

**Part 1: Significant Figures, Unit Conversions, and Matter**

- 1) Convert the following to scientific notation:
- |           |              |
|-----------|--------------|
| a) 73     | f) 0.0000843 |
| b) 0.023  | g) 0.00568   |
| c) 6590   | h) 416500    |
| d) 178    | i) 2156000   |
| e) 458212 | j) 0.587     |
- 2) Convert the following from scientific notation:
- |                          |                           |
|--------------------------|---------------------------|
| a) $6.3 \times 10^{-7}$  | f) $7.558 \times 10^{-3}$ |
| b) $5 \times 10^6$       | g) $2.001 \times 10^9$    |
| c) $5.6 \times 10^{-4}$  | h) $2.66 \times 10^4$     |
| d) $4.55 \times 10^{-7}$ | i) $8.5 \times 10^{-1}$   |
| e) $7.568 \times 10^2$   | j) $2.556 \times 10^{-2}$ |
- 3) Carry out the following conversions giving your answers in scientific notation:
- |   |                                   |
|---|-----------------------------------|
| a) $8.79 \times 10^{-4}$ L to $\text{cm}^3$ | f) 1.56 $\mu\text{g}$ to g        |
| b) 5.68 m to cm                             | g) 2.5 L to mL                    |
| c) 117 mg to g                              | h) $6.72 \times 10^{-7}$ kg to mg |
| d) 7.8 g to kg                              | i) 5.36 mL to L                   |
| e) $101.3 \text{ cm}^3$ to $\text{m}^3$     | j) 736.2 nm to m                  |
- 4) Perform the following operations. Convert all answers to scientific notation, showing the correct number of significant figures
- A)  $50.35 \times 0.106 - 25.37 \times 0.176$   
B)  $1252.7 - 9.4 \times 10^2 \times 12.3$   
C)  $(0.562 \times 19.34 - 7.00) \times 4.321$   
D)  $(0.4821 + 0.3285)$   
 $(0.0123 - 0.113)$   
E)  $25.00 \times 0.1000 - 15.87 \times 0.1036$   
F)  $3.65/0.3247 - 7.89/0.1254$   
G)  $0.0000481 - 0.000817$   
H)  $89.75 \times 10^{-12} + 6.1157 \times 10^{-9}$   
I)  $0.000159 + 4.0074$   
J)  $45.2 \times 23$
- 5) How many sig figs are in the following numbers?
- |                                      |                              |
|--------------------------------------|------------------------------|
| a) 236 m                             | f) 6532.000000 g             |
| b) 2000 people                       | g) 8500 L                    |
| c) $(1000 \text{ m})/(1 \text{ km})$ | h) $5.226 \times 10^{-12}$ g |
| d) 5026 g                            | i) $400 \text{ m}^2$         |
| e) 600.0 mL                          | j) 0.000023 cm               |
- 6) If the density of gold is  $19.3 \text{ g/cm}^3$  and the density of water is  $1.00 \text{ g/cm}^3$  what volume of water would be needed to be the same mass as a gold bar with the measurements: 5 cm x 4 cm x 15 cm?
- 7) Calculate the volume of a sheet of plywood with the following dimensions: Length: 2.78 cm; Width: 11.3 m; Thickness: 7.53 mm

