has dimensions of 4.5 cm by 5.2 cm by 6.0 cm. The block has a mass of 1587 g. From this information, calculate the density of lead.
144. Chromium exists in different oxide compounds. Calculate the empirical formulas, below
    a. 5.60 g Cr and 2.62 g O
    b. 1.24 g Cr and 0.76 g O
    c. 0.52 g Cr and 0.48 g O
145. Describe the experiments and contributions of these scientists to the development of the atomic model.
    a. Thomson
    b. Millikan
    c. Rutherford
    d. Chadwick