# IB Chemistry Summer Assignment

*The purpose of this summer assignment is to ensure you remember key information and skills from Chemistry I, and to help you refresh things you may have forgotten, so you will not be behind at the beginning of the school year. Complete the following assignment on separate paper, preferably in a bound notebook. Additionally, you are to complete this assignment in the order it has been assigned. If you complete the assignment at the pace I have laid out for you, it should not be too time consuming, it should serve its purpose well, and we should all be ready for a great new school year. If you do not, you will be* ***completely overwhelmed*** *by this assignment and* ***unprepared*** *for the coming school year. If you need additional information beyond what I have provided for you in the boxes, your Chemistry I notes or internet resources should prove useful.*

## Week One (May 24- 30)

*Review of significant figures, scientific notation, metric conversions, density, & nomenclature:*
*Significant figures*

- Count all numbers as significant except for leading and trailing zeros –placeholders
- Addition and subtraction: Keep the same number of places before or after the decimal as the number with the fewest places before or after the decimal.
- Multiplication and division: The answer should have the same number of significant figures as the number with the fewest total significant figures.

*Scientific notation*

- Move the decimal until you obtain a number equal to or greater than one and less than ten.
- Count how many places you moved the decimal in order to obtain your exponent. If you moved the decimal to the left, the exponent is positive; if you moved to the right, the exponent is negative.
  - Ex.: $105000 = 1.05 \times 10^5$, $0.0032 = 3.2 \times 10^{-3}$
- Addition and subtraction: Since decimal places must line up, exponents have to be the same. Add or subtract the numbers; exponents do not change.
- Multiplication: Multiply the numbers, and add the exponents.
- Division: Divide the numbers, and subtract the exponents.

*Metric conversions & Dimensional analysis*

- Review metric units and prefixes
- Remember to line up conversion factors so the units you are trying to get rid of divides out 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: a metal and a nonmetal or a polyatomic ion and a counter ion
  Remember, charges must balance out to an overall charge of zero.
  - Name the cation first, then the anion.
  - For metals that
    - only have one possible charge, simply name the metal
    - have more than one possible charge, the charge must be indicated
      - Write the name of the metal followed by roman numerals in parentheses to indicate the charge (stock system),
        i.e. iron (III)—$Fe^{3+}$ vs. iron (II)—$Fe^{2+}$

- For nonmetals, change the ending to –ide.
- For polyatomic ions, simply keep the name the same. (The common polyatomic ions—name, formulas, and charges—will need to be memorized for the class)

- Covalent: 2 nonmetals or a metalloid and a nonmetal
  - Name the elements in the order in which they appear.
  - Do not change the name of the first element; change the ending of the second element to –ide.
  - Add prefixes to each element to
- Acids: Compounds beginning with hydrogen
  - Binary acids: hydrogen + one other element
    - Add the prefix "hydro-" to the name of the second element and change the ending of the element name to "-ic" and add "acid" (i.e. $H_2S$ = hydrosulfuric acid)
  - Oxyacids: hydrogen + a polyatomic ion containing oxygen
    - Do NOT add a prefix
    - If the polyatomic ion ends in –ite, change the ending to –ous and add "acid".
    - If the polyatomic ion ends in –ate, change the ending to –ic and add "acid".

1. **How many significant figures does each of the numbers contain?**
   **a. 0.0278 meter** | **d. 8021 yards**
   **b. 1.3 centimeter** | **e. 7.98 x$10^{-3}$ pounds**
   **c. 1.00 foot**
2. Round the following numbers to three significant figures.
   a. 4325 | b. 6.873 x $10^3$ | 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 x $10^{-7}$** | **b. 5.43 x $10^4$**
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 x $10^{-3}$) + (1.54 x $10^{-3}$) | c. (4.56 + 18.7)/(1.23 x $10^2$)
   b. (1.54 x $10^{-3}$) + (2.11 x $10^{-2}$) | d. (1.23 x $10^{-2}$)(4.56 + 1.87)
6. **Make the following conversion: How many cm/sec are in 50 km/hr?**
7. Make the following conversions:
   a. 65 kg to grams | c. 0.25 hectometers to cm
   b. 750 decigrams to grams | d. 23.8 milligrams to kg
8. **How many cubic meters ($m^3$) are there in 1.773 x $10^5$ 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 has a mass of 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. $SbCl_3$** | **e. $NaHCO_3$** | **m. $PbSO_4$**
   **b. $As_4O_{10}$** | **j. $Ba(OH)_2$** | **n. $KrF_2$**
   **c. $NH_4NO_3$** | **k. $FeCl_3$** | **o. NaCl**
   **d. $IF_5$** | **l. HF** | **p. $P_2O_5$**