- 8) How many seconds are there in a leap year?
- 9) A clock gains 0.050 seconds in one hour. How many minutes does the clock gain in 365 days?
- 10) The density of a substance is 23.7 mg/mL. What is the density in g/L?
- 11) A car with a maximum speed of 115 km/hr can travel how many meters per second?
- 12) Complete the following:  
 A) \_\_\_\_\_  $\text{mm}^2 = 1 \text{ m}^2$   
 B) \_\_\_\_\_  $\text{km}^2 = 1 \text{ m}^2$   
 C) \_\_\_\_\_  $\text{cm}^2 = 1 \text{ mm}^2$   
 D) \_\_\_\_\_  $\text{cm}^2 = 1 \text{ mm}^2$
- 13) Vioxx is a drug used to treat arthritis. If a patient takes one 125  $\mu\text{g}$  tablet per day, how many milligrams of Vioxx are in their 1 month (30 day) supply?
- 14) A prescription pain reliever contains 30 mg of Codeine per tablet. The package directions recommend taking no more than 8 tablets in a 24 hour period. How many grams of Codeine per day is the maximum recommended dose?
- 15) What state of matter is represented by each of the following?  
 a) ice                                      b) clouds in the sky                      c) hydrogen in the sun  
 d) rock                                        e) air    f) vegetable oil
- 16) Classify each of the following as either a chemical change (primarily) or a physical change.  
 a) electrolysis of water                                      b) separating an alcohol-water mixture  
 c) formation of fog    d) burning wood  
 e) rusting iron    f) converting sand to glass
- 17) Draw a graph of temperature vs. energy showing the phase changes. Be sure to label all the phases, phase changes, melting points, boiling points etc.
- 18) For each of the following write whether it is a mechanical mixture (M), a solution (S), or a compound (C).  
 a) soda pop                                      b) sugar                                      c) milk                                      d) muddy water  
 e) baking soda ( $\text{NaHCO}_3$ )                      f) pizza                                      g) bronze
- 19) Write the chemical formula for the following compounds:  
 A. chlorine tetroxide                      B. trisilicon tetranitride                      C. iron(III) hydroxide  
 D. radium carbonate                      E. hydrobromic acid                      F. disilicon hexaiodide  
 G. sulfurous acid                      H. chromium(II) oxalate                      I. phosphoric acid  
 J. dinitrogen pentoxide                      K. tungsten(V) bromide                      L. tin(II) bicarbonate  
 M. mercury(I) nitrate                      N. copper(I) phosphate                      O. sulfuric acid  
 P. beryllium oxide                      Q. molybdenum(VI) iodide                      R. ammonia
- 20) Write the name of the following compounds:  
 A.  $\text{CoF}_3$                       B.  $\text{PBr}_5$                       C.  $\text{KMnO}_4$                       D.  $\text{FeC}_2\text{O}_4$   
 E.  $\text{HNO}_3$                       F.  $\text{Sn}(\text{CN})_2$                       G.  $\text{LiOH}$                       H.  $\text{Na}_2\text{HPO}_4$   
 I.  $\text{Cu}(\text{NO}_3)_2 \cdot 6\text{H}_2\text{O}$                       J.  $\text{NH}_4\text{NO}_3$                       K.  $\text{N}_2\text{S}_5$                       L.  $\text{CuSO}_4$   
 M.  $\text{V}_2\text{O}_5$                       N.  $\text{Ni}_3(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$                       O.  $\text{H}_3\text{PO}_4$                       P.  $\text{S}_4\text{N}_2$   
 Q.  $\text{CS}_2$                       R.  $\text{W}(\text{CN})_6$                       S.  $\text{TaCl}_3$                       T.  $\text{Li}_2\text{Cr}_2\text{O}_7$