15. Write the formula for the following compounds:
   a. ammonium sulfide
   b. aluminum sulfate
   c. iron (II) carbonate
   d. lead (II) phosphate
   e. diphosphorus pentoxide
   f. calcium fluoride
   g. tin (II) nitrate
   h. zinc sulfite
   i. antimony (III) chloride
   j. silver sulfide
   k. magnesium hydroxide
   l. nickel (II) acetate

## Week Two (May 31 - June 6)

*Review of atomic structure & chemical reactions:*
*Atomic structure:*

- An atom is made up of protons and neutrons (both found in the nucleus) and electrons (found in the orbitals surrounding the nucleus).
- The atomic number of an element is equal to the number of protons.
- The mass number (different than the average atomic mass) is the sum of the protons and neutrons.
- A charge written in the upper right corner indicates that electrons have been lost or gained.

Nitrogen- 15 (+3) cation

Mass Number → $^{15}_{7}N^{+3}$ ←ion charge
Atomic # → 7

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

*Chemical reactions:*

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

16. Complete the following table

| Element/Ion | Atomic Number | Mass Number | # Protons | # Neutrons | # Electrons |
|---|---|---|---|---|---|
| $^{1}H$ | | | | | |
| $^{12}C$ | | | | | |
| $^{7}Li^{+}$ | | | | | |
| $^{35}Cl^{-1}$ | | | | | |
| $^{39}K$ | | | | | |
| $^{24}Mg^{+2}$ | | | | | |

**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)**
   **f. Iron (s) + silver acetate (aq) → iron (II) acetate (aq) + silver (s)**
   **g. Ammonium sulfide (aq) + iron (II) nitrate (aq) → ammonium nitrate (aq) + iron (II) sulfide (s)**

18. 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. $FeCrO_4$
19. **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) →**
    d. **Lead (II) nitrate (aq) + copper (I) sulfate (aq) →**
    e. **Aluminum (s) + copper (II) chloride →**
20. 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 figs)
21. **How many cubic decimeters ($dm^3$) are there in 4312 cubic centimeters ($cm^3$)?**
22. A cylindrical glass tube of length 27.75 cm and the radius 2.00 cm is filled with argon gas. The empty tube weighs 188.25 grams and the tube filled with argon weights 188.87 grams. Use the data to calculate the density of argon gas. (Volume of a cylinder = $\pi r^2 h$.)

## Week Three (June 7-13)

*Review of stoichiometry:*
You must have a balanced chemical equation first.
Line up conversion factors using dimensional analysis.
- grams ↔ moles, same substance: use molar mass
- particles ↔ moles, same substance: Avogadro's number ($6.022 \times 10^{23}$ particles = 1 mol)
- volume of a gas ↔ moles, at STP: use standard molar volume (22.7 L = 1 mol)
- volume of a solution ↔ moles: use molarity (Molarity = moles of solute/ liter of solution)
- moles one substance ↔ moles another substance: use mole ratio (coefficients in balanced equation)
  ***Key step in all stoichiometry problems.

Limiting reactant problems: when you have more than one given, solve for all to determine the limiting reactant and the amount of product formed.

23. **Determine the moles of barium bromate that can be prepared from 7.000 moles of each $HBrO_3$ and $Ba(OH)_2$ given this balanced equation:**
    $$2\ HBrO_3 + Ba(OH)_2 \rightarrow Ba(BrO_3)_2 + 2\ H_2O.$$
24. How many molecules of ammonia would be produced if 13.4 grams of nitrogen gas reacted at STP? $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3\ (g)$
25. **$6\ NaOH + 2\ Al \rightarrow 2\ Na_3AlO_3 + 3\ H_2$**
    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. $4\ FeCr_2O_7 + 8\ K_2CO_3 + O_2 \rightarrow 2\ Fe_2O_3 + 8\ K_2CrO_4 + 8\ CO_2$
    How many grams of iron (II) dichromate are required to produce 44.0 grams of carbon dioxide?
27. **Given the following balanced equation**
    $$4\ Hg\ (l) + O_2\ (g) \rightarrow 2\ Hg_2O\ (s)$$
    **What volume of oxygen gas will be required to produce the 23.7 grams of mercury (I) oxide at STP?**
28. 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.
    $$2\ KOH + (NH_4)_2SO_4 \rightarrow 2\ H_2O + 2\ NH_3 + K_2SO_4$$
29. **What reactant is limiting if 3000 $cm^3$ of $Cl_2$ at STP react with a solution containing 25.0 grams of NaBr? $Cl_2 + 2\ NaBr \rightarrow Br_2 + 2\ NaCl$**

30. Write the formula for the following compounds:
   a. Ammonium phosphate
   b. Iron (II) hypochlorite
   c. Potassium sulfide
   d. Tin (II) bromide
   e. Lithium chromate
   f. Sulfurous acid
   g. Zinc bisulfite
   h. Sodium sulfite

**31. 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. $H_2O_2$**

32. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
   a. Sulfuric acid (aq) + potassium hydroxide (aq) →
   b. Iron (s) + copper (II) sulfate (aq) →
   c. Zinc (s) + sulfuric acid (aq) →

## Week Four (June 14 - 20)

*Review of Periodic Table & electron configuration:*

Review the Periodic Table: families, trends, electron configuration, and valence electrons.

Remember how to use your Periodic Table to determine electron configuration.

- Period tells you the main energy level being filled (Remember to subtract one for the d-sublevel, and 2 for the f-sublevel)
- "Block" tells you the energy sublevel being filled
- Column within the block tells you the number of electrons within the sublevel.

**33. In what order are the elements listed on the PRESENT 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 on the Periodic Table?**

**36.** What is the most reactive metal on the Periodic Table?

**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 electrons are in the valence shell of:
   a. the Halogens?
   b. the Oxygen family?
   c. the alkali metals?
   d. the boron family?
   e. the neon gases?
   f. the alkaline earth metals?
   g. the carbon family?
   h. the nitrogen family?

41. Why do atomic radii decrease from left to right within a period? Why do they decrease down a group?

**42. Arrange the following in order of decreasing radius: Br, I, Se, Li.**

43. Arrange the members of each of the following sets of elements in order of increasing first ionization energy:
   a. the alkali metals
   b. the elements in the second period
   c. Br, Cl, B, Ga, Cs, and H

**44. Write the electron configuration (long way) for:**
   **a. palladium.**
   **b. sulfur**
   **c. francium**

45. Write the orbital notation (boxes) for:
   a. scandium
   b. magnesium
   c. cadmium

**46. Write the electron configuration using the Noble Gas core method (shorthand) for**
   **a. radium.**
   **b. lead**
   **c. californium**

47. Make the following conversions:

a. $9.57 \times 10^{-8}$ mm to nm
b. 2.00 L to mL
c. 35.38 $cm^3$ to $dm^3$
d. 5000 $cm^3$ to mL

**48. Find the mass of 250.0 mL of benzene. The density of benzene is 0.90 g/mL.**

49. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:
   a. barium carbonate (s) + hydrochloric acid (aq) →
   b. chlorine (g) + magnesium iodide (aq) →
   c. aluminum sulfate (aq) + calcium phosphate (s) →
   d. iron (s) + hydrochloric acid (aq) →

**50. If 81.00 g of $H_2O$ is formed during this reaction, what mass of BaO was used?**
**$BaO + H_2SO4 \rightarrow BaSO_4 + H_2O$**

## Week Five (June 21 – 27)

*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 the that the component in which you are interested contributes to the compound.
3. Divide the mass due to the component by the molar mass and multiply by 100.

*Empirical formula:* (simplest whole number ratio of atoms in a compound)
1. Percent 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 small: Divide all answers from step 2 by the smallest mole number from step 2.
4. Multiply 'til 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 atoms (subscripts) by this ratio to find the molecular formula.

**51.** Calculate the percentage composition of iron (III) oxide

**52. Calculate the percentage of nitrogen in $(NH_4)_2SO_3$.**

53. Determine the percentage of sodium in sodium sulfate.

**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. Citric acid, an organic acid found in lemons and other fruits, contains 37.5% carbon, 58.3% oxygen, and 4.20% hydrogen. What is the empirical formula of citric acid? What is the molecular formula if it has a molecular mass of 192 amu?