**Part 2: The Mole**

- What is the molar mass of the following compounds?
  - $\text{Pb}(\text{C}_2\text{O}_4)_2$
  - $\text{Ni}(\text{OH})_2$
  - Tin (IV) acetate pentahydrate
  - $\text{CH}_3\text{COOH}$
- Calculate the mass of the following:
  - 7.01 mol of  $\text{SiF}_4$
  - $6.59 \times 10^{-4}$  mol  $\text{H}_3\text{PO}_4$
  - 0.0765 mol  $\text{Li}_2\text{HSO}_4$
  - 6.85 mol  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
- Calculate the number of moles of the following
  - 8.00 kg CrS
  - 76.3 mg of  $\text{I}_2$
  - 2.00 L of  $\text{N}_2$  at STP
  - 35 g of Au
- Calculate the number of atoms in the following:
  - 1 molecule of  $\text{CH}_3\text{COOH}$
  - 70 molecules of  $\text{BrF}_5$
  - 2.78 mol  $\text{NiSO}_4 \cdot 5\text{H}_2\text{O}$
  - 8.5 L of HCl gas at STP
- What is the percentage composition of each element in
  - $(\text{NH}_4)_2\text{SO}_4$
  - $\text{Cr}_3(\text{PO}_4)_2 \cdot 7\text{H}_2\text{O}$
- What is the empirical formula for the following compounds?
  - 26.6% K, 35.4% Cr, 38.0% O
  - 46.2% C, 7.69% H, 46.2% O
  - 72.4% Fe, 27.6% O
- What is the volume of 37.84 mol of  $\text{CO}_2(\text{g})$  at STP?
- Compute the mass needed to make 500.0 mL of solution at the indicated molarity.
  - 0.85 M  $\text{H}_2\text{SO}_4$
  - 4.1 M  $\text{Mg}(\text{OH})_2$
  - 0.069 M NaBr
- What is the concentration of  $\text{BaCl}_2$  if you mix 25.0 g of  $\text{BaCl}_2$  into 450.0 mL water?
- What would the final concentration be if you added 30.0 mL of water to 15.0 mL of 1.750 M NaOH?
- How many grams of  $\text{Li}_3\text{PO}_4$  are contained in 7.45 L of 0.175 M  $\text{Li}_3\text{PO}_4(\text{aq})$ ?
- What would the final concentration of RbCl be if you mixed 250.0 ml of 0.250 M RbCl with 350 mL water?

### Part 3: Stoichiometry and Reactions

- 1) Translate the word equations into chemical symbols and balance the resulting equations. Include phases where stated. Include *energy* in the equations where appropriate.
  - a) lithium + water → lithium hydroxide + hydrogen (*exothermic*)
  - b) hydrogen chloride gas, *when heated*, decomposes to hydrogen gas and chlorine gas
  - c) water is separated *by electrolysis* into hydrogen gas and oxygen gas
  - d) solid iron (II) oxide and carbon powder react to form molten iron and carbon dioxide gas
  - e) Gaseous chlorine gas *reacts violently* with solid sodium to form solid sodium chloride
- 2) Balance the following equations and classify each reaction as one of: synthesis, decomposition, single replacement, double replacement, neutralization or combustion.
  - a)  $\_\_ \text{Sr} + \_\_ \text{O}_2 \rightarrow \_\_ \text{SrO}$
  - b)  $\_\_ \text{C}_6\text{H}_{12}\text{O}_6 + \_\_ \text{O}_2 \rightarrow \_\_ \text{CO}_2 + \_\_ \text{H}_2\text{O}$
  - c)  $\_\_ \text{H}_3\text{PO}_4 + \_\_ \text{KOH} \rightarrow \_\_ \text{K}_3\text{PO}_4 + \_\_ \text{H}_2\text{O}$
  - d)  $\_\_ \text{H}_2\text{O} \rightarrow \_\_ \text{H}_2 + \_\_ \text{O}_2$
  - e)  $\_\_ \text{Fe}(\text{HCO}_3)_3 + \_\_ \text{MgSe} \rightarrow \_\_ \text{Fe}_2\text{Se}_3 + \_\_ \text{Mg}(\text{HCO}_3)_2$
  - f)  $\_\_ \text{Br}_2 + \_\_ \text{KCl} \rightarrow \_\_ \text{KBr} + \_\_ \text{Cl}_2$
- 3) Complete and balance the following reactions and classify each reaction
  - a)  $\text{NO}_2$
  - b)  $\text{HCl} + \text{KOH}$
  - c)  $\text{Cu} + \text{Fe}(\text{NO}_3)_2$
  - d)  $\text{MgSO}_4 + \text{BeCl}_2$
- 4) How many grams of sodium oxide are produced when 73.2g of sodium react completely with oxygen gas?
- 5) What mass of oxygen is required to react completely with 24.0g of propane?
- 6) If a sample of ethane is burned in excess oxygen, what mass of  $\text{H}_2\text{O}$  is produced if the reaction also produces 63L of  $\text{CO}_2$  at STP?
- 7) How many grams of bromine are produced by the decomposition of 24.5g of hydrogen bromide gas?
- 8) Hydrazine ( $\text{N}_2\text{H}_4$ ) is a rocket fuel prepared according to the reaction:  
$$2 \text{NH}_3(\text{aq}) + \text{NaOCl}(\text{aq}) \rightarrow \text{N}_2\text{H}_4(\text{aq}) + \text{NaCl}(\text{aq}) + \text{H}_2\text{O}(\text{l})$$