**56. Perform the indicated operations and round off your answers to the proper number of significant figures. Assume that all numbers were obtained from measurements.**
**a. 18.56 + 1.233 b. 1.234 x 0.247 c. 4.3/8.87**

57. Make the following conversions:
   a. 3.5 L to $cm^3$
   b. 105 m to km
   c. $2.0043 \times 10^{-5}$ kg to g
   d. 1.549 mm to dm

**58. Write the electron configuration (long way) for yttrium.**
59. Write the orbital notation (boxes) for zinc.
**60. Write the electron configuration using the Noble Gas core method for mendeleevium.**
61. A rubber balloon weighing 144.85 grams is filed with carbon dioxide gas and reweighed. The weight of the balloon plus gas is 153.77 grams. The volume of the balloon filled with carbon dioxide is 4.55 L. What is the density of carbon dioxide?
**62. Write the formulas for the following compounds:**
**a. silver oxide**
**b. mercury (II) perchlorate**
**c. oxygen difluoride**
**d. acetic acid**
**e. barium hypobromite**
**f. chromium (II) bicarbonate**
**g. hydrochloric acid**
**h. aluminum bisulfite**
**i. cobalt (III) sulfate**

63. 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. $Hg_3N_2$

**64. 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) →**
65. $CaCl_2 + 2\ AgNO_3 \rightarrow 2\ AgCl + Ca(NO_3)_2$
How much AgCl can be produced from 107.0 grams of $CaCl_2$?

## Week Six (June 28 - July 4)

*Review of solution concentration:*
*Molarity* (M):
Molarity = moles of solute/liters of solution
*molality* (*m*):
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? (The density of water is 1.00 g/mL)
69. Determine the final volume if 4.907 moles of $Al_2O_3$ is dissolved to make a 0.500 M solution.
**70. Calculate the number of cubic centimeters ($cm^3$) in 1.6 cubic meters ($m^3$).**
71. Calculate the empirical formula of the compound which has the following percentage compositions: 21.8 % Mg, 27.9% P, and 50.3% O.
**72. Perform the indicated operations and round off your answers to the proper number of significant figures. Assume that all numbers were obtained from measurements.**
**a. $(1.54 \times 10^3) + (2.11 \times 10^3)$**
**b. $(4.56 + 8.7)/(1.23 \times 10^{-2})$**
73. Make the following conversions:
a. $7.8825 \times 10^5$ mm to cm
b. $3.44 \times 10^{-4}$ mL to $dm^3$
**74. A flask built to hold exactly 2.5000 L is filled with nitrogen. The mass of the nitrogen in the flask at standard conditions is 0.1250 grams. What is the density of the nitrogen?**
75. Write the formulas for the following compounds:
a. Phosphorus pentabromide
b. Iron (III) bicarbonate
c. Mercury (I) bisulfite
d. Potassium iodide
e. Lead (IV) chlorite
f. Potassium dichromate

**76. Write the name of the following compounds:**

**a. $BrO_3$ (not an ion)** | **b. $Sb_2O_5$** | **c. LiH** | **d. $SF_6$** | **e. $SnI_4$** | **f. $K_2O$** | **g. $H_2SO_4$**

77. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:

a. Magnesium (s) + oxygen (g) →

b. Ammonium phosphate (aq) + barium hydroxide (aq) →

**78. An essential amino acid which cannot be made (synthesized) by the body and must be obtained in the diet is methionine. What is the percentage of carbon in this amino acid if the formula of methionine is $CH_3SCH_2CH_2CHNH_2COOH$?**

79. Write the electron configuration (long way) for barium.

**80. Write the orbital notation (boxes) for selenium.**

81. Write the electron configuration using the Noble Gas core method for protactinium.

**82. Given the following balanced equation: $4\ Hg\ (l) + O_2\ (g) \rightarrow 2\ Hg_2O\ (s)$**

**How many grams of oxygen will be required to react with 67.3 grams of Hg?**

83. Arrange the members of each of the following sets of elements in order of increasing electron affinities:

a. the elements in the second period | b. Li, K, C, F, and Cl

**84. Arrange the following elements in order of increasing electronegativity:**

**a. the Group 14 elements** | **b. P, S, Cl, and I.**

## Week Seven (July 5 - 11)

*Review of gases:*

Remember temperature must be in Kelvin anytime you are working with gases.

Remember at STP 1 mol of a gas has a volume of 22.7 L

Remember, at constant pressure and temperature conditions, equal volumes of gases contain equal moles, so coefficients in a balanced chemical equation can be used as volume ratios for gases

*Combined gas law*

Use for changing conditions of a single gas.

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

*Ideal gas law*

Use when mass or moles of a gas are referred to, and you are not at STP.

$PV = nRT$

*Dalton's law*

For a mixture of gases, the total pressure is equal to the sum of partial pressures of the individual gases.

$P_{total} = P_1 + P_2 + P_3 \ldots$

85. A rigid container holds a gas at a pressure of 0.55 atm at –100.°C. What will the pressure be when the temperature is increased to 200.°C?

**86. What is the volume at STP of a sample of $CO_2$ that has a volume of 75.0 mL at 30.0°C and 98 kPa?**

87. What is the volume of a sample of oxygen gas that has a mass of 50.0 grams and is under a pressure of 1.20 atm at 27.0°C?

**88. If 20.0 $dm^3$ of methane, $CH_4$, react with 200.0 $dm^3$ of oxygen, calculate the volume of carbon dioxide produced.**

$$CH_4\ (g) + 2\ O_2\ (g) \rightarrow CO_2\ (g) + 2\ H_2O\ (l)$$

89. If 20.0 grams of KOH react with 15.0 grams of $(NH_4)_2SO_4$, calculate the following:

$$2\ KOH + (NH_4)_2SO_4 \rightarrow 2\ H_2O + 2\ NH_3 + K_2SO_4$$

a. the mass of $NH_3$ produced
b. the $cm^3$ of $NH_3$ produced at STP

**90. 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.**

91. Ammonia is produced by the reaction of nitrogen and hydrogen according to this balanced equation:

$$N_2 (g) + 3 H_2 (g) \rightarrow 2 NH_3 (g)$$

What volume of ammonia would be produced if 13.4 grams of hydrogen gas reacted at STP?

**92. 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?**

93. Write the formulas for the following compounds:
a. nitrogen triiodide
b. calcium perchlorate
c. iron (II) chromate
d. iron (III) carbonate
e. ammonia
f. nitric acid

**94. Write the name of the following compounds:**
**a. NaOH**
**b. $NI_3$**
**c. $ClF_3$**
**d. $P_3H_5$**
**e. $UF_6$**
**f. $Cl_2O_3$**
**g. CsF**
**h. CO**
i. **$Cu_2S$**

95. Write the electron configuration using the Noble Gas core method for gold.

**96. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:**
**a. Ammonium nitrite (s) → nitrogen (g) + water (l)**
**b. Ammonia (g) + oxygen (g) → nitrogen (II) oxide (g) + water (l)**
**c. Magnesium hydroxide (aq) + phosphoric acid (aq) → magnesium phosphate (s) + water (l)**

97. Calcium dihydrogen phosphate is an important fertilizer. What is the percent phosphorus in $Ca(H_2PO_4)_2$?

98. If 20.0 L of methane, $CH_4$, (measured at STP) react with excess oxygen in a combustion reaction, calculate the mass of water produced.

**99. Nitrogen gas in a steel cylinder is under a pressure of 150 atm at 27°C. What will be the pressure in the tank if the tank is left in the sun and the temperature rises to 55°C?**

## Week Eight (July 12 - 18)

**100. How many significant figures does each of the numbers contain?**
**a. 0.2003 ton**
**b. 0.046 tons**
**c. $1.0 \times 10^{12}$ atoms**
**d. $1.73 \times 10^{24}$ atoms**

101. Make the following conversions:
a. 0.002023 mg to kg
b. 0.00031 grams to dg
c. 62,000 mg to dag

**102. A book is found to have a mass of 0.6321 kg. Calculate its mass in grams and its density if its volume is 12 $cm^3$.**

103. Calculate the number of $dm^3$ in 2000 $cm^3$.

**104. 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.**

105. 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

**106. Write the electron configuration (long way) for carbon.**

107. Write the orbital notation (boxes) for chlorine.

108. **Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or composition/synthesis) for each of the following:**

   a. **Calcium oxide (s) + diphosphorus pentoxide (s) → calcium phosphate (s)**
   b. **Sodium carbonate (aq) + sulfuric acid (aq) → sodium sulfate (aq) + carbon dioxide (g) + water (l)**
   c. **Iron (II) sulfide (s) + hydrochoric acid (aq) →**

109. The sugar substitute sodium benzosulfimide (sodium saccharin) has a sweetness of about 500 times that of regular sugar. Calculate the percentage of sodium and carbon in the sweetener if its formula is $C_7H_4O_3SNNa$.