NaOCl is common "bleach" and  $\text{NH}_3(\text{aq})$  is produced by passing  $\text{NH}_3(\text{g})$  into water. If  $1.25 \times 10^{-4}$  kg of hydrazine is required, how many L of ammonia gas (at STP) is required in the reaction?
- 9) a) What mass of CuO is required to make 18.0 g of Cu according to the reaction  
$$2 \text{NH}_3 + 3 \text{CuO} \rightarrow \text{N}_2 + 3 \text{Cu} + 3 \text{H}_2\text{O}$$
  
b) If the reaction actually produces 6.5 g of Cu, what is the % yield?
- 10) Tetraethyl lead,  $\text{Pb}(\text{C}_2\text{H}_5)_4$ , is an anti-knock agent which was added to some gasolines. Tetraethyl lead burns according to the equation  
$$2 \text{Pb}(\text{C}_2\text{H}_5)_4(\text{l}) + 27 \text{O}_2(\text{g}) \rightarrow 2 \text{PbO}(\text{s}) + 16 \text{CO}_2(\text{g}) + 20 \text{H}_2\text{O}(\text{l})$$
  - a) What volume of  $\text{O}_2(\text{g})$  at STP is consumed when 100.0g of  $\text{PbO}(\text{s})$  are formed?
  - b) How many molecules of  $\text{CO}_2$  are formed when  $1.00 \times 10^{-6}$  g of tetraethyl lead is burned?
  - c) How many molecules of  $\text{H}_2\text{O}$  are formed when 135 molecules of  $\text{O}_2$  react?
  - d) What volume of  $\text{O}_2(\text{g})$  at STP, in mL, is required to react with  $1.00 \times 10^{15}$  molecules of tetraethyl lead?

**Part 4: Periodic Table, Atomic Theory and Solution Chemistry**

- Which atom is bigger: Bi or P? Why?
- Complete the following table:

Atom/Ion	Atomic #	Mass #	Protons	Neutrons	Electrons
$^{39}\text{K}^{+1}$					
$^{41}\text{Ca}$					
$^{69}\text{Ga}^{+3}$					
$^{37}\text{Cl}^{-1}$					
$^{18}\text{O}$					
$^{235}\text{U}^{+4}$					