**110. $SnO_2$ 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?**

111. If 20.0 grams of hydrogen gas react with 15.0 grams of nitrogen, which gas is the limiting reactant? How many $dm^3$ of ammonia will be produced? Assume the reaction takes place at STP.

112. **Sea water contains roughly 28.0 grams of NaCl per liter. What is the molarity of sodium chloride in sea water?**

113. White lead contains 80.1% lead, 16.5% oxygen, 3.10% carbon, and 0.260% hydrogen. What is the formula of this compound?

**114. 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.**

115. Which has the largest ionization energy: N, P, or As? Why?

## Week Nine (July 19 - 25)

**116. How many mL are in 5,000.00 $dm^3$?**

117. A sample of seawater has a mass of 159 grams and has a volume of 156 mL. What is its density?

**118. Write the names of the following compounds:**

| | | | |
|---|---|---|---|
| **a. $XeF_4$** | **d. $N_2O_4$** | **g. PbO** | **j. $SO_3$** |
| **b. $CaH_2$** | **e. $H_3BO_3$** | **h. NaBr** | **k. $Hg_2O$** |
| **c. $As_4O_6$** | **f. $I_2O_5$** | **i. $Li_2Cr_2O_4$** | **l. $Ca(C_2H_3O_2)_2$** |

119. Write the formulas for the following:

| | |
|---|---|
| a. Calcium sulfide | g. Cobalt (II) bisulfate |
| b. Hydrobromic acid | h. Barium carbonate |
| c. Hydrogen cyanide | i. Copper (II) hydroxide |
| d. Sulfuric acid | j. Perchloric acid |
| e. Copper (I) sulfate | k. Iron (III) phosphate |
| f. Aluminum oxide | l. Lead (II) oxide |

**120. Write the electron configuration (long way) for nitrogen.**

121. Write the orbital notation (boxes) for nitrogen.

**122. Write the electron configuration using the Noble Gas core method for arsenic.**

123. For the reaction $2\ KMnO_4 + H_2SO_4 \rightarrow K_2SO_4 + Mn_2O_7 + H_2O$,
how many moles of $Mn_2O_7$ can be formed from 196.0 grams of $KMnO_4$?

**124. KOH with a mass of 50.0 grams is neutralized by 20.0 grams of sulfuric acid. The products are potassium sulfate and water. Calculate the moles of potassium sulfate produced**

125. 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.

**126. How many grams of water vapor will be produced when 1.18 grams of oxygen react completely with hydrogen to form water?**

127. What mass in grams of KCl is there in 2.50 L of a 0.50 M KCl solution?

**128. What is the molarity of a solution containing 12.0 grams of NaOH in 250.0 mL of solution?**

129. 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

**130. Which has the larger radius, Br or $Br^-$? Why?**

**131.** For the compound sodium sulfate decahydrate, $Na_2SO_4$, calculate the percentage composition.

**132. A compound is analyzed and found to contain: 0.89 grams K, 1.18 grams Cr, and 1.27 grams O. Determine the empirical formulas for this compound.**

## Week Ten (July 26 – August 1)

133. Calculate the number of kilometers in 105 meters.

**134. There are 5,280 feet in one mile, 1760 yards in 1600 meters, 39.3 inches in one meter, and . You are a middle-distance runner. Calculate the following:**

**a. How many inches are in 800 meters?**

**b. Is the 3200 meter relay longer or shorter than the two-mile relay?**

135. You fill a 1.00 L balloon with 0.054 grams of air. What is the density of the air in the balloon?

**136. Write the formulas for the following:**

**a. Potassium chloride**

**b. Potassium permanganate**

**c. Potassium perchlorate**

**d. Calcium carbonate**

**e. Barium phosphate**

**f. Carbonic acid**

**g. Sodium bisulfate**

**h. Phosphorus pentafluoride**

**i. Silver oxide**

**j. Lead (II) chlorite**

**k. Copper (I) chromate**

**l. Calcium perchlorate**

**m. Acetic acid**

137. Write the names of the following compounds:

a. $CuSO_4 \bullet 5H_2O$

b. $Cr(OH)_3$

c. HClO

d. $HClO_2$

e. $HClO_3$

f. $HClO_4$

g. $Al(MnO_4)_3$

**138. Write the electron configuration (long way) for fluorine.**

139. Write the orbital notation (boxes) for phosphorus.

**140. Write the electron configuration using the Noble Gas core method for antimony.**

141. 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 hydroxde (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)