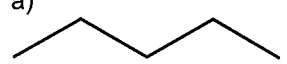
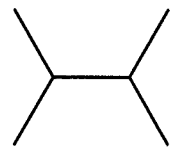
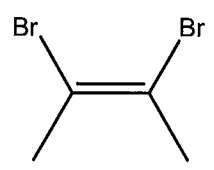
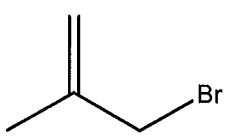
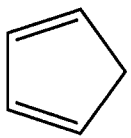
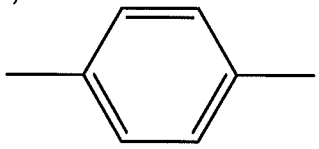
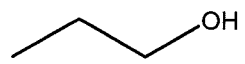
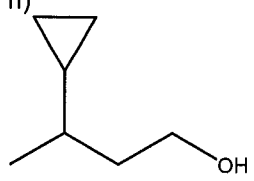
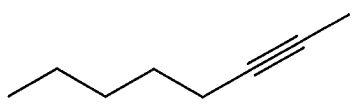
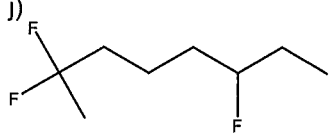
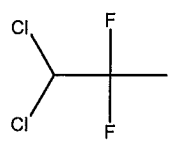
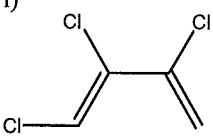
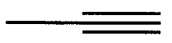
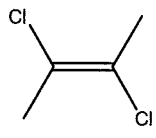
- Naturally occurring silver consists of 51.8% Ag-107 and 48.2% Ag-109. What is the expected average molar mass of a sample of natural silver, expressed to 3 decimal places?
- What are the electron configurations for:  
a) P    b) Cl    c) Ar    d)  $\text{F}^{-1}$     e)  $\text{S}^{-2}$     f) He
- Name at least one trend among each of the following periodic families:
  - Alkali Metals
  - Alkaline Earth Metals
  - Halogens
  - Noble Gases
- If a noble gas *could* form a +1 ion, which of the noble gases would form a +1 ion most easily?
- With respect to electrons, how does an ionic bond differ from a covalent bond?
- Indicate whether the following compounds are ionic, pure covalent, or polar covalent. Explain.  
a) NaCl    b)  $\text{H}_2\text{O}$     c)  $\text{NO}_2$     d)  $\text{CS}_2$
- Why does a certain covalent compound have a distinct odour while a certain ionic compound has no detectable aroma?
- How many valence electrons are there in:  
a) Si    b)  $\text{K}^{+1}$     c) Ne    d)  $\text{O}^{-2}$     e)  $\text{H}^{-1}$     f) N
- Which would be miscible with water: ethanol or ether? Why?
- Why are some solvents polar and some non-polar? Which would you use to dissolve salt?
- Draw electron dot structures (Lewis Structures) for:  
a)  $\text{C}_2\text{H}_4$     b)  $\text{H}_2$     c)  $\text{PO}_4^{-3}$     d) HCN    e)  $\text{NH}_4^{+1}$
- What will be the  $[\text{Cl}^{-1}]$  if 60.0 g of  $\text{BaCl}_{2(s)}$  is dissolved in 600.0mL of  $\text{H}_2\text{O}$ ?
- If 35.0g of  $\text{V}(\text{NO}_3)_5$  is dissolved in 1.0L of  $\text{H}_2\text{O}$ , what will the  $[\text{NO}_3^{-1}]$  be?
- What mass of NaBr must be dissolved in 4.9L to make a 5.2 M NaBr solution?
- If 700.0mL of 1.9 M KCl is mixed with 1.05 L of 0.750M  $\text{MgCl}_2$ , what will the final  $[\text{Cl}^{-1}]$  be?

### Part 5: Organic Chemistry

- List the 10 straight chain alkanes by name.
- Draw:
  - 1,3,3-trifluoro-2-pentanol
  - trans*-2-hexene
  - 3,4,5,6-tetraethyl-nonane
  - 2-octyne
  - 3,5-diethyl-4-methyl-heptane
  - cyclooctene
  - 2-bromo-3-heptyne
  - 3-chloro-1-cyclobutanol
  - 1-ethyl-3-propyl-benzene
  - 1,3-cyclohexadiene
  - 2,2,3,3-tetrabromo-pentane
  - cis*-3-nonene

3. Draw and name all 9 isomers of  $C_5H_{10}$

4. Name:

a) 	b) 	c) 
d) 	e) 	f) 
g) 	h) 	i) 
j) 	k) 	l) 
m) 	n) 	o) 