**142. 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.**

143. A volume of 3.0 L of air is warmed from 50°C to 100°C. What is the new volume if the pressure remains constant?

**144. 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?**

145. If 20.0 $dm^3$ of methane, $CH_4$, react with 200.0 $dm^3$ of air, calculate the $dm^3$ of carbon dioxide gas produced.

$$CH_4 (g) + 2\ O_2 (g) \rightarrow CO_2 (g) + 2\ H_2O (l)$$

**146. Ammonia is produced by the reaction of nitrogen and hydrogen according to this balanced equation:**

$$N_2 (g) + 3\ H_2 (g) \rightarrow 2\ NH_3 (g)$$

**What mass of ammonia would be produced if 13.4 grams of nitrogen gas reacted?**

147. 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

148. How does the number of valence electrons in an atom relate to the element's position on the periodic table?

## Week Eleven (August 3 - August 8)

149. Make the following conversions:
  a. 2.90 cm to decameters
  b. 45.6 milliters to hectoliters

**150. 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.**

**151. Chromium exists in different oxide compounds. Determine the empirical formula of a compound containing 5.60 grams Cr and 2.62 grams O**

152. Write the formulas for the following compounds:
  a. Aluminum sulfate
  b. Hydrobromic acid
  c. Mercury (I) hypochlorite
  d. Phosphoric acid
  e. Magnesium bicarbonate
  f. Tin (II) phosphate
  g. Zinc chloride
  h. Tin (IV) carbonate

**153. Write the name of the following compounds:**
  **a. $Li_2HPO_4$**
  **b. $Ca(NO_2)_2$**
  **c. $Ni(ClO_4)_2$**
  **d. $Mn(NO_3)_2$**
  **e. $Al(C_2H_3O_2)_3$**
  **f. $(NH_4)_3PO_4$**

154. Write the electron configuration (long way) for krypton.

**155. Write the orbital notation (boxes) for rubidium.**

**156. Write a balanced equation and indicate the reaction type (single or double replacement, decomposition, or synthesis/composition) for each of the following:**
  **a. Potassium carbonate (aq) + barium chloride (aq) → potassium chloride (aq) + barium carbonate (aq)**
  **b. Cadmium phosphate (s) + ammonium sulfide (aq) → cadmium sulfide (s) + ammonium phosphate (aq)**

**157. Express the following exponentials as ordinary numbers:**
  **a. $7.23 \times 10^4$**
  **b. $8.193 \times 10^2$**
  **c. $1.98 \times 10^{-3}$**

**158. The volume of a sample of water is found to be 86.3 $cm^3$. What is the volume of the sample in $mm^3$?**

159. Calculate the percentage of oxygen in calcium chlorate

**160. Determine the moles of $Na_2S$ that can be prepared by the reaction of 0.2240 moles of sodium with 0.1320 moles of sulfur. Which reactant in the limiting reactant?**

**$16\ Na + S_8 \rightarrow 8\ Na_2S$**

161. If 46.2 grams of sulfur trioxide gas decompose into oxygen and sulfur dioxide, how many liters of oxygen gas will be produced at STP?

**162. Which has the largest atomic radius: S, Se, or Cl? Why?**

**163.** Which should have the largest difference between the first and second ionization energies: Si, Na, P, or Mg?

**164. A volume of 20.0 L of $O_2$ is warmed from –30.0°C to 85.0°C. What is the new volume, if the pressure is kept constant?**

**165. What mass NaCl would be required to make 100.0 mL of a 0.20 M NaCl solution?**

166. Complete the following table

| Element/Ion | Atomic Number | Mass Number | # Protons | # Neutrons | # Electrons |
|---|---|---|---|---|---|
| $^{74}As^{-3}$ | | | | | |
| $^{108}Ag$ | | | | | |
| $^{108}Ag^{+1}$ | | | | | |
| $^{33}S^{-2}$ | | | | | |
| $^{238}U$ | | | | | |

**167. Explain the contributions of the following to the development of the model of the atom:**

**a) Thomson**

**b) Millikan**

**c) Rutherford**

**d) Chadwick**

You will have a quiz over elements, ions, and compounds every week. Your first quiz will be over elements 1-54; you must know element names with the correct spelling and the corresponding chemical symbol. Start reviewing your monatomic and polyatomic ions so you know them.